Integration of Traditional and Agile Project Management Methodologies for the Management of UK Construction Projects

by

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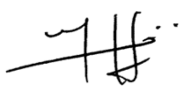

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Abstract

Over the years, the traditional project management (TPM) methodology has been reckoned as the wellspring of formality in project management and has been used successfully for the management of projects. However, due to the large and complex nature of construction projects, the traditional methodology seems to have become inefficient in resolving widespread and deep-seated challenges. Therefore, the agile methodology was formally launched in the year 2001 in a bid to curb the challenges associated with the use of the TPM methodology.

The agile project management (AgPM) methodology was originally developed as a new way of managing software development projects but has gained considerable attention from scholars for the management of non-software projects. Studies also have highlighted the benefits of using the AgPM methodology in other industries, e.g., the use of agile in the IT industry to improve communication, flexibility, customer collaboration, attention to excellence, short iterative planning and developmental cycles, as well as the enhanced communication. Likewise, recent evidence suggests that these benefits can also be realised in construction project management. However, contrary to the adoption of new ways of managing construction projects, the UK construction industry majorly adopts the traditional methodologies in managing construction projects.

In a bid to dissuade the industry's proclivity towards the use of the TPM methodologies for the management of construction projects, the UK government has introduced several initiatives and publications to promote reforms in the construction industry. Notwithstanding, due to the apprehensiveness for change from the practitioners of the TPM methodology, coupled with several barriers, e.g., the rigid organisational structure, shortage of skills/experience in the use of AgPM, the adoption of the AgPM methodology has remained underutilised, whilst construction projects have continued to underperform. Therefore, this research aims to integrate the strengths of the TPM and AgPM methodologies in a framework (TRAGILE) in order to allow for the realisation of the benefits of the AgPM methodology and also to improve the performance of UK construction projects.

To accomplish the aim of this research, a mixed research approach comprising of qualitative and quantitative methods was chosen for data collection from the participants selected through purposeful sampling method to gather information. Opinion-based questionnaire surveys (open-ended) was conducted at the first phase of the study based on the findings gathered from literature review covering areas including: the UK construction industry, available management methodology used within the UK construction industry and the perceptions of construction practitioners on the use of agile project management methodology. To enable further expansion of key findings from the first phase, questionnaires were sent to a sample of 200 participants within the UK construction industry.

Findings from this study reveals that the practitioners within the UK construction industry are aware of the availability of the AgPM methodology that can be integrated to improve the performance of construction projects. Also, there seems to be a readiness from the UK construction practitioners to embrace the potential benefits of the AgPM methodology in managing construction projects. However, due to the barriers associated with the adoption of new management methodologies, the adoption of the AgPM methodology has remained stunted, whilst construction projects have continued to underperform. A framework for the integration of the TPM and AgPM methodologies (TRAGILE) was developed based on ideas and analogies from nuclear physics (i.e., fission and fusion) for the management of UK construction projects in a more flexible and effective and efficient manner. The framework is validated by practising industry professionals and academia and is identified as a comprehensive guide for the integration of the strengths of the TPM and AgPM methodologies for the management of UK construction projects.

Key words: UK Construction Industry, Construction Projects, Project Management Methodologies, Traditional Project Management Methodology, Agile Project Management Methodology, Integration of Traditional and Agile Methodologies, TRAGILE.

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Dedication

This PhD is dedicated to God almighty and to my mum, who passed away in March 2022.

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First and foremost, I give honour and glory to the Almighty God, who provided me the opportunity and gave me grace and strength to complete the PhD. My PhD journey has been filled with ‘peaks and valleys’ and in many ways lonely, but it is intellectually rewarding. My appreciations also go to several people who helped and supported me through this journey.

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Not forgetting my church family, TRM, for your encouragement and care these past years, thank you. I am so glad to be a member of the family.

Definition of Terms

Agile project management methodology: a family of development methodologies where requirements and solutions are developed iteratively and incrementally throughout the life cycle (APM Glossary of Terms, 2022).

Closure: the formal end point of a project, programme or portfolio; either because planned work has been completed or because it has been terminated early (APM Glossary of Terms, 2022).

Construction method statement: a plan detailing how a piece of work is to be carried out (APM Glossary of Terms, 2022).

Construction industry: refers to the industrial branch of manufacturing and trade related to building, repairing, renovating, and maintaining infrastructures (Hussain *et al*, 2022).

Control: tracking performance against agreed plans and taking the corrective action required to meet defined objectives (APM Glossary of Terms, 2022).

Implementation (phase): the third phase of the project life cycle where the project management plan (PMP) is executed, monitored and controlled. During this phase, the design is finalised and used to build the deliverables (APM Glossary of Terms, 2022).

Initiation: the beginning of a project at which point certain management activities are required to ensure that the project is established with clear reference terms and adequate management structure (APM Glossary of Terms, 2022).

Monitoring: the recording, analysing and reporting of project performance as compared to the plan in order to identify and report deviations (APM Glossary of Terms, 2022).

Performance: used to describe the quality of the delivery and the deliverables (outputs) of the project (APM Glossary of Terms, 2022).

Planning: determines what is to be delivered, how much it will cost, when it will be delivered, how it will be delivered and who will carry it out (APM Glossary of Terms, 2022).

Procurement: the process by which products and services are acquired from an external provider for incorporation into the project, programme or portfolio (APM Glossary of Terms, 2022).

Procurement strategy: the high-level approach for securing the goods and services required from external suppliers to satisfy project, programme and portfolio needs. See also Strategic sourcing (APM Glossary of Terms, 2022).

Project: a unique, transient endeavour undertaken to bring about change and to achieve planned objectives (APM Glossary of Terms, 2022).

Project management: the application of processes, methods, knowledge, skills and experience to achieve specific objectives for change (APM Glossary of Terms, 2022).

Project lifecycle: a framework comprising a set of distinct high-level stages required to transform an idea of concept into reality in an orderly and efficient manner (APM Glossary of Terms, 2022).

Project phase: are the stages of a project from its conception to its completion (PMBOK, 2017).

Project Team: group of people working in collaboration or by cooperation towards a common goal (APM Glossary of Terms, 2022).

Project management methodology: the application of a system of methods in executing projects based on a specific way of thinking in order to achieve the project goals Rasch, 2019).

Traditional project management methodology: a step-by-step predictive approach to project management, also known as the waterfall methodology (APM, 2019).

CHAPTER 1 INTRODUCTION

1.1 Background of Study

The UK construction industry makes a vital contribution to the economy, society, and the environment (CIOB, 2019; Rostami and Thomson, 2017; Loosemore, 2016; Mahamid *et al*, 2012). Recently, the Gross Value Added (GVA) of the construction industry in the UK was over four billion British pounds (Statista Research Department, 2022), and it provided approximately 2.08 million jobs, equivalent to 6.6% of all UK jobs (Naoum *et al*, 2020; House of Commons Library, 2019). The UK construction industry is comprised of three major sectors: the contracting, service, and product sectors (BIS, 2013), all of which differ considerably in so many ways (Dykstra, 2011) and responsible for the creation, building and maintenance of workplaces, infrastructures, and homes in which we live (HM Government, 2018); only few sectors have such impact on communities across the country.

According to the Office for National Statistics (2017), the construction industry is categorised as section F, specifically defined as follows: SIC 41: Construction of buildings; SIC 42: Civil engineering; SIC 43: Specialised construction activities. Department for Business Innovation Skills (2013) also recognises the UK construction industry as one of the knowledge-based value-creating industries in the country. Activities in the construction industry cover a wide range of business interests from simple to the very complex projects, all amalgamated by their mutual usage and development of land. Typologically, the UK construction industry is predominantly project-based (Koolwijk *et al*, 2020; Koolwijk *et al*, 2018; Liu and Shi, 2017; Vrijhoef and Koskela, 2005), which has been predominantly managed using traditional management methodologies. Before proceeding in this discussion, it is essential to define project management methodology (PMM) and traditional project management (TPM) methodology.

Several definitions of project management methodology (PMM) have been presented by scholars based on their different schools of thought (Kidane, 2019), and since there is no universal consensus as to what constitutes a PMM, a few definitions are presented in this study. Whitaker (2014) defines PMM as a documented and discoverable set of policies, practices, processes, tools, techniques, and templates which provide guidance for the management of projects. Similarly, Jovanović and Berić (2018) define PMM as a set of methods, techniques, procedures, best practices, systematically structured to create project's activities in conformity to the project's goals. Cohen (2019) defines PMM as a system of methods used in executing projects based on a specific way of thinking. Despite slight discrepancies in the definition of PMM, an examination of the definitions and descriptions presented above reveals that the components of and the requirements to be placed on a PMM can be extracted as follows: PMM is the application of a system of methods in executing projects based on a specific way of thinking in order to achieve the project goals. According to Ozmen (2013), PMM not only plays a vital role in ensuring the project team adheres a common goal, but also helps to provide benchmarking studies that may produce continuous feedback for the organisation. Besides, literature suggests numerous benefits of adopting a PMM within an organisation including knowledge management/project documentation; repeatability/sustainability; benchmarking/comparability of success and ongoing improvement impacts (Ozmen, 2013). In the TPM methodology, projects are typically executed in a linear sequence: initiation, planning, execution, monitoring, and closure phases (Sennett, 2022).

In the past few decades, globalisation has spurred the need for more flexibility in work processes (Erixon, 2018), coupled with the need to remain sustainable and the unprecedented changes wrought by the COVID-19 pandemic (Shibani, 2020; Parliament of the United Kingdom, 2020). Therefore, organisations are changing from the traditional hierarchical project management approach to a more synergetic approach in order to effectively manage the changing needs of their clients. Notwithstanding, the UK construction industry has continued to struggle in making considerable deviations from the traditional project management methods employed due to its apprehensiveness for change, coupled with the fragmented state of the industry (Higham and Thomson, 2015; Opoku and Fortune, 2013).

Studies have argued that construction projects are one of the most complexes of all undertakings (Koo and O'Connor, 2021; Trinh and Feng, 2020; Patil and Patil, 2020), and due to the increasing complexity of construction projects, the UK construction industry is justifiably lethargic when it comes to innovation (Naoum *et al*, 2015). Gidado (1996, p. 214) also notes that the continuous demands for innovation in the construction industry, together with technological advances, economic liberalisation and globalisation, environmental issues and fragmentation, have resulted in a spiral and rapid increase in the complexity of construction processes, thus reducing the propensity for improvement in terms of performance and innovation within the industry (Sarhan *et al*, 2018; Haddow, 2018; Dromey *et al*, 2017; Ajayi *et al*, 2015; Proverbs, Holt and Cheok, 2000; Barlow, 2000; Agapiou *et al*, 1995). Hence, the industry is faced with multiple challenges associated with low productivity, defective project delivery, poor performance, resource inefficiency, sustainability issues (Iacovidou *et al*, 2021; Hussain *et al*, 2020; CIOB, 2016).

Construction Excellence (2020) also reveals that the performance of UK construction projects is poor, and the plateaued performance of the industry has remained a major concern despite several reviews and policy initiatives to improve the performance of the industry. Consequently, the UK Government's targets for construction by the year 2025 are focused on how to improve the overall performance as well as meet the growing demand for innovation (Department for Business Innovation Skills, 2013). Hence, there are several ongoing debates on how best to move the industry forward as well as improve the performance of UK construction projects (Papachristos *et al*, 2020; Ward, 2018; HM Government, 2017; Addis, 2016).

Studies have attributed the issue of poor performance in construction projects to lack of effective management methods (Wang *et al*, 2018; Varajao *et al*, 2017). Construction Industry: Statistics and Policy (2019) also highlights some deep-seated structural issues, including manpower shortage, widening skills gap, poor reputation, inadequate training, and lack of policy and industry oversight. Meng (2012) also opines that performance issue is not only a function of management methodologies but can also be attributed to internal and external factors. The internal factors can be generated from the clients, designers, contractors, consultants as well as the suppliers who provide labour, materials, and equipment for the project. Conversely, the external factors are usually beyond the control of the project team and may include factors, such as adverse weather conditions, unforeseen site conditions, market fluctuations, and changes in regulations which may affect changes in price (Arefazar *et al*, 2019), all of which have further exacerbated the industry’s performance and lowered its gross profitability (UK Industry Performance Report, 2018).

Over the years, the traditional project management methodology has been reckoned as the wellspring of formality in project management, and it has been used successfully to manage all types of projects (Kibler, 2019; Spalek, 2016; Salameh, 2014; Wysocki, 2011). However, in this present context where deadlines are shortened, coupled with the increased hunger for innovative changes, the traditional, structured, rigid, normative methodology seems to have become inefficient in resolving all the widespread and deep-seated challenges associated with construction projects' complexities (Kibler, 2019; Salameh, 2014; Owen *et al*, 2006). Besides, studies have also discouraged the use of a single (traditional) methodology (one-size-fits-all) in managing construction projects due to its distinctive and complex nature (Cote, 2019; Al-Zwainy *et al*, 2016; Wysocki and Mcgary, 2010; Koskela 1993).

In a bid to further dissuade the industries proclivity towards the sole use of traditional methodologies for the management of construction projects, the UK government have introduced several initiatives and publications to promote reforms (Langford and Murray, 2008). For example, Farmer's report (2016) to the UK Government, tagged "Modernise or Die," incites an urgent action towards change in the way construction projects are managed based on the current and likely future state of the industry. However, contrary to the adoption of changes and embracing new ways of managing construction projects, the UK construction industry is infamously typified by its aversion towards change (Al-Saeed *et al*, 2020; Edwards *et al*, 2017). Hence, the PRINCE2 (Projects in Controlled Environment 2), which emphasises organisation and control, has been endorsed both by the government and private sectors as a '*de facto* standard' for the management of simple and complex projects (Naik and Jenkins, 2020; PRINCE2, 2018, p.1; Matos and Lopes, 2013, p. 788; The Stationery Office, 2012, p.3).

Over the years, studies have proposed ways of improving the performance of the UK construction projects. For example, there was the idea of lean production originally introduced by the International Automotive Project group at the Massachusetts Institute of Technology in the 1980s, following a study of the new production methods used in Japan by Toyota (Lui and Shi, 2017). Later, the idea of "lean thinking" spurred the interest of many scholars (Lekan *et al*, 2020; Lappalainen, 2020; Aziz and Hafez, 2013; Koskela, 1992). Examples include Koskela who coined the term "lean construction" in 1992; Womack and Jones, in 1996, who detailed five operational principles of general applicability of the lean thinking idea. Nevertheless, the lean idea was not fully appropriated in the UK construction industry due to its paucity in theory, considering that the lean theory was just emerging (Mossman, 2009; Henrich *et al*, 2006). Ballard (2000; 1994) proposed the Last Planner System (LPS) which is a realistic approach to collaboratively manage project-based production, engaging with last planners, i.e., the people responsible for getting the work done in the planning and efficient execution of a project. Furthermore, Sacks *et al* (2009) investigate the requirements for the implementation of BIM-based lean production management system in the construction industry. Shou *et al* (2014) also proposed the integration of operation and maintenance management systems using BIM technology and lean idea due to the prevalent issues around project management as well as the inadequate application of BIM technology. Howbeit, these propositions have had very little impact due to their theoretical nature and the industry's hesitation with the adoption of new ideas.

In view of the nimbleness of today's world and a drive for a quick-responding business environment, studies are now shifting their focus from only the "lean thinking" ideas to embracing of the concept of agile methodology that optimises performance and deliver successful results. Agile is part of the digital transformation that has been incorporated into the construction industry owing to the introduction of Industry 4.0 and Construction 4.0 (Suresh *et al*, 2020). The agile concept was originally developed for use in the software industry to curb the deficiencies associated with the traditional methodology (Bergmann and Karwowski, 2019; Savas, 2019). However, the agile methodology has evolved and taken roots in other industries, such as manufacturing, creative industry, marketing/advertising, event planning companies, product development companies, and finance (Seymour and Coyle, 2019; Brinks and Johnson, 2019; Narayanamurthi, 2017).

Even though the agile methodology was developed based on delivering results at a constant pace of value, sustainable development has always been part of the agile principles. According to Zakrzewska *et al* (2022, p.855), "improving the timeliness of deliveries, increase in productivity and improving the atmosphere in the organization" consequently, the integration of agile methodology results in a significant contribution to sustainable developments in project management. The agile methodology is conceptualised to include and go beyond flexibility, leanness and the acceptance of change as an inevitable part of the project management process (Kasturiwale and Rathod, 2021; Dingsøyr et *al,* 2012). It can also be appreciated as an effective methodology in satisfying the ‘stakeholders’ needs’ while delivering timely results due to its leanness, dynamism, and consistency (Ribeiro and Fernandes, 2010). According to Conboy (2009, p. 336), flexibility within the agile methodology relates to the ability of a system “to create change, or proactively, reactively, or inherently embrace it” in a timely manner through its internal components and its relationships with its environment. Moreover, the leanness within the agile methodology encapsulates the contribution to customer value through economy, quality, and simplicity (Zakrzewska *et al*, 2022).

Likewise, construction projects require flexibility and a management process that responds to changes that occur during its lifecycle (Turner, 2014). More so, in a construction project, timely execution may seem daunting, considering that time is one major factor, and completion on time would bring many benefits to the clients, contractors, and society. Hence, adopting the agile methodology in construction projects will enables the project team to quickly adapt to changes in its delivery (Cruz and Alves, 2022), thus reducing the time between identification and resolution of an issue.

Zakrzewska *et al* (2022) also argues that the agile methodology is more sustainable than the traditional methodology and presented their findings in three perspectives. Firstly, that agile methodology places more emphasis on teamwork and stakeholder engagement, thus, significantly increasing the importance of the social aspects of project management, which is one of the three pillars of sustainable development. Secondly, considering the interconnectedness of sustainability and complexity of projects in the context of socio-political or ecological systems and their interactions, when managing complex projects, the principle of the agile methodology suggests that projects should be managed in an agile manner. Lastly, the long-term orientation, interests of stakeholders and value orientation (Khizar *et al*, 2021). Furthermore, Flumerfelt *et al* (2012) notes that one of the major characteristics of the agile methodology is sustainability. This means that the agile methodology is capable of enduring alterations and interruptions within a project environment. Hence, Arell (2023) describes the agile development method as an approach creates positive economic, social, and environmental outcomes to their customers through sustainability; stating further that agile practices work directly with sustainability. For example, the user stories in agile method could be used to capture the outcomes intended to achieve in a project, and with each iteration in the project lifecycle, the outcomes can be checked and adjusted using the Plan-Do-Check-Act (PDCA) process. Thus, leading to reduced power consumption, less production waste, a better work-life balance for the development team.

Rosing *et al* (2015, p.559) also describe agile as a "persistent behaviour or the ability of a sensitive entity that exhibits flexibility to accommodate expected or unexpected changes rapidly, follows the shortest time, uses economical, simple and quality instruments in a dynamic environment and applies updated prior knowledge and experience to learn from the internal and external environment." The agile methodology is not formulated on the need for anticipation, like the traditional methodology, but on the need for continuous adaptation and improvement (Savas, 2019; Scrum Manager, 2019). Some scholars even believe that the agile methodology will become the management methodology of the 21st century (Bergmann and Karwowski, 2019). However, it is important to note that both the traditional and agile methodologies have their individual strengths and weaknesses when compared to different project characteristics even though they both share some common characteristics (Chang and Lou, 2013).

The integration of the agile methodology in construction have been investigated by several studies. For example, Mohamed and Moselhi (2019); Pareliya (2018) suggest the utilisation of the iterative concepts of agile in managing the execution phase of construction projects, drawing on its ability to effectively accommodate changes during the entire project life cycle. Mnqonywa *et al* (2018) recommends that the adoption of agile in the design phase of construction projects can enhance efficiency and transparency, thus limiting the issues associated with the design stage. Likewise, Rasnacis and Berzisa (2017) liken the implementation of agile in construction to the improvement of a development process, which entails faster delivery, better ways of communication, better quality, better risk analysis, and less cost. Besides, following the propositions and ideas to improve performance and productivity, the UK construction industry has adopted five strategies built on the following (UK Construction Sector Deal, 2019):

- Ideas - the world's most innovative economy
- People - good jobs and greater earning power for all
- Infrastructure - a major upgrade to the UK's infrastructure
- Business environment - the best place to start and grow a business.
- Places - prosperous communities across the UK

Nevertheless, the industry has remained unsuccessful in adopting new methodologies for the management of construction projects (Ebiloma and Rimtip, 2019). Findings have attributed this mainly to the apprehensiveness for change and the seemingly outrageous cost associated with transitioning into a new methodology (Ingle, 2019; Dhir *et al*, 2019; Dromey *et al*, 2017; Rasnacis and Berzisa, 2016; Hoda and Murugesan, 2016; Koch and Turk, 2013). Also, considering the intangibility of construction projects, coupled with the high level of complexities and uncertainties associated with them, several reports have suggested that rather than borrowing ideas from other industries, the UK construction industry can as well adopt an entirely different approach in managing construction projects (Farmer, 2016). However, Dubois and Gadde (2002) argue that the construction industry may become better, first, in changing its traditional behaviour (mindset) and discarding the weaknesses of the traditional methodology before adopting the standards of other industries. Assuming all the assertions are correct about the peculiarities and complexities of construction projects, "[...] *it might well be that management techniques that improve performance in other industries are not readily transferable to this context, if construction follows a different logic, then it might even be a mistake to try to adopt management techniques applied in other contexts*" (Dubois and Gadde, 2002, p. 622). Hence, Lalmi *et al* (2021) suggest the creation of a unique, customisable methodology based on the integration of traditional and agile methodologies.

The integration of traditional and agile methodologies in this context would enable a gradual introduction of agile benefits to be realised into the UK construction industry whilst retaining the existing benefits of the TPM methodology (Singh, 2016). Consequently, elements of the traditional methodology would provide a structured environment for project management wherein the project can be divided into manageable and controllable standardised stages while imposing discipline on knowledge integration within each of the stages of the project (Varajao *et al*, 2017; Colomo-Palacios *et al*, 2014), whereas the agile element would be useful in responding to the changes in the dynamic construction project environment wherein requirements are constantly changing (Meredith and Scott, 2017).

1.2 Rationale for Study

Construction is a major component of every nation's economy; whether a nation is developed or under-developed, the construction industry plays a vital role (Olanrewaju and Abdul-Aziz, 2015). In the UK, despite the increasing digitalisation of the economy, the construction industry has remained as a central part of economy, providing homes, infrastructure, and employment (ONS, 2021). However, the UK construction industry has also been faced with challenges associated with poor performance, low productivity, unreliable project delivery, skilled labour shortages, and resource inefficiency (Iacovidou *et al*, 2021; Hussain *et al*, 2020; CIOB, 2016). According to Gruneberg (2018), while providing a safe and fulfilling life for all its employees and those who use its output, the UK construction industry should at best, be profitable and perform optimally. Poor performance has remained an issue several years after the economic recession of the year 2008, despite reviews and policy initiatives from the government (Papachristos *et al*, 2020). Reports from Construction Excellence (2020) also attests to the poor and plateaued performance of UK construction industry, and prior to these reports, the UK Industry Performance Report (2019) revealed that the performance of the construction industry fell by 6% in 2018 with a further fall of 2% in 2019.

Glenigan UK Construction Industry Forecast for 2021-2022 also reveals that the COVID-19 pandemic has imposed a massive shock to the UK construction industry, and it may take a while for the industry to fully recover to its full glory (Glenigan, 2021). In a reflection on how the COVID-19 pandemic has changed the global workforce, Gartner research cited in State of Agile Report (2022, p.4) finds that, "in response to the pandemic, organisations are accelerating the adoption of new processes, practices, and technologies to support changes to product and service delivery." Also, organisations will need to adapt to succeed because the radical improvement in innovation and technology resulting from the COVID-19 pandemic has exposed processes and skills gaps that have hampered organisational performance.

Therefore, the 'new normal' will be led by organisations that are able to quickly identify and address the critical skills needed to drive their business" (State of Agile Report, 2022, p.4).

Studies have revealed that one of the major issues affecting the performance of construction projects is the management methods adopted (Abbasbhai and Patel, 2020; Saraf, 2013). Hence, Dromey *et al* (2017) bids construction project managers to re-evaluate their current management practices, seeing that the industry plays a key role in the nations' economy. Besides, various research reports have also called for innovation in the management methodologies used in managing UK construction projects (Sawhney *et al*, 2020; Abusalah and Tait, 2018; Woodhead *et al*, 2018; Farmer, 2016) since the traditional methodologies no longer seem sufficient to resolve all the widespread and deep-seated issues associated with construction projects' complexities. In addition, several UK government published reports have suggested a radical change in the way we build and the need to embrace a holistic approach in implementing changes to improve the performance of construction projects. However, rather than the adoption of a radical change in the management practices for UK construction projects, the industry has insisted on the traditional ways of managing construction projects.

As a result, one of the UK government targets for the industry is to improve the performance of construction projects by the year 2025 as well as meet the growing demand for innovation (Department for Business Innovation Skills, 2013). Even so, debates are ongoing whether the targets of Construction 2025 has been successful up to this point in time (Papachristos *et al*, 2020; Ward, 2018; HM Government, 2017; Addis, 2016). For example, CITB (2020) analysis and forecast suggests that construction outputs will need to grow at an average rate of 4.4% across 2021-2025 to meet up with Construction 2025 target, thus presenting significant challenges for the industry. This research is motivated by the need to contribute to the tackling of the incessant performance issues associated with the UK construction projects and the increased call for research to understand how to mitigate them.

Over the years, there has been an increased focus from researchers on procurement in the UK construction industry. This is partly because choosing the right procurement method is absolutely crucial for the delivery of a project on time, on budget and to a high quality (CIOB, 2010). Hence, a large portion of these research have focused particularly on identification of the best procurement selection strategies, whereas only very few studies have delved into the delivery of construction projects. Construction delivery refers to the comprehensive process of carrying out and completing construction projects, requiring careful planning, design, implementation (construction) measures from different parties (CIOB code of practise, 2022). These parties includes: the project owner**:** who commissions and fund (directly or indirectly) the project. The project owner has the final say in selecting a contractor, delivery method, and other key decisions. The designer: this is typically an architect or an engineer, who plan the design and look after the construction of the building. The contractor: they look after the daily operations on the construction site, and also involved in hiring subcontractors for specific tasks; and the construction project manager: who can also function as a consultant for the project owner (CIOB code of practise, 2022).

To ensure effective delivery of a construction project, the focus of the parties involved is usually on defining the delivery methodology that best suits the needs and benefits of the project (CIOB code of practise, 2022). Considering the limitations associated the TPM methodology discussed in section 1.2, and the lethargic nature of the industry towards the adoption and embrace of an entirely new delivery methodology, coupled with the seemingly exorbitant cost of transitioning. There is need for studies to investigate how the gap in managing the complexities associated with the delivery of construction projects will be resolved. Although the application of the AgPM methodology in construction is a relatively new concept, and research findings within this field as well as on the effectiveness of the AgPM methodology in construction projects are limited. However, given that construction projects have continued to underperform, questions concerning whether the adopted methodology is sufficient remain open to enquiry. Particularly, it is useful to understand whether the AgPM methodology holds more benefits over the TPM methodology, what benefits they yield, and whether their practices require establishment of any supporting mechanisms (Padalkar *et al*, 2016).

Even though this area of study has lacked thorough investigation by scholars, findings suggests that the AgPM methodology offers considerable potentials in improving the performance of construction projects, guided by the agile values and principles (Ingle, 2019; Mohamed and Moselhi, 2019; Kibler, 2019; Mnqonywa et al, 2018; Burmistrov et al, 2018; Rasnacis and Berzisa, 2017; Streule et al, 2016; Spalek, 2016; Serrador and Pinto, 2015; Špundak, 2014; Ribeiro and Fernandes, 2010; Owen et al, 2006; Owen and Koskela, 2006b). Nevertheless, only a few studies have been conducted on the integration of the AgPM methodology in the management of construction projects (Sinha and Sinha, 2020; Jørgensen, 2019; Codreanu, 2016; Serrador and Pinto, 2015; Stavru, 2014; Conforto et al, 2014; Bennett and Lemoine, 2014; Špundak, 2014; Dingsøyr et al, 2012; Baskerville et al, 2011). Considering the challenges associated with introducing an entirely new methodology, this research aims to develop a framework that integrates the strengths from the traditional (TPM) and agile project management (AgPM) methodologies in a framework for the management and delivery of UK construction projects, to appropriate the benefits from both methodologies.

1.3 Research Aim, Objectives, and Questions

The research aim, objectives and questions have been developed to address the identified gaps in literature. The aim of this research is to develop a framework that integrates the strengths of the traditional and agile project management methodologies to improve the performance of UK construction projects. To achieve the aim of the research, the following objectives have been derived:

1. Review the performance of the UK construction industry and identify key factors leading to poor performance
2. Examine the traditional management methodology used within the UK construction industry, identifying its strengths and weaknesses in relation to the performance of construction projects
3. Evaluate the agile methodology and its contribution in improving the performance of UK construction projects
4. Assess the perception of UK construction practitioners on the use of agile project management methodology to improve the performance of construction projects
5. Identify critical factors that hinder the adoption of agile project management in the management of UK construction projects

6. Explore the integration of the strengths of TPM and AgPM methodologies for the management of UK construction projects.

Research questions in this study lays out the specific inquiries that needs to be addressed under the above-mentioned objectives of the research and helps to set the boundaries for the study (Gunatilake, 2013). These research questions are presented in Table 1-1.

Table 1-1 Research Objectives and Research Questions

S/N	Research objectives	Research questions
1	Review the performance of the UK construction industry and identify the issues leading to poor performance	What are the issues affecting the performance of the UK construction industry?
2	Examine the traditional management methodology used within the UK construction industry, identifying its strengths and weaknesses in relation to the performance of construction projects	Are TPM methodologies sufficient for managing the complexities of construction projects?
3	Evaluate the contribution of agile project management methodology in improving the performance of UK construction projects	What is the contribution of the AgPM methodology in improving the performance of UK construction projects?
4	Assess the perception of UK construction practitioners on the use of agile project management methodology to improve the performance of construction projects	How do the actors involved in managing construction projects view the agile methodology?
5	Identify critical factors that hinder the adoption of agile project management in the management of UK construction projects	What are the obstacles/challenges in adopting the agile methodology in the UK construction industry?
6	Explore the integration of the strengths of TPM and AgPM methodologies for the management of UK construction projects.	How can the strengths of the TPM and AgPM methodologies be integrated for the management of UK construction projects?

1.4 Scope and Limitation of Study

This study is focussed on the development of a framework that integrates the TPM and AgPM methodologies for the delivery of UK construction projects. Procurement and construction delivery methods are related, but different processes. Procurement refers to the process used to award a construction contract, whereas construction project delivery refers to the allocation of responsibilities and the process used in carrying out the construction work after the contract has been awarded (CIOB code of practice, 2022; Bauld, 2015). Over the years, there has been an increased focus on procurement strategies in the UK construction industry. A large portion of these research have focused particularly on the identification of the best procurement selection strategies. This research on the other hand focuses on the delivery of construction projects, and how the application of a delivery method that supports the integration of the traditional and agile methodologies can lead to improved performance in construction projects.

To achieve the aim of this research, two phases of data collection was conducted within the UK. For the first and second phase of data collection (open-ended survey and questionnaire survey), UK construction professionals (practitioners), including project managers, site managers, contractors, consultants, quantity surveyors, architects, etc., were selected since these parties are more related to the strategic level and have a holistic view about construction project life cycle. Additionally, the participants selected in this study emerged from both the public and private sectors of the UK construction industry. The choice of gathering relevant empirical data from UK construction professionals from both the public and private sectors was considered appropriate for this research. Furthermore, in the development of the framework that integrates TPM and AgPM, this research also provides five implementation strategies to enable organisations in the adoption of the framework.

1.5 Originality and Contribution to Knowledge

After completion of the early phases that deals with procurement and appointment of a contractor for the project (who appoints a construction project manager), the construction project manager subsequently manages the project schedule and budget of the project on behalf of the owner. Effective management methodology is crucial for construction project delivery in providing a structured approach to planning, executing, and controlling construction projects, whilst resolving all the widespread and deep-seated challenges associated with construction projects' complexities (Shah *et al,* 2023). They set clear objectives, define scopes, allocate resources efficiently, and manage challenges as they arise in the project lifecycle. Construction projects in the UK are typically managed with the traditional methodologies. However, considering the limitations associated with the sole use of the traditional methodology in resolving all the issues associated with managing the complexities of construction projects, coupled with the fragmented state of the industry and the difficulty to effectively predict the project environment (risks) while accommodating customers' requirements. There is need for studies to investigate how the gap in managing the complexities associated with construction projects will be resolved. Therefore, this research aims to develop a framework that integrates the strengths of the traditional and agile project management methodologies to improve the performance of UK construction projects.

Although the application of agile methodology in construction is a relatively new concept, and research findings within this field as well as on the effectiveness of agile methodology in construction projects are limited. Another area that has lacked thorough investigation from scholars is whether the integration of the TPM and AgPM methodologies for the management of construction projects will yield improved performance in construction projects, considering their individual strengths and weaknesses. Notwithstanding, findings have also suggested that the agile methodology offers considerable potentials in improving the performance of construction projects, guided by the agile values and principles, as stated in the agile manifesto (Ingle, 2019; Mohamed and Moselhi, 2019; Kibler, 2019; Mnqonywa *et al,* 2018; Burmistrov *et al,* 2018; Rasnacis and Berzisa, 2017; Streule *et al,* 2016; Spalek, 2016; Serrador and Pinto, 2015; Špundak, 2014; Ribeiro and Fernandes, 2010; Owen *et al,* 2006; Owen and Koskela, 2006b). However, only a few studies have been conducted on the integration of the AgPM methodology in the management of construction projects, considering the challenges associated with introducing an entirely new methodology (Sinha and Sinha, 2020; Jørgensen, 2019; Codreanu, 2016; Serrador and Pinto, 2015; Stavru, 2014; Conforto *et al*, 2014; Bennett and Lemoine, 2014; Špundak, 2014; Dingsøyr *et al*, 2012; Baskerville *et al*, 2011). Therefore, this study seeks to address this knowledge gap by:

- highlighting the strengths and weaknesses of TPM and AgPM methodologies
- expounding understanding through critical review of literature and data findings on the need to integrate the strengths of AgPM methodology into the existing TPM methodology whilst eliminating their weaknesses
- identifying the major barriers to the adoption of AgPM methodology in the management of UK construction projects
- proposing a solution that allows the adoptions of the strengths of the AgPM methodology through the development of a framework that integrates the strengths of the TPM and AgPM methodologies.

Successful completion of this study will contribute to knowledge in construction management in the following ways:

- It will add to existing literature as well as expand knowledge and understanding on the adoption and integration of AgPM methodology in managing construction projects.
- Findings will bridge the existing knowledge gaps - with the integration of agile methodology for the management of construction projects, as well as aid the adoption and applicability of AgPM in the UK construction industry to improve the performance of construction projects.
- It will aid and inform future researchers who might be interested in doing advanced work on the subject.

1.6 Research Process

Research process encompasses the identification, location, assessing, and analysing of all the information required to support research (University of South Florida, 2020). This research follows a well-structured design based on the pragmatic approach to studies. Since the aim of this study is focused on developing a framework for the integration of the traditional and agile project management methodologies, the research process began with the review of relevant literature at the initiation stage, which led to the identification of gaps and the development of the research aim and objectives. The second stage of this research involved the development of a semi-structured interview (in the form of an open-ended survey), which was administered to UK construction practitioners to explore their perceptions of the UK construction industry, the management of construction projects and the need for the integration of the AgPM methodology. Stage three consisted of the development and administration of questionnaire surveys to further corroborate the findings from the second stage. This stage also enabled in the identification of the strengths and weaknesses of the TPM and AgPM methodologies, and the barriers to the adoption and integration of the AgPM methodology. Data analysis and findings from stage three led to the development of the framework, which was achieved in stage four, together with conclusions and recommendations. Figure *1-1* summarises the methodological process adopted in this study.

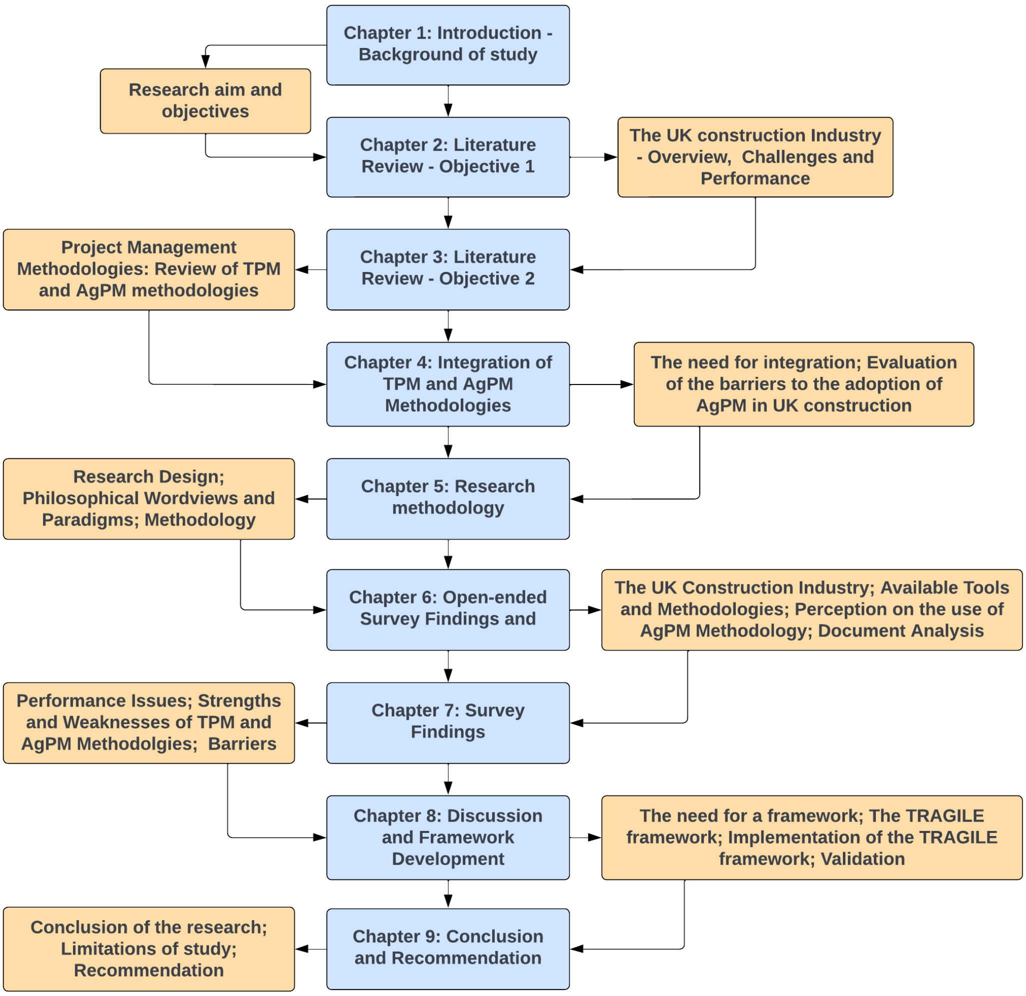

Figure 1-1: Research Process

1.7 Thesis Structure

This thesis consists of nine chapters. The contents of each chapter are detailed in a summary format as follows:

- Chapter one provides a general introduction of the thesis, detailing the nature of the problem investigated. It begins by positioning the UK construction industry as a strategic industry necessary for economic growth, and it encompasses justification for selecting the topic for addressing the research problem. This chapter also covers the aim and objectives, scope and limitations, and contribution to knowledge.
- Chapter two presents literature pertinent to the UK construction industry. Discussions in this chapter emphasise the complexity of construction projects and the need for improved performance, especially in the management of construction projects. This chapter also addresses the recurring issues leading to the poor performance of the UK construction industry. Hence, a review of UK construction reports from the year 1944 to 2018 was conducted, together with a review of the industry's performance.
- Chapter three deals with literature on construction project management, including the life cycle of construction projects delineated in a construction process map. Furthermore, a review of the TPM and AgPM methodologies was conducted, which enhanced the identification of the strengths and weaknesses of the TPM and AgPM methodologies. Based on the identified weaknesses of the TPM methodology in managing UK construction projects, discussion is provided on the benefits of integrating the AgPM methodology in the management of UK construction projects.
- Chapter four provides further discussion on the need for the integration of the TPM and AgPM methodologies. Discussion in this chapter encompasses the management of construction projects, including the phases of construction projects. Also, the benefits of integrating the TPM and AgPM methodologies are provided in this chapter, along with the barriers to the adoption and integration of AgPM in the management of UK construction projects.
- Chapter five presents the methodological approach employed in this study. Discussion begins with the design of this research, which is the plan within which the study is conducted. This is followed up with discussions on research

philosophical paradigms, with justifications on the researcher's chosen paradigm for this study. Also, discussion is presented on the selected strategy of inquiry (mixed research approach) while demonstrating that the mixed research approach not only aligns with this study but also fits well into the study to reduce the researcher's bias. This chapter then concludes with a discussion on the development of the research instrument and the validity of the study.

- Chapter six focuses on in-depth data analysis of the unstructured interview findings from the first phase of this study. Discussions cover findings on the UK construction industry, methodology adopted in the management of UK construction projects, and methodological selection approach. More so, findings on the perception of UK construction practitioners are presented, including their knowledge and awareness as well as the need to integrate the AgPM methodology for the management of UK construction projects.
- Chapter seven presents findings from the questionnaire survey carried out in the second phase of this study. Descriptive data was gathered from a Likert presented to UK construction professionals via MS forms. Descriptive analysis was conducted for the independent variables whereas internal consistency and descriptive/inferential analysis was conducted for the independent variables. IBM SPSS data analysis software was used to analyse the quantitative data while running reliability (Cronbach's Alpha), descriptive analysis, and correlation analysis.
- Chapter eight concentrates on the development of the framework that integrates TPM and AgPM methodologies based on the findings from this study. The framework was developed borrowing ideas and analogies from nuclear physics whereby the fission approach was used in separating the strengths and weaknesses of TPM and AgPM methodologies, followed by a fusion approach to integrate their individual strengths into a framework.
- Chapter nine is the final chapter of this thesis, which presents summary and major conclusions drawn on each research objective of this study. This chapter also details the major conclusions drawn from this study and provides recommendations for the implementation of the developed framework and for further research work.

CHAPTER 2 THE UK CONSTRUCTION INDUSTRY

2.1 Introduction

This chapter provides a detailed consideration of literature in relation to the research objective one which aims to review the UK construction industry with the view of gaining understanding of its performance. Discussion in this chapter begins with an overview of the construction industry, followed by a critical review of construction industry’s reports from the year 1944 to 2018. This is followed by discussions on the performance of the industry, followed by a summary of the chapter.

2.2 The UK Construction Industry: An Overview

The UK construction industry is very complex, with a great deal of diversity (CIOB, 2014), and it is comprised of many different interconnected businesses and specialisms that cut across every segment of the economy (Dykstra, 2018; CIOB, 2014). It consists of three major sectors, including the contracting sector, service sector, and product sector (Department for Business Innovation and Skills, 2013), and each of these sectors differs considerably in so many ways (Ofori and Moonseo, 2006). Therefore, construction practitioners tend to specialise in one or two of these sectors (Dykstra, 2018; Gruneberg, 2018; Oakland and Marosszeky, 2017), thus posing a significant problem with coordination and integration amongst the various parties (Xue *et al*, 2014).

The impact of the construction industry is unique among the major economic sectors (Olanrewaju and Abdul-Aziz, 2015). For example, in the UK, the construction industry serves as an essential component of the nation’s economy and a major driver of growth (Arefazar *et al*, 2019; Oyedele, 2016; Naoum, 2015; Olanrewaju and Abdul-Aziz, 2015; Ofori, 2015). It represents 13% of Gross Domestic Products (GDP) (RICS Insight Paper, 2020) and provides employment for about 2.3 million people, which is equivalent to 10% of all UK jobs (CIOB, 2020). This clearly establishes the fact that the UK construction industry is far more than just an economic driver but an essential component in shaping and influencing the lives of people and the world at large (CIOB, 2020).

Given the importance of the construction industry to the economy, several prominent studies have been undertaken to identify and document the challenges and opportunities that the industry presents (Sawhney *et al*, 2020), thus revealing that the industry has been characterised by its high diversity of its agents and processes, high resistance to change, and low incorporation of innovative technologies and methodologies compared to its manufacturing counterparts (Rivera *et al*, 2021). Also, the UK construction industry has been inundated with some well-known problems and challenges, of which many have lingered for several decades (Rivera *et al*, 2021). These challenges have also been exacerbated with the growing number of processes and participants involved. Furthermore, fragmentation and the traditional structure of industry has made it challenging to adopt new and innovative approaches or methodologies (Oesterreich and Teuteberg, 2016). Some of these challenges are discussed below:

Delays and overruns: Delays and cost overruns are one of the major problems in the UK construction industry. The UK construction industry has faced countless challenges in the last couple of years following the pandemic, ranging from supply chain issues, budget inaccuracies or labour issues, these challenges has led to significant delays on construction projects across the UK (Burns, 2023). According to Construction News (2022), nearly nine in ten large construction projects are behind schedule following the pandemic disruption. Causes of delay and overruns in the UK construction industry cuts across several areas ranging from the difficulty of accessing both building materials and labour (RICS, 2022) to the inherent technical issues as well as administrative and legal issues in carrying out tendering procedures. Consequently, distorting the natural mechanisms of competitiveness as they make it significantly more difficult for different construction agents to foresee the proper fulfilment of the contract on time and in form (Yeganeh *et al*, 2019).

Ineffective knowledge management: The structure of the UK construction industry and the limited internal networks do not necessarily allow for efficient access to information from previous projects and sometimes not even from the current project. Hence, lessons learnt from a project largely remains with the individuals who participated in the project and do not extend to the entire organisation. The lessons may include the technical information, actual budget and execution times, deviations, incident handling and on-site problem solving, etc (Håkansson and Ingemansson, 2013).

Focus on classic routine activities: There is focus on monotonous processes with little or no innovation, and there is no implementation of learnings acquired from different projects or teams due to the inability of the industry to effectively collate and disseminate information (Yeganeh *et al*, 2019; Håkansson and Ingemansson, 2013).

Extensive regulation limiting innovation: Construction projects operate in public and private regulated contexts related to consumer protection, safety, and technical and environmental standards. Hence, some regulations may stand as an obstacle to the adoption of innovative practices when the original goal of the project is distorted. This can be seen in the case wherein the bidding process of the project is prolonged and leads to a more expensive execution of the project, or the rigour of technical regulations that lack the agility to adapt to changes in the industry (Håkansson and Ingemansson, 2013).

High diversity of agents leading to fragmentation: Construction projects are executed by temporary alliances of unequal organisations which in turn are involved in other similar projects. Each organisation involved in a construction project has different equipment, profiles, training, culture, and, above all, interests while seeking to complete its activities in the shortest time possible to be able to use its resources in other projects (Hall *et al*, 2020; Kannimuthu *et al*, 2018). Fragmentation in the UK construction industry generates a hierarchy of processes, with few long-term relationships between teams, generating conflicts between prime contractors and subcontractors as well as ultimately making it even more difficult to integrate the supply chain (Håkansson and Ingemansson, 2013).

Shortage of skilled workers: The UK construction industry is plagued with a low-skilled workforce, high job rotation, rising average age of employees, and little turnover. Studies have revealed that shortage of skilled workers in the industry is mainly because the industry is unattractive to the young and trained workers considering the safety issues, wages, and working conditions (Yap *et al*, 2019).

Design changes during construction: Changes in design stage of a construction project seem recurrent for diverse reasons, including discrepancies in the design, modifications by the client, regulatory changes, but, above all, early tenders where the economic criteria prevail over technical quality of the design and energy efficiency or environmental considerations, as second priorities, which cause alterations in the costs and schedule (due to timeouts, demolitions, or reworks) (Yap *et al*, 2019; Håkansson and Ingemansson, 2013; Dubois and Gadde, 2002).

Poor planning: Poor planning issues in the UK construction industry has led to several problems, such as delays, overruns, client dissatisfaction, reworks due to the lack of availability of material, equipment, people, and other factors (Zidane *et al*, 2018; Shen and Lin, 2014).

High accident rate: The construction environment and its traditional interaction dynamics generate an accident-prone environment, with low trained and unmotivated personnel lacking a suitable safety culture. These problems are further increased by poor construction health and safety plans, along with well-established bad practices (Shuai and Li, 2013).

In the year 2008, the UK construction industry was hit hard by the world economic recession which led to further issues in the industry. Even though it seemed the industry was slowly regaining its glory, the performance again declined in the year 2013, followed by a further decline by 3.0% in the year 2017 (ONS, 2021). Furthermore, the performance of the UK construction industry was again hampered in the year 2020, following the EU referendum and the COVID-19 pandemic, causing business investors to hold back on investments (CIOB, 2020). This led to an overall decline in output of the industry by 35% y-o-y in April 2020 (de Best, 2021), as shown in Figure 2-1.

Figure 2-1: UK Construction Performance
Source: S&P Global, CIPS

Over the years, several debates have been ongoing, arguing if the performance of the industry is commensurate with the economic growth of the nation. For example, Sir Jon Egan (1998, p.04) states as follows: "*The construction industry as a whole is under-achieving. It has low profitability and invests too little in capital, research, development, and training. Too many of the industry clients are dissatisfied with its overall performance*." In this statement, Egan (2008) evaluates the overall performance of the industry based on certain areas, such as low profitability, investment in R&D, and client dissatisfaction. Likewise, Farmer (2016, p.07) in his review points out some of the issues mentioned by Egan (2008), and he states as follows: "*Extremely poor level of Productivity, Low Predictability, Lack of Collaboration and Improvement Culture, Structural Fragmentation, Leadership Fragmentation, Lack of Research/Development and Investment in Innovation, Dysfunctional Training Funding & Delivery Model, Low Margins, Adversarial Pricing Models & Financial Fragility, Poor Industry Image is one of the critical symptoms of the poor performance of the current construction industry in the United Kingdom*." Hence, it is evident that the performance of the UK construction industry can be judged in several ways. It is also important to note these issues are not just peculiar within the UK. Most advanced economies also experience regression, steadiness, or sluggishness in their construction projects' performance, which suggests that it is a feature of the industry and not the country (Green 2016).

In a bid to improve the performance of the UK construction industry, several studies and reports have been published (Construction Excellence, 2020; McKinsey and Company, 2020; The UK Industry Performance Report, 2019). However, only little progress has been made, seeing that systemic innovation is difficult. As a mature industry, the UK construction has become fragmented vertically, with separate parts of the production processes involving specialized firms; horizontally, with many firms striving to compete; and longitudinally, with relationships between suppliers and clients infrequently sustained across projects (Hall *et al*, 2020). Besides, fragmentation of the industry presents a "never-ending stream of problems that require local incremental innovations" (Levitt 2007, p. 624). Hence, the potential for "systemic" innovations are usually bypassed with localised innovative moves that offer less comprehensive benefit but fit within the existing modules of work and specialisation of the industry (Katila *et al,* 2018). Before evaluating the performance of the UK construction industry, a review of the UK government's efforts (UK construction reports) in eradicating these issues would be considered.

2.3 UK Construction Reports

Since the Second World War, the UK construction industry has been faced with several calls for change, particularly in terms of performance, productivity, and relationships between clients and project team (Construction Excellence, 2020; Hegazy and Hegazy, 2012). These appeals for change are evident in several reports and enquiries released over the years, including the Simon Report (1944), Emmerson Report (1962), Latham Report (1994), and through to some more recent reports like the Farmers Report (2016) and Construction Sector Deal (2018). The reports were driven by main stakeholders who wanted a better performing industry to serve their needs. For example, between 1944 and 1980, there were powerful government or parastatal clients, and between 1980 and 2016 was the era dominated by powerful private clients and construction professionals who wanted to modify the restrictions and guidelines for conducting businesses between themselves and the government (Langford and Murray, 2008). Subsequent discussion in this section evaluates some of the key government reports on construction, including their impacts and limitations. The aim of this review is to carefully identify and synthesise the recurring issues within the UK construction industry as well as enable the researcher to generate evidence for further evaluation.

2.3.1 The Simon Committee Report (1944)

The Simon Committee Report (1944) was published at a very favourable period wherein the UK government and other professional bodies were working towards implementing change in the industry. At that point in time, construction project managers adopted the traditional processes in which the design and the construction phases were carried out independently (design bid build). Howbeit, a less procedural method of tendering from the government was sought by construction practitioners to enhance improved performance of the industry. Therefore, the Simon committee analysed the precontracting stage of a construction project wherein the architect assumes the leadership role of the entire process, and it criticised the possibility for a single architect or a builder to have all of the specialist know-how required to manage the entire processes in construction management. The Simon committee (1944) emphasised collaboration and recommended that all stakeholders must have a thorough understanding of the project requirements to reduce the workload on the architect. Furthermore, it noted the importance of timely delivery of projects as it was one of the criteria in facilitating and promoting the selection of firms and workforce.

Another major recommendation from the report was that the government should embark on a national training programme for construction managers and a more collaborative approach to the management of tender and bidding processes in the industry. However, the suggestions and recommendations by Simon (1944) were not effective at that time since there was no tool, technique, or processes that could enable project stakeholders to clearly define their needs and the expected outcomes of a project (Faisandier *et al*, 2020; Rastogi, 2018). Also, considering a multi-stakeholder's perspective, where there are different levels of stakeholders, it was almost impossible to effectively predict future outcomes of a project without necessary tools (Oakland and Marosszeky, 2017). The changes implemented following the report were not holistic due to some of the persistent traditional practices within the industry (Gruneberg, 2018), however, the report was considerably accepted and became the first major general report that was commissioned by the UK government on the procurement procedures of projects by clients. Besides, the government embarked on its first national planning programme to promote a balance between the building programme and the available resources, which is suggestive of the fact that the industry is responsive to change (Langford and Murray, 2003).

2.3.2 Phillip Report on Building (1948 – 1950)

This was the first post-war report on building in the UK construction industry. During that period, uncertainties and lack of effective communication between clients and the project team propelled construction clients to seek for better performance through enhanced productivity and better management of construction projects. Prior to that period, between the 1940s and early 1950s, over the fence method of communication was employed by project line managers (what we know as project managers today) as best practice in managing projects (Kerzner, 2018), thus giving no room for construction clients to easily inquire about their project's progress. While the Simon (1944) report focused on contracts and procurement processes, the Phillip report sought for more effective ways to improve the performance of construction projects through the need for effective communication between the clients and stakeholders, which has been a growing concern in industry till date (Pandit *et al*, 2019; Olarenwaju *et al*, 2017; Hoezon, *et al*, 2006; Gorse *et. Al*, 1999; Emmerson 1962). Phillip therefore assessed:

- the UK construction organisations and the efficiency of building operations in the industry
- the position of profession in relation to the construction industry
- the arrangements for financing operations and the types of general contracts in use, and, consequently, made some recommendations.

Considering the Phillip's agendas, of which the first agenda was assessing the efficiency of building operations, Wild (2001) agrees that a lot more than just a written report within the limited time frame was required to effectively carry out such task. For example, and just to mention a few, such agenda required:

- a comprehensive knowledge of all the operational programme of works and site planning, including the supply of materials and tools
- a balance of operation and other aspects of construction, as well as a progress report which will be evaluated periodically
- work studies which would assist in reducing time wastage

- an incentive scheme
- a joint production committee.

Again, in consideration to Phillip's second agenda, which aimed to inquire into the position of professional in relation to the construction industry, it is evident that construction projects require many professionals and trade workers at different stages of the projects. Besides, the roles and status of professionals in the industry is not debatable. However, the report reveals a conservative treatment towards construction professionals and coordinating bodies because, while the report discusses incentive measures for operatives in the industry, the needs of construction professionals in the industry are bypassed as a problem. Phillip also believed that a high level of certainty could be attained in the industry, considering the uncertainties at that time, and therefore proposed for skills acquisition, better management processes, efficient pre-planning and design output, and the abolition of clauses (including labour clauses, variation clauses, cost variation clauses, contract clauses).

Phillip's proposition for skills acquisition was closely related to Simon's (1944) recommendation for a training programme. However, Phillip's was hinged on the government's renewed interest on training since no one was charged with keeping under review the arrangements for training at different levels and their progressive development following previous reports (Wild, 2001). Furthermore, Phillip's recommendation for the abolition of clauses was quite pertinent. After the war, inflation influenced competition in the price of building materials. Hence, variation clauses protected contractors from certain risks due to changes in prices of building materials and wages (Wild, 2001). Nevertheless, as soon as the economic situation was stable, Phillip's recommendation for the abolition of clauses, which reflected the uncertainties of post-war construction era to avoid undue price gambling, seemed inevitable.

The Phillip report was not fully appropriated due to some of its weaknesses, and, to some extent, the objectives of the report were based on previous trends in the country and presumptions as to what could work given the vast experience of the committee. Also, a much deeper look into the line-up of inquiries in the report reveals how unrealistic and overzealous the report is, undermining the consequences of the slow recovery in productivity during the post war (Wild, 2001), which could lead to exacerbation of problems. Nonetheless, the Phillip report constituted a guide for further researchers in the industry.

2.3.3 The Emmerson Report (1962)

This report was published during economic and social development in the UK. Five years prior to this period, the UK market fell a great deal and was faced with several challenges. As a result, this report was published based on a survey request from the minister of works on the resolution of problems facing the construction industry, which was also critical for improved performance. The delivery of the report was conducted informally, partly because it seemed the best way of encouraging free expression of opinion and partly because of the time factor. In the report, Emmerson (1962, p.3) first acknowledged the positive aspects of the industry: "*Because this study is intended to detect signs of ill-health it may give a false picture. I must, therefore, emphasize most strongly that in a more balanced survey I should wish to pay tribute to the remarkable recovery of the building materials industries and the construction industries from the war period when they were practically closed down; their flexibility in meeting new demands on their services in the past fifteen years; the introduction of new materials, increased mechanization and new techniques; the steady rise in output, and the avoidance of major industrial disputes*."

Furthermore, Emmerson evaluated the deficiencies and the fragmented state of the construction industry, whilst acknowledging the disparity between the design phase and the construction phase. Asserting that in no other industry are the roles of construction design team far removed from the roles of the production team. Therefore, Emmerson (1962) suggested a standardisation of sub-contracts between stakeholders in order to promote integration of knowledge amongst the contractors (Nawi *et al*, 2014). Consequently, Emmerson (1962) criticised the lack of cohesion amongst the parties in a construction contract, which was aggravated by the methods of training and the codes of conduct for the members of professional bodies and suggested a common form of contract between building and civil engineering works. In addition, some of the drawbacks of Phillip report were subtly addressed in the attempt to proffer a better solution to the issue of performance.

Emmerson’s (1962) report was not very innovative due to the limited time available for the report to be published and the inability of the committee to consult with direct labour schemes of local authorities who at the time played a key role in preserving the traditional system. Nonetheless, many of the issues raised by Emmerson (1962) were further developed in the Banwell Report published in 1964.

2.3.4 The Barnwell Report (1964)

In the opening statement of the report, the Barnwell committee described the UK construction industry as lively, full of new ideas and not afraid to make changes. However, considering the industry and its associated professionals as a whole, the Barnwell committee also noted that the industry do not appear to move forward with the speed and purpose of its active members. Owing to the disparity of various sections of thew industry. Hence, the focus of the report was on the relationship among the project team, contracts, and other construction processes. The committee outlined the main problems within the industry, namely that ‘the various sections of the industry have long acted independently, and consequently stated as follows: “While we make suggestions for alterations in practices and procedures, these will be of no avail until those engaged in the industry themselves think and act together.” Whereas the UK construction practitioners sought for the government’s intervention on regulation of contracts, Barnwell (1964) analysed the traditional disparity between the design and construction processes and criticised the industry for lack of speed and purpose. The report cited two sets of opposing parties who were also key players of the industry at that time:

- those who were willing to accept change and not afraid to change their practices and procedures
- those who did not appear to want to move forward despite the speed and purpose of other members.

Further evaluation of the report however revealed that the latter were the majority in the construction industry - those who were deeply rooted in their traditional ways and were still practising the traditional form of contracting (Construction News, 1996). Banwell (1964) elaborated on the team in the design and construction of a project, and provided a number of recommendations on the theme of thinking and acting together, including:

- that the Department of Education and Science, University Grants Committee, and various professional institutions should ensure that training in the several disciplines of the building industry take place within the same establishment, and, where possible, with common syllabuses or parts of syllabuses

- that the Royal Institute of British Architects (RIBA) should set up a clearing house between the various professional institutions for the exchange of information on educational policy and developments in joint training
- that the National Joint Consultative Committee of Architects, Quantity Surveyors, and Builders (NJCC) should take the initiative in reconvening its sub-committee on post qualification training.

The report also demonstrated that one of the most significant problems facing the UK construction industry was the need to instigate a collaborative thinking amongst the UK construction practitioners. Therefore, the committee was set out with fervour in promoting ways of abolishing the traditional practices within the UK construction industry. The recommendations of the report were adopted by many local authorities although were not adopted by the Ministry of Works, and action on contracts was not supported by industry bodies, such as the Joint Contracts Tribunal and the Civil Engineering Conditions of Contract Standing Joint Committee (Construction News, 1996). To an extent, the report wrought considerable changes. For example, the recommendation for a common form of contract for building and civil engineering across the UK, England, Scotland, and Wales led to the implementation of a standard form of measurement for quantity surveyors.

One interesting aspect about the Barnwell (1964) report and some other preceding reports was that they all recommended and advocated for change in the way things were being done. However, targets or benchmarks to ascertain when these changes were to be fully implemented were not set out. Besides, there was no criteria to measure the number of changes implemented, thus making it difficult to establish the level of changes if it does occur. Hence, it remains debatable the degree to which the recommendations was implemented (Langford and Murray, 2008).

2.3.5 The Latham Report (1994)

The Latham (1994) report was published when the construction industry was badly hit by recession. Construction industry's output had declined by 39% between the year 1990 and 1993; half a million construction industry jobs were lost between the year 1989 and 1993; and 35,000 small businesses had gone bust due to insolvency

(Adamson and Pollington, 2006). The issues faced by the industry at that time were strident but temporal due to recession. Also, the industry was considered to be wasteful compared to other industries as at then. So, the issues associated with the industry were more of a universal concern, considering that the industry's performance was short of good value to the customers, partly due to the universal nature of the industry, fragmentation, and contracting arrangements which seemed to be full of oppositions. As a result, the Latham (1994) report, tagged "Constructing the Team," was published to investigate the underlying problems associated with the UK construction industry.

Although previous reports have addressed similar issues, and their recommendations were not fully appropriated, Latham (1994) however centred on the relationships between the construction team members as well as a mutual benefit for both the clients and practitioners. Latham (1994) emphasised that clients should be at the centre of construction process and the industry should deviate from its traditional structure which was majorly adversarial and transform to a more integrated approach that allows collaboration and teamwork. Latham (1994) further proposed several recommendations for the industry, including:

- embarking on best practice for client
- adoption of the New Engineering Contract (NEC) as a less adversarial contractual arrangement
- legislations to prevent 'set offs'
- partnering as a means of promoting long-term contracting arrangements
- registered and approved list of contractors, sub-contractors, and consultants for public sectors
- higher level of standardisation and better integration of contract documents
- obligatory defects insurance
- implementation of codes of practice and guidance documents for clarification, coordination, and standardisation of practices across the industry
- the obligation to deal fairly with each other in mutual cooperation
- provision of unified documentation that clearly defines roles and responsibilities
- allocation of project risks to those who can best manage, estimate, and adapt it
- avoidance of conflict and hasty resolutions to disputes
- strict responsibilities to work as a team with shared financial motivation.

Latham (1994) also recommended a reduction in construction cost by 30% by the year 2000, which also became a motivating factor for the implementation of the recommendations from previous reports. The report had several positive impacts in the industry. For example, it led to the creation of the Construction Industry Board (CIB) in 1995, which later oversaw the implementation of Latham's (1994) recommendations and other organisations. Also, a number of other organisations were established following the Latham report (1994), including:

- Reading Construction Forum
- Design Build Foundation
- Construction Best Practice Programme
- Movement for Innovation
- Rethinking Construction
- Constructing Excellence
- Construction Clients' Group

These organisations were later amalgamated by Constructing Excellence in 2003, and some of the recommendations were implemented by the Housing Grants, Construction and Regeneration Act (The Construction Act) which, amongst other things, set out fair payment practices and regulated 'set off.' Furthermore, the Scheme for Construction Contracts, which was applicable when construction contracts did not comply with the Housing Grants, Construction and Regeneration Act, established the right to adjudication (Design Building, 2022).

2.3.6 Tavistock Studies into the Building Industry: Communications in the Building Industry (1996)

This report comprises two interim reports that came out of a unique research project as the 1965 report cover states: 'The study breaks new ground in two important aspects: it is the first example of an industry as a whole inviting research into its own operations; and it is the first application of the combined resources of operational research and the social sciences to a research project' (Boyd and Wild, 2008, p.69). The study investigated in detail, the operations of the UK construction industry unlike previous studies that saw only a macroeconomic analysis and produced recommendations (Langford and Murray, 2003), with the aim of defining the scope and cost of a more major project. The study covered Britain in the early 1960s and the building industry communications research project. In the early sixties, there was a positive outlook in the country with growing affluence and a belief in a better future with major social change (Marwick 1995). However, the positive outlook also masked the poor economic state of the country both in relation to the rest of the world as well as in the fixed and social infrastructure. Consequently, the paradox between belief and reality governed actions and experiences throughout that period.

Following the victory in the World War II, whereby, as a country, the people had worked together through the fears and agonies of war, there was a general belief in a rightful position in the world and that the British citizens deserved a reward from their actions. This instigated Britain to maintain expensive activities overseas, including a nuclear capability, while increasing wages and changing social structures. In particular, home ownership doubled to nearly 40% from the early 1950s to the 1960s. In reality, the country was in a state of insolvency with major reduction in gold and currency reserves whilst post-war reconstruction was based on loans from the USA and Canada, which many regarded as extremely unfavourable terms (Childs 1992). Also, the country's share in the world's trade market declined from 25% to 15% alongside several other issues which influenced the nature of reconstruction work, the approach, and ultimately the volatility of the quantity of work. Therefore, in order to meet up with the reconstruction demand at the right price, improvement in productivity became a major issue, which also aligned with an economist's view of the world.

Hence, the Tavistock studies came as an egalitarian outlook that cuts across previously quite rigid class and professional boundaries, a strong belief in technology for new products, new processes, and new organisations as well as finally a rational planning and decision-making process as a modern model of action. Tavistock considered the building process based on the client's building needs while determining the role of the resource controller in communications. Tavistock mapped communication in construction into eight phases:

- Phase 0 Client deciding to build
- Phase 1 Client consulting building team sponsor
- Phase 2 Sponsor investigating and preparing the brief
- Phase 3 Preparing and gaining client's acceptance for sketch plans
- Phase 4 Preparing contract documents, Obtaining final approvals

- Phase 5 Preparing and agreeing contract. Setting up a construction team
- Phase 6 Construction to completion
- Phase 7 Handing over and settling final account

From the communication phases suggested by Tavistock, two themes can be drawn: first, there seems to be a considerable variety and confusion in the arrangements of the phases; second, there is a distinction between formal and informal communications. This was the first time that the informal aspects of construction was acknowledged. Also, the first four phases relate to the client as well as the relationship between the client and industry. The study provided a distinction about the level of sophistication of the client depending on their understanding and experience of the building process, which affects the way they make approaches and decisions. In conclusion, the study identified five questions that needed to be addressed:

- How can the industry help prospective clients to understand what can be done for them?
- How can the industry help clients to have their needs met during the building process?
- How is the design team built up and how does it communicate to create a total design?
- What minimum information is required in contracts so that those concerned know what is expected of them?
- What is the nature of communications in the construction team to ensure efficient construction control?

The study was successful in shifting the focus of the industry from contracts to uncertainty, interdependence, and analysis of the roles of resource controllers, and thus for the first time developed a real appreciation of the meaning of fragmentation in an industry. Even though the study did not have a direct influence on the industry, it created a set of new theories not just about the industry but also about complex, interdependent, and uncertain situations in general. Besides, the novelty of the approach used in this study, coupled with the complexity of the subject and the abstract language of the analysis, may have led to the minimal impact of the study

2.3.7 The Egan Report (1998): Rethinking Construction

This was a report from the UK construction task force to the deputy prime minister on the need to improve the quality and efficiency of the industry, considering that construction is one of the pillars of the domestic economy. Although Latham (1994) addressed some of crucial concerns regarding the UK construction industry, however, since most members of the Latham (1994) task force were clients and people from manufacturing, their suggestions were inclined towards the reduction of waste (lean thinking). The Egan (1998) report focused on performance and productivity due to the industry's underachievement, low profitability, non- investment in capital research/development and training, and client's dissatisfaction, considering the perceived wastefulness of the industry due to the impression that it does not deliver good value to the clients.

Egan (1998) acknowledged that the industry was at best excellent since it was capable of delivering projects like every other industry. However, Egan emphasised the need to for the industry to modernise in order to tackle the severe problems it was facing. Furthermore, regarding the wastefulness of the industry, Egan (1998) agreed that the industry's perception of wastefulness was not entirely wrong because of the low level of productivity, which means that construction workers still engaged in their daily work processes but took longer time than required to complete their task, delivered less value, and still got paid, thus indirectly increasing the cost of construction works without adding value to the clients (Seadon and Tookey, 2018). In terms of performance also, Egan (1998) asserted that the performance of the UK construction industry was underachieving in relation to the economic growth, arguing further that the private and government clients were dissatisfied due to the industry's low profitability and little investment in the capital, research, development, and training. Egan (1998) also addressed the issue of fragmentation within the industry which has inhibited performance improvement.

Although the issue of performance and productivity has been ongoing in the industry despite several published reports in the past, as a way of addressing it, Egan (1998) recommended and proposed five key drivers of change. The first recommendation centred on committed leadership. Egan (1998) understood the importance of committed leadership in improving the performance and sustainability of the industry

(Pejman and Heap-Yih, 2020; Opoku *et al*, 2015). Hence, this recommendation was applicable to construction practitioners, suppliers, and designers alike. According to CITB (2018), strong leadership is contributory to improving the performance and productivity of the UK construction industry. Studies also acknowledge strong and committed leadership, and they recommend the bottom-up leadership style for the UK construction industry (Alwan *et al*, 2017). This is because construction project managers rely mostly on the employees who do not report directly to them to fulfil some of the required tasks (Pejman and Heap-Yih, 2020; Fasaghandis and Wilkinson, 2019; Alwan *et al*, 2017; Opoku *et al*, 2015).

Second, Egan (1998) acknowledged that the clients play a vital role in effectively developing the workflow and project execution process (Durdyev *et al*, 2018; Kärnä *et al*, 2004), and suggested that clients should be the centre of construction process. Previously, Latham (1994) also proposed a similar recommendation of clients as the focus of construction processes. However, the industry's focus seemed more on the employers and their contractual chain (Contasfor, *et al*, 2015). In the third recommendation, Egan (1998) proposed an integrated process and team on the basis that designers, contractors, and suppliers work together to eliminate waste in project delivery process and promote learning from the experience. Egan's (1998) second and third recommendations demonstrate that he understood how to successfully run an organisation with clients at the focal point, since most successful businesses work backwards from the needs of their clients and focus on value generation for their clients (Holroyd, 2003), hence his suggestion for the integration of processes and the project teams to deliver value to the clients and reduce waste.

The fourth recommendation of Egan (1998) was for a quality driven agenda in the industry (Construction Excellence, 2020). Quality, from his point of view, means a zero tolerance to defective projects. Hence, one of his goals was to promote the industry to a point where projects are delivered on time, on budget, and without any form of defects. Egan's (1998) fifth recommendation called for a total commitment to the people in order to ensure that all stakeholders are carried along in the processes, with no one left behind. Again, this recommendation was as a result of Egan's (1998) understanding on how to appeal to the emotions of the team, and that by showing commitment, valuing their effort and hard work, the team would in turn work harder at delivering value (Holroyd, 2003).

Furthermore, Egan (1998) also set out targets for improvement in construction projects, such as a 10% annual reduction in construction cost and time as well as a 20% annual reduction of defective project output, suggesting also that if the industry was not ready to carry out the targets, the clients should take the initiative (Contasfor *et al,* 2015). Egan (1998) proposed a radical change in the construction industry, stating thus: '*We [the task force] wish to emphasise that we are not inviting UK construction to look at what it does already and do it better; we are asking the industry and Government to join with major clients to do it entirely differently. What we are proposing is a radical change in the way we build*' (Langford and Murray, 2008, p. 181).

Egan's (1998) recommendations were quite impressive, and, after three years, they were reemphasised in the agile manifesto (Agile Alliance, 2001). However, most of Egan's targets were not achieved (see Figure 2-2). For example, capital cost remained approximately the same, construction timeline increased slightly rather than a decrease as proposed by Egan (1998), project cost and performance prediction only improved by 2-3%, defective project output slightly on the increase rather than a 20% reduction as proposed by Egan (1998), and productivity significantly declined by 7% against the forecast of 10% increase (Mottram and McDermott, 2002). Besides, the weaknesses of the report are not just in the overly ambitious targets but rather lie in the fact that Egan (1998) set up arbitrary targets without providing actionable plans on how to realise them (Gruneberg, 2018). Moreover, since there was no measure in place to monitor the achievements of the targets and no form of penalty for defaulting organisations, the underachievement of Egan's (1998) targets and recommendations only led to further criticism since the entire nation was updated on the yearly review of the industry's progress.

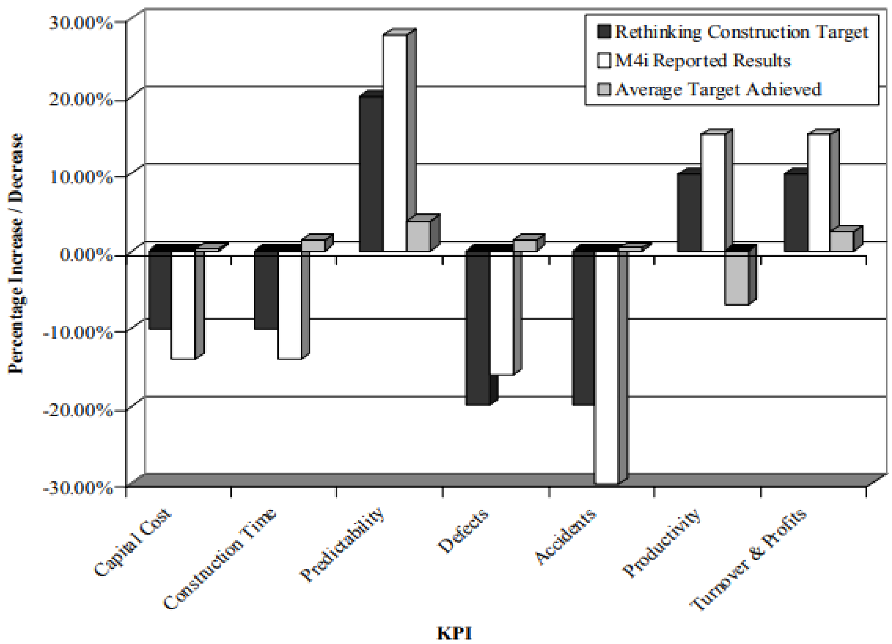

Figure 2-2: M4i report on Egan (1998) Targets
Source: Research Institute for the Built and Human Environment Salford University, UK

2.3.8 Wolstenholme Report (2009)

The Wolstenholme (2009) report tagged "Never Waste a Good Crisis," was published in the depth of severe economic crisis in the UK. After the publication of the Egan (1998) report, the progress recorded based on Egan's (1998) recommendations were nowhere near enough. Although few of Egan's (1998) targets had been met in full, most were fallen considerably short. Also, where improvement has been achieved, too often the commitment to Egan's principles has been skin-deep. Therefore, the main objective of the Wolstenholme (2009) report was in analysing the 10-year developmental process of the industry since the Egan report (1998). Furthermore, the report considered whether the principles behind the Egan (1998) agenda were still relevant a decade after its publication and suggested that while some of the ideas need to be updated, the need for change is as strong today as it was eleven years ago.

The body of the report was consistent with Egan's improvement agenda and a focus on the industry's KPIs. Therefore, in agreement with Egan's (1998) targets and recommendations, Wolstenholme (2009) emphasised that if we cannot measure it, we cannot manage it, asserting thus: "*The KPIs allow individual firms to benchmark their performance with other firms. They also enable Constructing Excellence to measure* *improvement across the industry in its annual Industry Performance Report"* (Wolstenholme, 2009, p. 10). … *"First is the promotion of environmental and social issues as the key drivers for measuring long term success"* (Wolstenholme, 2009, p. 25). Wolstenholme (2009) also revealed in his assertion that in the later years that followed, several developmental improvements were made following the Egan (1998) report: "*…It is heartening to look at the demonstration projects to see that some very good work has been done"* (Wolstenholme report, 2009, p. 3).

Furthermore, some of Egan's recommendations were taken into consideration, leading to some of the targets being met. For example, Egan's target for productivity and profitability was met, to some extent due to the buoyancy of the global economy, rather than resultant improvements in organisations and project performance (Gledson *et al*, 2012; Green, 2011). According to the UK Industry Performance Report (2017), the construction industry made good use of the minimal resources and workforce they had after the severe credit crunch, and it became more productive and profitable. Nevertheless, the improvements were not as initially anticipated due to certain factors, such as the capability of the industry, structure of the industry, and delivery model. For example, Figure 2-3 reveals that three very important Egan's targets (including capital cost reduction by 10%, construction time, and improving predictability) were still beyond the industry's grasp (Cartlidge, 2017).

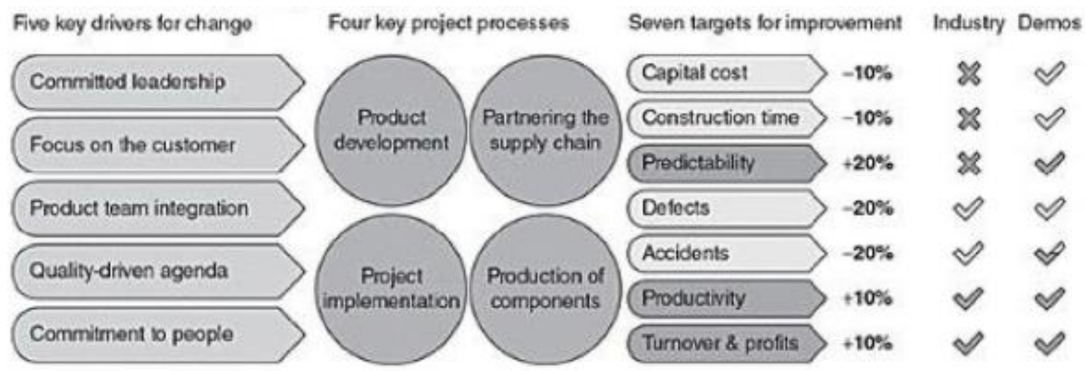

Figure 2-3: Egan's targets
Source: Wolstenholme Report (2009)

Wolstenholme (2009) therefore argued for the chances of change to be enacted in his era, considering that after several reports in the past decade the industry has not significantly changed. Also, Wolstenholme (2009) agreed that Egan's (1998) report had great impact on some parts of the industry. However, the emphasis on the transformation of the industry has remained incomplete since the industry has been sheltered by a strong economy. Hence, the economic crisis as at then seemed the perfect opportunity for the UK construction industry to restart the process and create a built environment sector that is deserving of the UK (Wolstenholme, 2009). Therefore, he suggested the need to thrive in value creation of the entire construction process rather than focusing on cost reduction measures, and in the abolition of clients-led era in order to create opportunities for suppliers and the likes to also add value to the industry through innovation, collaboration, and unified work-processes.

In summary, the Wolstenholme (2009) report was rather a uniting call to arms than an objective appraisal of the merits from the Egan (1998) report due to its uncritical nature (Green, 2011). At the tail end of the report, there were some pithy recommendations which Wolstenholme (2009) described as ideas for radical change. However, majority of the recommendations was straightforward, common-sense approach to best practice rather than a radical approach for change, which was needed in the middle of a recession (Mosey, 2009).

2.3.9 Farmer Report (2016)

The Farmer Report (2016) reviewed the UK's construction labour model in the following areas:

- How the construction labour model and recruitment practices impact on incentives for skills development in the sector (including the supply chain) and on the introduction of more novel techniques such as off-site construction.
- What business models and other arrangements could better support skills and skills pipelines in the sector?
- What measures could improve wider incentives for capacity investment and the introduction of new ways of working?
- What are the barriers and enablers to greater use of off-site construction?
- How could the range of participants in the UK housing market be broadened, including through the better introduction of institutional funds?

The review adopted a structure of evaluating and appraising the UK construction industry's current and future state with a strong medical process analogy of presenting the symptomatic analysis of the industry; providing a diagnostic assessment of the root causes; providing a prognosis for the future; establishing a treatment recovery plan for the future of the industry and keeping the industry under observation (success factor). Under the symptomatic analysis of the industry, Farmer (2016) highlighted 10 critical symptoms of failure and poor performance in the UK construction industry:

- Low productivity
- Low predictability
- Structural fragmentation
- Leadership fragmentation
- A dysfunctional training, funding and delivery model
- Workforce size and demographics
- Lack of collaboration and improvement culture
- Lack of R&D and investment in innovation
- Low margins, adversarial pricing models and financial fragility
- Poor industry image.

The symptoms of the 'ailing' UK construction industry presented by Farmer (2016) is synonymous to a sick or even dying patient that needs urgent attention. On the other hand, if Farmer's (2016) diagnosis of the industry is to be taken seriously, it seems that the industry was let down by those leading the previous change agendas, considering all the preceding reports and recommendations for the industry (Green, 2016). Furthermore, Farmer (2016) also identified three root causes of the poor performance of the UK construction industry: a). a 'survivalist' shape, structure, and set of commercial behaviours in reaction to the environment in which it operates; b). non-aligned interests of the industry and clients reinforced by traditional procurement protocols and a deep-seated cultural resistance to change pervading across both parties; c). no strategic incentive or implementation framework in place to overcome the issues above and initiate large-scale transformational change. Famer (2016) also confirmed that the industry would face unavoidable decline if longstanding issues were not properly addressed.

The "survivalist" metaphor used by Farmer (2016) was not such a bad aspiration for the UK construction industry (Green, 2016). However, despite Farmer's (2016) diagnosis and assertions about the industry, the symptoms are likely to be emphasised even more persuasively as the business environment gets more uncertain (Green, 2016). Whilst the diagnosis argues for a deep-seated market failure in the industry, there were ongoing industry trends and wider societal changes that represented both unprecedented risk and opportunity for the industry and its clients. Hence, if opportunities were not properly harnessed, the risks may become overwhelming. Subsequently, Farmer's (2016) prognosis revealed that the UK construction industry and its labour model was at a critical crossroads in terms of its long-term health, and then suggested radical treatment plan. In his recommendation, Farmer (2016, p.10) proposed that the industry needed to project its chronic underinvestment and underachievement as a result of a combination of economic, market, and behavioural factors. Hence, it requires an extensive and coordinated 'special measures' approach to drive transformational change. Farmer (2016) therefore offered ten recommendations for change based on past evidence and suggested that the industry would not change itself unilaterally at scale; it needs to be led by clients expressly changing their needs and commissioning behaviours or government acting in a regulatory or strategic initiation capacity to drive positive disruption, further proposing that a new, ambitious, and mutually beneficial three-way agreement is established between the construction industry, its end clients (private and public), and government acting as a strategic initiator. Farmer's (2016) recommendations brings the clients back to the driver's seat again (Green, 2016).

2.3.10 Construction Sector Deal (2018)

The construction sector deal (2018) was trailed towards the latter part of 2017 and launched in the Industrial Strategy: building a Britain fit for the future. In this report, the UK government published its long-promised construction sector deal – a document that the industry welcomed with cautious optimism even though worried on the lightness of its details (Owen, 2018). The idea behind this report was to position the UK to be the world's most innovative economy as well as increase the capacity of the construction sector to innovate – accelerating the development and commercialisation of digital and manufacturing technologies to create infrastructure that is higher performing and built more safely. Hence, the sector deal included a £170 million of government investment over three year period through the Industrial Strategy Challenge Fund and £250 million of match funding from industry (Construction Sector Deal, 2018). It was believed that this would transform the sector through better adoption of digital and manufacturing technologies to aid the quick delivery of quality infrastructure and housing at a reduced cost while boosting training and skills of construction practitioners.

Also, in relation to skills development of UK construction practitioners, the deal was expected to deliver:

- a transformed Construction Industry Training Board (CITB)
- a coordinated approach to making best use of the benefits of the apprenticeship levy in the industry
- a unified and more effective industry approach to promoting construction careers and removing barriers to employment in the industry
- a Construction Skills Strategy aimed at retaining and retraining a workforce able to deliver infrastructure and housing
- a new National Retraining Scheme with a £64 million investment for digital and construction training
- a T level to be taught from 2020.

The aforementioned objectives reaffirm the commitments set out in Construction 2025 (published in 2013) to achieve:

- a 33% reduction in the cost of construction and the whole life cost of assets
- a 50% reduction in the time taken from the beginning to end of new build and refurbished assets
- a 50% reduction in greenhouse gas emissions in the built environment
- a 50% reduction in the trade gap between total exports and total imports of construction products and materials.

Subsequently, the report sets out an ambitious partnership between the industry and government, as stated thus: "We are setting out an ambition for the construction sector to deliver: better-performing buildings that are built more quickly and at lower cost; lower energy use and cheaper bills from homes and workplaces; better jobs, including an increase to 25,000 apprenticeships a year by 2020; better value for taxpayers and investors from the £600bn infrastructure and construction pipeline; and a globally-competitive sector that exports more, targeting the $2.5tn global infrastructure market" (Construction Sector Deal, 2018, p.6). Further analysis of the report also reveals the

Government's direct pledge to support the industry, provided the industry is willing to also take positive steps to help itself (Owen, 2018). Although the report covers everything from increasing diversity among the UK construction workforce to changing the way business is done, there appears to be nothing very distinct, at least none that has not been previously published in the past reports.

Following the recommendations from the reports discussed above, it is evident that performance has been a major concern of the industry. Findings also reveals that the issue of performance has lingered due to the industry's inability to adopt innovative changes in satisfying construction clients with quality deliverables and value for their money. Also, suggestions on how to transform the industry's practices to alleviate issues leading to poor performance has recurred throughout the reports. Table 2-1 provides summary of the reports and their recommendations. The next section will review the state of the UK industry's performance based on the available literature and statistics.

Table 2-1: Summary of the UK construction reports

Simon Report

- Recommended that the government should embark on a national training programme for construction managers, and a more collaborative approach to design and construction.
- Impact: Minimal due to traditional practices and the inability for practitioners to adopt new practices.

Emmerson Report

- Recommendation: To bridge the disparity between the design and construction phase, Emmerson recommended for the standardisation of subcontracts.
- Impact: Minimal due to the short time frame in publishing the report.

Latham Report

- Recommended that clients should be the focus of construction process and the industry should deviate from the traditional approach to a more integrated approach that allows collaboration and teamwork.
- Impact: Minimal, but it birthed some change agenda in the industry.

Egan Report

- Recommended for committed leadership, a quality driven agenda, a focus on the clients, and an integrated process.
- Impact: Very innovative. It led to the creation of the 5-4-7 model which formed the basis for national improvement targets and headline KPIs

Farmer Report

- Ten recommendations among which includes that the industry needs to be led by clients.
- Impact: The government issued a Housing White Paper in 2017 based on findings from the report, identifying the need to improve housing productivity through the adoption of modern methods of construction (MMC).

1944 | 1948 | 1962 | 1964 | 1994 | 1996 | 1998 | 2009 | 2016 | 2018

Phillip's Report

- Recommended for better management, collaboration, co-ordination, and flexibility across the industry.
- Impact: Minimal impact due to unrealistic objectives of the report. However, it served as a guide for future research.

Barnwell Report

- Recommendation for a common form of contract across England, Wales, and Scotland was implemented.
- Impact: The impact remains debatable since there was no measure in place to ascertain if the recommended changes were appropriated

Tavistock Study

- Tavistock considered the building process based on the client's building needs, determining the role of the resource controller in communications.
- Impact: The study was ssuccessful in shifting the focus of the industry from contracts to uncertainty and interdependence and to the roles of resource controllers.

Wolstenholme Report

- Analysing the developmental process of the industry since the Egan Report (1998). Noted that some improvements were made following the Egan (1998) Report.
- Impact: However, it argued for the likelihood of change in the industry since the previous reports only had minimal impacts.

Construction Sector Deal

- Recommended an ambition for the construction sector to deliver better-performing buildings that are built more quickly and at lower cost, lower energy use and cheaper bills from homes and workplaces.
- Impact: The UK Research and Innovation (UKRI) transforming construction programme was born

2.4 Performance of the UK Construction Industry

Organizational performance is a subjective perception of reality that explains the multitude of critical reflection on the concept and its measuring instruments (Demeke and Tao, 2020). Several definitions have been attributed to the concept of organizational performance due to its subjective nature. According to Contu (2020), organizational performance refers to the extent to which the organization, with some informational, financial, and human resources, positions itself effectively on the business market. Whilst the definition above for organisational performance seems like a description of the level of achievement of the implementation of an organisation's tasks in an effort to realise its goals, another definition proposed by Pasolong (2007, p.176 cited in Silitonga and Widodo (2017) refers to organisational performance as the work achieved by employees within an organization, in accordance with the authority and responsibility of each in an effort to achieve the objectives of the relevant organization legally, not violating the law and in accordance with morals and ethics. Thus, it can be noted organizational performance is a representation of the work done in an organization in achieving goals that of course will be influenced by resources owned by the organization (Silitonga and Widodo, 2017).

Construction projects performance has remained a vital subject of interest for experts and academics (Mellado *et al*, 2019; HM Government, 2017) due to its significant contribution to the UK economy (Smith *et al*, 2020). Over the years, the UK construction industry has consistently been plagued with issues of underperformance, of which Farmers (2016, p. 7) notes thus: "Extremely poor level of productivity, low predictability, lack of collaboration and improvement culture, structural fragmentation, leadership fragmentation, lack of research/development and investment in innovation, dysfunctional training funding and delivery model, low margins, adversarial pricing models and financial fragility, poor industry image is one of the critical symptoms of the poor performance of the current construction industry in the United Kingdom." Moreover, the industry has continuously suffered several criticisms and the worst kind of public scrutiny (Hassan *et al*, 2020; Farmer, 2016; Wolstenholme, 2009; Beatham *et al*, 2004; Nicholson, 1999; Egan, 1998; Latham, 1994), resulting to ongoing debates on the sustainability of improvements in the industry (Papachristos *et al*, 2020; Ward, 2018; HM Government, 2017; Addis, 2016).

Aside from crisis situations in the country, the performance of the UK construction industry has remained oscillatory (McKinsey and Company, 2020). According to the UK Industry Performance Report (2019), the UK construction industry slowly revived after the 2008 economic crash but declined again by 6% in GDP in 2018 with a further 2% decline in 2019. Although the report notes that the decline may have been affected by the adverse weather in the country; however, it is difficult to quantify the exact impact on the industry. In 2020 also, Construction Excellence reports that despite the several successful projects recorded in the past few years, leading to a growing confidence in the UK construction industry, overall, productivity and performance are seemingly low, leading to higher costs in the UK compared to other EU counterparts. This has also been exacerbated following the BREXIT decision, Covid-19 pandemic, material shortages, skill shortages, as well as the ageing workforce (Smith *et al,* 2020; Malik *et al*, 2019). Thus, impacting negatively on the performance of the industry.

Comparing the UK construction industry with other industries, Institute for Manufacturing, University of Cambridge (2021) reveals that in terms of R&D expenditure, manufacturing industries remain the largest contributors accounting for 42% while construction industry only accounts for 1.4%. In terms of venture capital investments, the UK venture capital market is relatively concentrated by two key sectors: IT (i.e., software related businesses, computer and data services, internet technologies, hardware, telecommunication services) and biotech and health care (i.e., biotech products and services, medical equipment and devices, pharmaceutical and drug delivery). Also, evaluating graduates by subject areas, construction remains relatively low in the UK, at 8.4%, especially when compared to countries such as Germany (23.4%), and Korea (20.7%).

It is important to note that the issues of underperformance in the UK construction industry is due to both macro factors (e.g., market/economy, the environment, or the society as a whole) as well as micro factors (i.e., project processes inefficiencies – e.g., PM methodologies). Soewin and Chinda (2018) broadly categorised the factors affecting the performance of construction industry into economic aspect, social aspect, environmental aspect, and technology aspects. The economic, social and environmental can be categorised under the macro factors and the technological and a segment of the social aspects can be categorised under the micro factors. In the past years, a number of studies have been conducted to improve performance at the micro level. For example, Cheung *et al* (2008) developed a web-based construction project performance monitoring system to help project managers in monitoring and assessing project performance. Zavadskas *et al* (2014) suggested a multi-criteria analysis to measure the performance of projects. Kylili et al (2016) investigated the performance measurement of R&D projects.

Likewise, some studies have attributed the growing trend of performance issues to the traditional method adopted in delivering construction projects; which has further been overwhelmed by the inherent characteristics of construction projects, coupled with the fragmented state of the industry carrying out these projects (Ekanayake *et al*, 2019; Demirkesen and Ozorhon, 2017; Shah *et al*, 2011; Yang *et al*, 2010; Shenhar and Dvir, 2007b; Arain *et al*, 2004; Williams, 1999). Hence, construction organisations are particularly focused on continuous improvement of their processes, with the goal of increasing efficiency through effective project management processes to deliver better results and also improve organisational performance (Souza and Alves, 2018; Savolainen *et al*, 2015). However, only a few studies have expounded on the impact of effective management methodologies (one of the micro factors) in the delivery of construction project (Al-Hajj and Zraunig, 2018). Before providing discussions on the micro factors (particularly, the management methodology), the following sections will review the UK construction industry's performance based on the macro factors, beginning from assessing the available performance measurement systems, and then an evaluation of the performance of the industry based on new performance measurement system adopted by the UK government.

2.4.1 Performance Measurement Systems

According to Stormi *et al* (2019), performance measurement system "is a set of metrics that measure the performance of an organisation." Neely *et al* (1995, p.424) also define performance measurement as "the process of quantifying effectiveness and efficiency of actions." In further elaboration, Neely (1996) notes that that effectiveness is the degree to which an endeavour is successful in producing a desired result (e.g., customers satisfaction) with resources (Sarhan and Fox, 2013) whilst efficiency is the capacity of an organization to produce the desired results with a minimum expenditure of energy, time, money, and human and material resources (Kibirige *et al*, 2019). Performance measurement is generally regarded as an essential component of organisational management practice. In fact, literature findings reveal that the subject of organisational performance measurement can be traced back to the 1860s and 1870s (Hegazy and Hegazy, 2012). Hence, discussions on performance measurement have gained considerable attention from construction researchers and experts in the last few decades (Liu *et al*, 2015; Neely, 1999; 1995) as a vital aspect for growth and improvement for any organisation.

Performance measurement is multifaceted, covering financial and non-financial, internal and external, backward and forward-looking measures in an organisation (Bourne *et al*, 2003a). Therefore, in measuring performance, it is expedient that organisations remain flexible in response to the changing requirements of the society while monitoring and evaluating their performance (Papulová *et al*, 2021). Performance measurement systems enable organisations to evaluate areas of improvement, predict potential issues, and improve internal business operations (Mellado *et al*, 2019). Studies have also revealed that performance measurement systems can influence behaviours to stimulate certain courses of action in an organisation (Bafadal *et al*, 2020; Banner, 2016; Rasit and Isa, 2014; Taylor, 2011; Neely *et al*, 1996). So, to access and evaluate the performance of the UK construction industry, various key performance indicators (KPIs) are set out, which provides an overview of the performance of the industry at both the organisational and project levels (Radujković *et al*, 2010; Swan and Kyng, 2004). Besides, these KPIs, when implemented correctly, provide useful information for organisations.

Over the years, the UK construction industry has relied on the orthodox measurement system of cost, time, and scope as its sole measurement for construction project performance while giving less attention to other aspects such as client satisfaction (Sarhan and Fox, 2013). Johnson and Babu (2018) believe that the orthodox measurement system of cost and time are the major indicators for measuring construction performance since it affects all the project participants with equal positive and negative repercussions. Likewise, some scholars agree that if a construction project is completed on time, within the budget and set quality, then that project is successful (Sibiya *et al*, 2016; Jugdev and Müller, 2005). Even though it seems the impact of the orthodox performance measurement system is irrefutably evident in various aspects of business operation within the construction industry, recent studies argue that the orthodox measurement system does not provide a balanced view of construction projects performance. Hence, various scholars have criticised it as a "lagging" measure of performance rather than leading measure (Mellado *et al*, 2019). Besides, its method of implementation and actions/decisions is usually carried out at the end of a project, further concurring to the earlier claim as a "lagging" measure of performance (Bassioni *et al*, 2003). Some of the weaknesses, identified in literature, of the orthodox performance measurement system include:

- It is based on short-termism (Banks and Wheelwright, 1979; Hayes and Garvin, 1982, Neely, 1999).
- The traditional performance measurement system lacks strategic focus (Skinner, 1974, Neely 1999).
- It encourages local optimisation (Hall, 1983; Fry and Cox 1989).
- It encourages minimisation of variance rather than continuous improvement (Johnson and Kaplan, 1987; Lynch and Cross, 1991).
- The traditional performance measurement system is not externally focused on other aspects of construction projects (Kaplan and Norton, 1992).
- It does not accurately reflect the interest of stakeholders (Kaplan and Norton, 1996; Mbugua *et al*, 1999).
- It uses lagging metrics (Ghalayini and Noble, 1997), and overly relies on the financial aspects (Ernst and Young, 1998; Clark and Clegg, 1999; Olve *et al*, 1999).

Due to the evolving nature of construction project in terms of its functionality, user requirements, and environmental issues (Mellado *et al*, 2019), construction managers require an up-to-date, forward-looking, and a balanced performance measurement system in order to make better decisions for their organisations (Hegazy and Hegazy, 2012). This explains the emphasis on adopting a more effective performance measurement system to quantify the construction industry's effectiveness (ISO 9001:2015; Neely and Platts, 2014; Horta and Camanho, 2014; Yang *et al*, 2010; Neely *et al*, 2002) and to move the industry towards best practice in response to Latham (1994) Report and Egan (1998) Report. Consequently, various performance measurement models and techniques as well as new performance indicators that utilise both the financial and non-financial measures of construction industry's performance were developed. Examples include the Balanced Scorecard, Baldrige Performance Excellence Program, and Business Excellence Models (Bassioni *et al*, 2004a; Davis and Albright, 2004; Kaplan and Norton, 1996; 1992). Thus, an all-encompassing approach to measuring the performance of the industry, as well as construction projects has become acceptable. Figure 2-4 illustrates the limitations of the traditional performance measurement indicators and the focus of the new indicators.

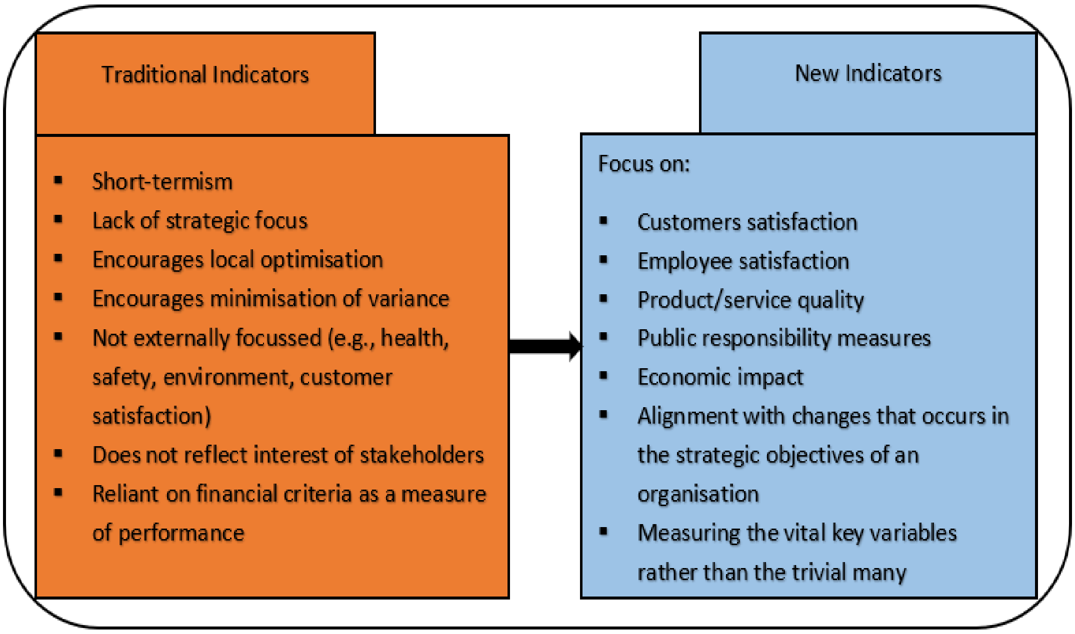

Figure 2-4: Comparison of traditional and new indicators

In the design and selection of new performance measurement systems, some of the criteria for the new indicators include transparency, usability, ease of implementation, ease of understanding with visual impact, focus on improvement, low in cost, and must be related to the organisation's strategy and objectives (Ahmad and Dhafr, 2002). Hence, discussions in the following section elaborate more on the new performance measurement system.

2.4.2 New Performance Measurement System

Several reports and enquiries on the performance of the UK construction industry and the projects they execute have led to the identification for areas of improvement (Hegazy and Hegazy, 2012). Among these areas include: the changing nature of the construction projects; increasing complexity of construction projects; constant need for improvement; national and international awards; changing roles in organizations; changes in external demands; impact of information/ technology advancement (Neely, 1999). Subsequently, proposal was made for the introduction of an industry-wide measurement framework for measuring the UK construction industry's performance from several scholars. For example, based on KPIs: a set of measures focusing on aspects of organisational performance, that are the most critical for the current and future success of the organisation (Domínguez *et al*, 2019), Hegazy and Hegazy (2012) proposed a benchmarking model established on financial KPIs to benchmark and evaluate the construction industry's performance at the corporate level. The Construction Best Practice Program - Key Performance Indicators (CBPP-KPIs) was also proposed to aid the industry in measuring its performance as well as improving its productivity (Beatham *et al,* 2004; Cox *et al*, 2003). Kaplan and Norton (1992) proposed a balanced scorecard metrics for measuring construction project performance, and their classification was based on the internal processes (P), customers (C), financial (F), learning and growth (L&G) (Barros *et al*, 2019). Furthermore, Project Management Body of Knowledge (PMBOK) described time, cost, quality, scope, and *customer satisfaction* (new indicator) as performance measurement indicators for construction project performance (PMI, 2008).

Despite these proposals for new performance measurement systems, several criticisms soon ensued. For example, one of the criticisms was that the benchmarking model focused mainly on senior management rather than organisational or corporate performance measure, and the CBPP-KPIs had no specific procedures for measuring the construction industry's performance (Hegazy and Hegazy, 2012). Furthermore, the balanced scorecard metrics would have been ideal for measuring the performance of construction projects. However, two very important indicators, including environment and safety (E&S), were lacking. It therefore stirred further debates on the need to employ a more balanced financial and non-financial performance measurement systems to cover every aspect of the industry's processes (Zamim, 2021; Horta and Camanho, 2014; Ladrum *et al*, 2000).

In a bid to address these criticisms, as an attempt to promote an efficient performance measurement system, the UK government partnered with a team of organisations, known as the KPI working group, including: The Department of Trade and Industry (DTI); The Construction Industry Board (CIB); The Construction Best Practice

Program (CBPP); and a third-party financial analyst, to design and develop the new performance measurement system (Construction Statistics Annual 2001). Accordingly, the KPI working group (1999) identified a set of financial and non-financial parameters for measuring the performance of the industry (Dawood *et al*, 2006; Beatham *et al*, 2004; Takim and Akintoye, 2002), namely time, cost, quality, client satisfaction, client changes, business performance, health and safety (Mahmoud and Scott, 2002). The parameters also correlate with internal service quality, employee satisfaction, employee retention, external service quality, customer satisfaction, customer retention, and profit. Thus, the aforementioned indicators meet the criteria for a good performance measurement system (Villazón *et al*, 2020; Iuga *et al*, 2015; Neely and Adams, 2001; Love and Holt, 2000; Neely, 1999; Lynch and Cross, 1995; Kaplan and Norton, 1992).

The new KPIs proposed by the KPI working group (1999) were further classified into three levels - headline indicators, operational indicators, and diagnostic indicators (Nudurupati *et al*, 27; Costa *et al*, 2004). The headline indicators were derived from the 5-4-7 model (Figure 2-5) proposed by Egan (1998) in "Rethinking Construction," which forms the basis for national improvement targets (Sibiya *et al*, 2016). It covers three major areas, such as the major drivers for change within the UK construction industry, the project process improvement strategy, and the targets for improvement. By design, the headline indicators for measuring the industry's performance deals with the overall health of an organisation, and shows the improvements demonstrated. Furthermore, the headline indicators are employed extensively in the UK to measure performance and drive improvement (Sibiya *et al*, 2016).

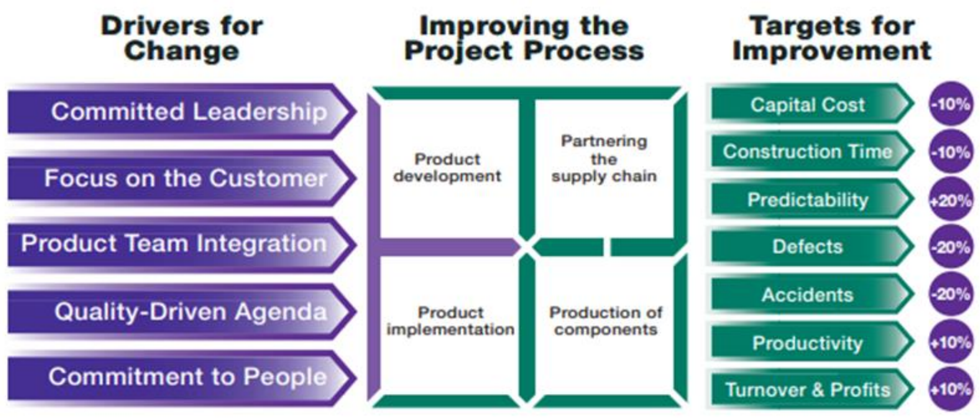

Figure 2-5: 5-4-7 model of rethinking construction
Source: Takin and Akintoye (2002).

Later on, the 5-4-7 model was updated into a 5-6-10 (Figure 2-6) model for benchmarking construction projects performance (Takin and Akintoye, 2002). The 5-6-10 model consists of five drivers for change, with six processes for improving construction projects, and ten headline KPIs, including: client satisfaction (product); client satisfaction (service); defects; predictability of cost; predictability of time; profitability; productivity; safety; construction cost; construction time (Sibiya *et al*, 2016). A good number of these indicators, such as construction cost, construction time, defects, client satisfaction with product and service, profitability and productivity, were designed to encourage result driven thinking whilst predictability of design cost and time, predictability of construction cost and time, and safety were designed to encourage process-oriented thinking in the construction industry (Takin and Akintoye, 2002).

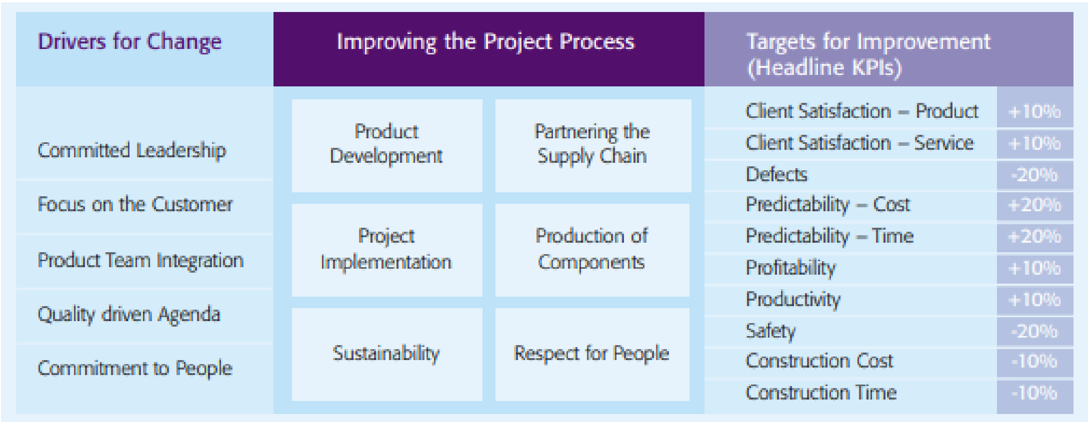

Figure 2-6: 5-6-7 model
Source: Construction Excellence

Operational and diagnostic indicators, also referred to as secondary indicators, were designed to enable improvements in both project and organisation's overall performance (Sibiya *et al*, 2016). Operational indicators cover specific aspects of organisations' activities that allow management to identify and focus on specific areas of improvement while the diagnostic indicators provide information why certain changes may have occurred in headline and operational indicators, and are useful for analysing, in detail, areas of improvement (The KPI Working Group, 2001).

In spite of the foregoing, some studies suggested additional performance indicators based on organisational information and decision structure (Barros *et al*, 2019), with claims that none of the indicators provided by the UK Working Group (2001) could measure the performance of suppliers in a project environment (Costa *et al*, 2004; Takim and Akintoye, 2002). Moreover, Takim and Akintoye (2002) argued that there was no provision for measuring performance at project selection phase such as the analysis stage. Hence, Takim and Akintoye (2002) proposed a new classification for measuring construction performance, catering also for the deficiencies from the classification of the KPI Working Group (2001). Takim and Akintoye (2002) classified their performance measurement system into procurement, process, and results oriented. Likewise, Sikka *et al* (2006) proposed a classification of performance measurement system and classified them into three conceptual phases, namely the pre-construction, construction, and post-construction phases, since the criteria for construction projects usually change with time in each phase of a project. However, to remain abreast with the ongoing changes in the industry and the need to provide a balanced performance measurement system all year round, the KPIs provided by the UK Working Group (2001) are updated yearly (Glenigan, 2021). Therefore, in line with the UK Industry Performance Report (2018), evaluations on the performance of the UK construction industry would be conducted based on the following key indicators that satisfy the criteria for new (balanced) performance measurement system:

- Economic indicators
- Client satisfaction
- Contractor satisfaction
- Profitability/Productivity
- Predictability
- Environmental indicators
- Respect for people

2.4.3 Performance of the UK Construction Industry: New Performance Indicators

2.4.3.1 Economic Indicator

The construction industry has deep-rooted influence on the UK economy and even a much deeper impact on the lives of everyone (Chartered Institute of Builders, 2014). Hence, a modern, competitive, and effectual construction industry is vital for the nation’s economic prosperity (Jones *et al*, 2018). According to the UK Industry

Performance Report (2018), the rise and fall in construction performance (Figure 2-7) can be attributed to political instability, delay in business investment decisions, weak consumer spending, government finance under pressure. According to APM (2022), most project professionals in the UK attest that the ongoing political instability in the country has negatively impacted on the projects they are working on.

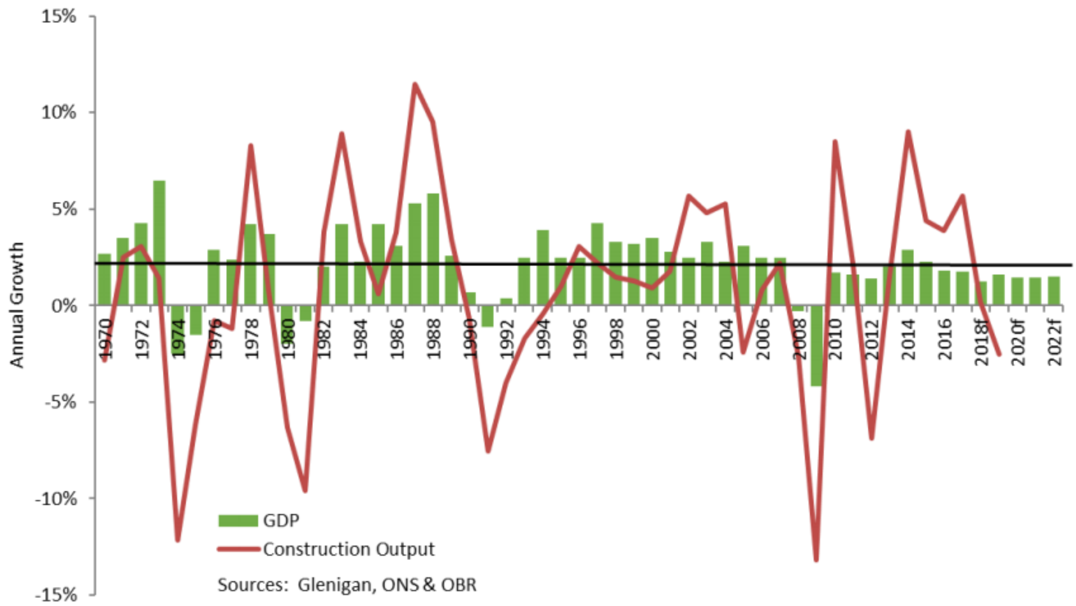

Figure 2-7: Construction Output & Economic Growth
Source: UK Industry Performance Report, 2018

Furthermore, a survey of 1000 project professionals conducted by APM and research company, census wide highlights the potential knock-on effects of the unstable political environment, as 64% of respondents nationwide expects it to negatively impact projects their organisation or they are currently undertaking (APM, 2022). Also, the issue of political uncertainty in the country has further exacerbated the delays in organisational business decisions due to financial uncertainties (Larsen *et al*, 2016; Choudhry *et al*, 2014), inflation (Samarghandi *et al*, 2016), political involvement (Al Hadithi *et al*, 2018), economic and financial problems of the client (Aziz and Abdel-Hakam, 2016). Lately, so many other factors have in fact hampered the economic growth of the UK construction industry, including the uncertainties associated with the Brexit decision and the global COVID-19 pandemic (ONS, 2021).

Even though economic uncertainty and performance instability has been an ongoing issue, Brexit and COVID-19 have however intensified the level of uncertainties. The

Brexit decision triggered a huge concern for businesses; hence, investors are hesitant to invest (Malik *et al*, 2018). Bourke (2018) argues that the Brexit decision has both positive and negative impacts on the nation's economy, emphasising that while the UK will possess the ultimate power to make decisions and establish trade alliances with other nations without the interference of the EU, the UK will also experience a season of decline in aggregate demand which will depreciate the economic value and reduce productivity because of labour shortage. The ONS (2020) survey report confirms Bourke (2018) predictions as the output of the UK construction industry further fell by 40.1%, which is the biggest fall since 2010 due to the cumulative effect of Brexit, Figure 2-8. Bachman (2020) also reports that the impact of COVID-19 pandemic will affect the global economy in three main ways, including a direct effect on production, by creating supply chain and market disruptions, and by its financial impacts on organisations. Therefore, Maital and Barzani (2020) suggest a collective resilience at all levels of business operations since an economic recession seems inevitable.

Figure 2-8: Monthly construction output from 2010 to 2020
Source: ONS, 2020

2.4.3.2 Clients' Satisfaction

The construction industry is a global market with different clients and competitors (Niranjan and Nisha, 2018) who are identifiably based on the different market characteristics as well as their behavioural traits. The role of these clients is very crucial in effectively developing the work processes and executing the project from start to finish (Durdyev *et al*, 2018; Kärnä *et al*, 2004). Clients represent various parties that directly commission the construction industry to create or modify built assets (Farmers, 2016). Latham (1994) in his report emphasizes that clients are the core of construction processes, and their needs must be met by industry. Clients of the UK construction industry include: the central government (when procuring construction activities through government agencies or departments or via regulated industries), regional or local government, registered providers, private real estate developers, developers, direct or indirect investors, corporate occupiers, and, at the domestic end of the market, the public at large (Farmers, 2016).

Over the years, client satisfaction has been a top tool for measuring business successes all over the world based on their total purchase and consumption experience with goods or services (Khadka and Maharjan, 2017). Fornell *et al* (2020) also note that clients' satisfaction is critical in predicting the macro-economic growth and changes in an economy. It can either be determined by their 'subjective needs' (e.g., clients' needs and emotions) or 'objective needs' (e.g., the products and services delivered to them) (Boothman and Craig, 2016, p.1258). Accordingly, the UK construction industry measures its clients' satisfaction based on the following (UK Industry Performance Report, 2018; 2017):

- Client Satisfaction - Overall
- Client satisfaction - Product
- Client Satisfaction - Value for Money
- Client Satisfaction - Quality of Service
- Client Satisfaction - Defects

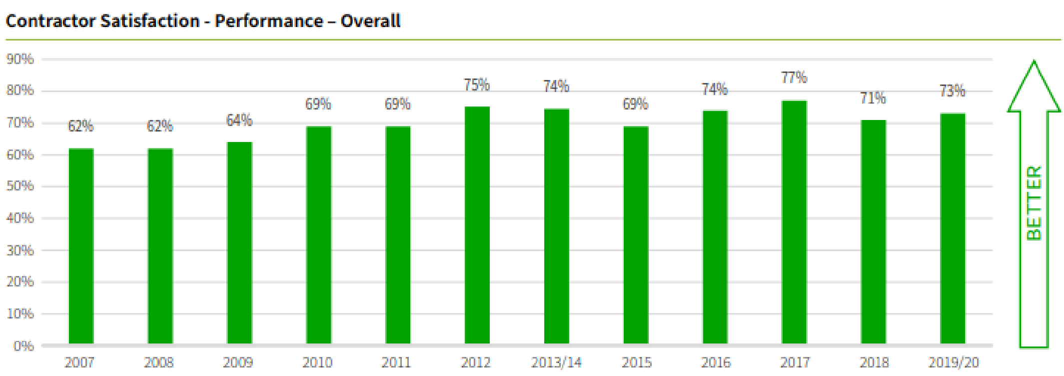

Figure 2-9: Client satisfaction from 2007 to 2020
Source: UK Industry Performance Report (2021)

Figure 2-9 reveals the overall performance of UK construction industry with respect to product, services, and value for money (UK Industry Performance Report, 2021). Assessing the performance individually, the annual KPI surveys report reveals that the client satisfaction with respect to the products improved to 92%, and client satisfaction based on service also strengthened with 89%, rating their satisfaction as 8 out of 10 or higher. Client satisfaction based on value for money went up to 89% whereas client satisfaction with respect to defects went up to 87%, rating the impact of defects as 8 out of 10 or better. Overall, comparing the client satisfaction of the year 2018 and 2020, Figure 2-9 however reveals that the overall client satisfaction declined by 4% when compared to the year 2018 (UK Industry Performance Report, 2021).

2.4.3.3 Profitability

Profitability is the ability of a given investment to earn return from its use (Tulsian, 2014). Profitability can be described as the primary measure for an organisation's overall achievement (Nishanthini and Nimalathasan, 2013). The survival of any organisation depends on its ability to compete, and their competitive ability depends largely on their profitability and efficiency (Gruneberg, 2018). Profitability of the UK construction industry has become an enduring problem (Farmer, 2016). In 1998, Egan expressed deep concerns about the underachievement of the construction industry with respect to its level of profitability. In 2017, PwC report also revealed that the construction industry had suffered low profit margins for a very long time and struggled to fully recover following the economic crisis in 2008. Even though a 0.2% improvement in profitability was recorded in the year 2017 (UK Industry Performance Report, 2017), reports reveal that the construction industry has remained under pressure for improved profitability (Figure *2-10*) because its level of improvement in terms of profitability is rather too slow (UK industry performance report, 2018).

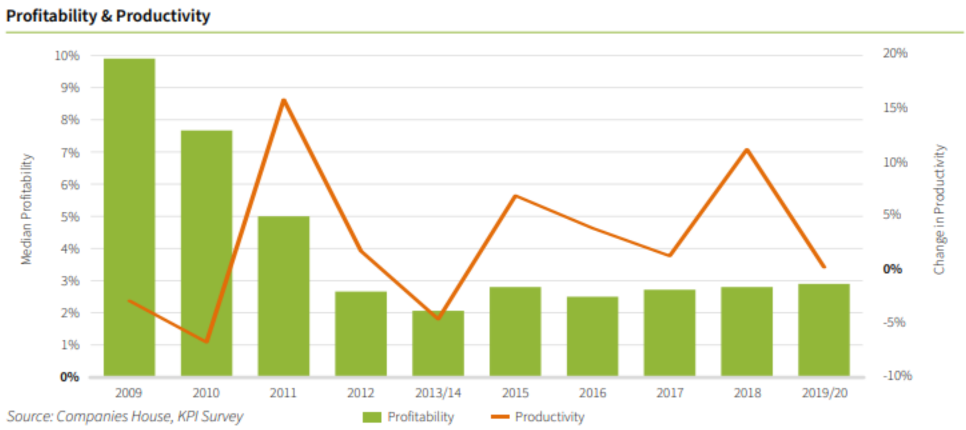

Figure 2-10: Profitability and productivity of the UK construction industry
Source: UK Industry Performance Report (2021)

Figure 2-10 above reveals that the performance of the industry in terms of profitability and productivity improved slightly for a second consecutive year in 2020, rising from 2.8% to 2.9% (UK Industry Performance Report, 2021). Accordingly, UK Industry Performance Report (2021) expatiated that in nominal terms, the industry's productivity rose by 4.8% during the years 2018 and 2019. However, in real terms, industry productivity growth stalled after the sharp 11.2% jump in real terms during the previous year. In comparison with the previous year, it can be deduced that the growth in profitability is very sluggish, Figure 2-11. The industry only experienced a peak in 2009 after the recession and successively declined in the following years, indicative of the fact that the construction industry has struggled to regain its pre-crisis profit margins.

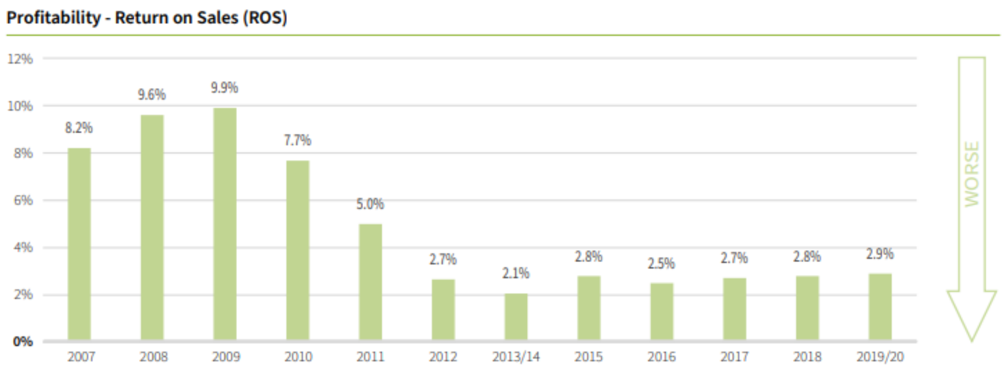

Figure 2-11: Profitability growth in United Kingdom's construction industry from 2007 to 2020
Source: UK Industry Performance Report (2021)

2.4.3.4 Productivity

Productivity issue in construction is not only applicable to the UK; other nations of the world have also suffered the same and even worse fate (Wijesinghe, 2018). There are several definitions of productivity depending on the context of the industry. OECD Manual (2001) defines productivity as a ratio between the output volume and the volume of inputs. Productivity in construction is measured in terms of the unit rate, which is actual number of work hours required to perform the appropriate unit of work (Hasan *et al*, 2018). Dixit *et al* (2018) also note that productivity can be measured at three levels: the industry or sector level, the project level, and the activity or process level. However, the standard of measurement, the productivity of the construction industry has remained an ongoing concern in the UK and in the world at large (Remon and Hafez, 2013). This has been demonstrated in the successive UK construction reports over the past three decades, including for example the Latham Report (1994), Egan Report (1998), and Construction 2025 (HM Government 2013) Report.

According to ONS (2021) Report, average productivity levels in the construction industry have remained consistently below the UK average and have grown more slowly until recently. Also, the UK government recognises the risks associated with poor productivity in the UK economy (CIOB, 2016). For example, during the summer budget presentation of 2015, the chancellor, George Osborne, declared thus: "*Britain still spends too much, borrows too much, and our weak productivity shows we don't train enough or build enough or invest enough. This we are determined to change"* (Duncan, 2015, p.3). According to Krugman (1994), who is also an economist, productivity is not everything, but eventually productivity amounts to almost everything. Therefore, a nation's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker. The issue of low productivity often contributes to the rise in cost of a building project without necessarily adding value to the customers (Seadon and Tookey, 2018). In the year 2011, there was a sharp jump in the productivity of the construction industry, due to the credit crunch of that year, since contractors efficiently utilised minimal workforce (UK Industry Performance Report, 2017). Subsequently, the industry's productivity gradually increased, and the UK Industry Performance Report (2021) reveals that productivity rose by 3% in the year 2019/20, suggesting that businesses were making more efficient use of their workforces, see Figure 2-12 below.

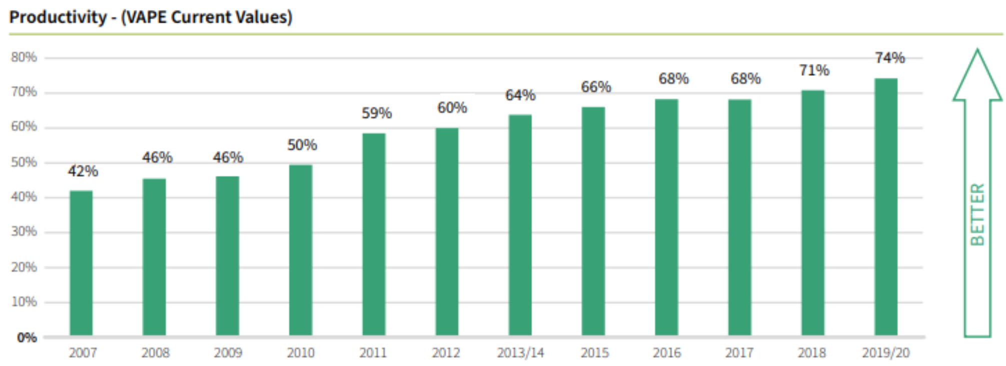

Figure 2-12: Productivity of the UK construction industry from year 2007 to 2020
Source: UK Industry Performance Report (2021).

2.4.3.5 Predictability

The issue of predictability in the delivery of construction projects has carried on for many years despite all the efforts made by construction managers and construction management theorists in introducing a variety of technical and process-based innovative solutions (Gledson, 2017; de Melo *et al*, 2016; Crotty, 2012; Love *et al*, 2011). The predictability of UK construction project cost and time is quantified and recorded annually through the industry's key performance indicators (KPI) as measured via the overall project phase, the design phase, and the construction phase. According to Farmer (2016), one of the symptoms of failure and poor performance in the UK construction industry is its low predictability. The latest results from the UK Industry Performance Report (2021) show an improvement in cost predictability while overall time predictability of projects was little changed, Figure *2-13* below. Project cost predictability improved to 68%, which was only a 2% increase from the previous year. The predictability of the cost of design also improved on the previous year, coming in on or under budget on 70% of the surveyed projects, just as predictability in the cost of construction also improved, with 67% of projects coming in on budget or better (UK Industry Performance Report, 2021).

Figure 2-13: Cost and time predictability of the UK construction industry
Source: UK Industry Performance Report (2021).

Findings from Figure 2.17 above also indicate that construction projects generally came in on time or better 61% of the time, which is slightly down on the record high compared to the year 2018. The design phase was delivered on time or better for 62% of all projects, up from 53% in the previous year, while the construction phase was on time or better for 58% of projects, slightly down compared to the previous year which recorded 59%. Overall, time predictability of the industry declined slightly whilst cost predictability slightly improved.

2.4.3.6 Environmental Impact

One of the most important priorities of any organisation of the 21st century is the delivery of quality output that is in conformity with the environmental guidelines. Ajayi (2016) notes that the construction industry produces the major portion of waste to landfill, consuming a very substantial proportion of mineral resources excavated from nature. In 2017, Ajayi and Oyedele also reported that out of 100% of waste generated in 2013, 44% was from construction projects while the remaining 66% was distributed among commercial, industrial, household, mining, and agricultural activities. Accordingly, Chinda (2016) notes that over 50% of construction and demolition waste (C&DW) in the UK is deposited directly to landfills. Besides, the UK Green Building Council (GBC) (2017) reports that the construction industry yearly consumes over 400,000,000 tons of construction materials which have great impact on the environment, and further asserts that the industry has a long way to go before it can be considered sustainable. Figure *2-14* below reveals the following based on UK Industry Performance Report (2021):

- On-site energy usage rose in the 2019/20. Median energy use, at 376.4 CO2 per £100k of project value (2016 prices), was 11% higher than in the 2018 results, thus revealing a rise which may be due to the changes in the mix of projects with more energy intensive civil engineering and new build projects accounting for a slightly higher proportion of respondents.
- Also, KPI for median waste removed from sites rose in 2018. On average, 24.4 m3 of waste was removed from site per £100k project value (in 2016 prices), which was 33% up from 18.4 in 2017, and is the highest level since 2010.
- Mains water use rose by 13% on the usage recorded in the previous survey, indicating a progressive rise in mains water usage. In real terms (2016 prices), at 6.7 m3 / £100k project value, water usage is 68% up on the record low recorded in the 2015 survey, but it is still below the levels seen prior to 2010.
- Median commercial vehicle movements hopped up to 67% to 24.5 per £100k of project value (2016 prices).

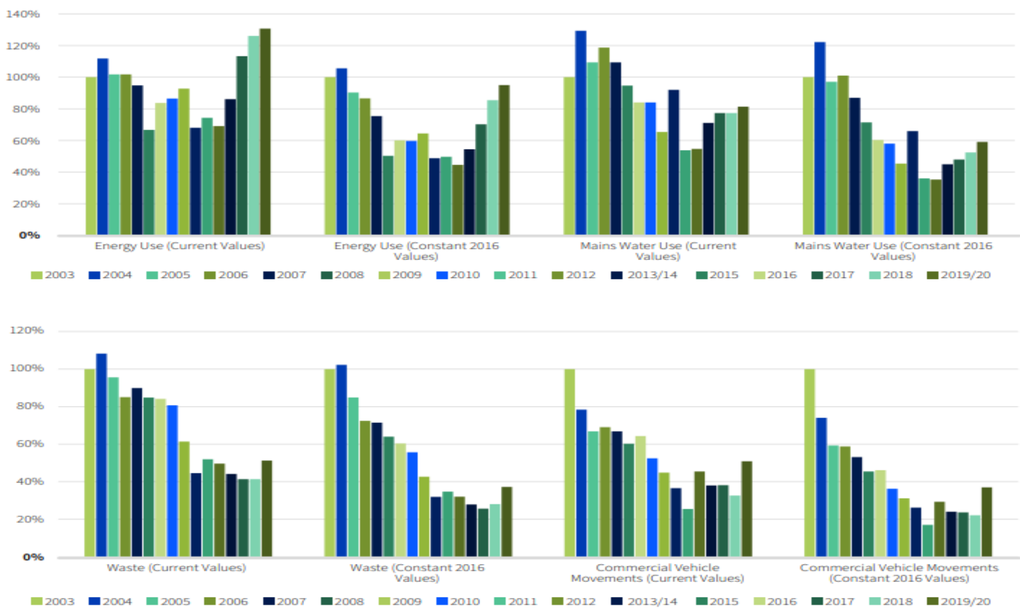

Figure 2-14: Environmental indicator for all constructions from year 2003 to year 2020
Source: UK Industry Performance Report, 2021

Apart from construction materials, the UK construction industry is filled with activities that directly involve and impact the environment (Wijesinghe, 2018). More so, environmental considerations have progressively increased internationally as every nation's construction industry is responsible for the amount of greenhouse emission it spills out (Gruneberg, 2018). The UK construction industry has remained the epicentre for waste production for some years now despite the adoption of various waste management strategies as well as government policies on the reduction of waste generation. Ajayi *et al* (2016) argue that there is an underlying culture that enhances the intensity of waste in the industry and agree that the non-collaborative culture of the industry is a major contributing factor. Over the years, the focus of the industry has been on making incremental progress. Consequently, it has set up targets (e.g., the Construction Sector Deal of 2018 comprising cost reduction targets, time reduction targets, and greenhouse gas reduction targets (Gruneberg, 2018). However, very little progress has been made owing to the increased demands for value, the complexity of construction projects, and the growing demand for environmentally compliant construction projects. Also, since there is no form of penalty for underachievement and no organisational responsibility (Gruneberg, 2018), these targets have led to further criticisms of the industry.

2.4.3.7 Respect for People

In the year 2018, staff turnover in the UK construction industry rose to 3.2% (UK Industry Performance Report, 2018), which was above the 2.6% recorded in the previous year and 2.7% in the year 2016. These results still remained below the 5.3% in 2015, indicating that faster rate of turnover may reflect an increase in hiring pressures as industry workload grew and there was reduced availability of overseas labour. In the year 2019/2020, there was no data available for the KPIs covering staff turnover and loss, sickness absence, investors in people, CSCS use and qualification skills/training. Hence, values presented by the UK Industry Performance Report (2021) (and cited in this discussion) for those periods is an estimate drawn from the previous surveys. The reports reveal as follows:

- Women employed in construction accounted for only 13% compared to 26% in the median firm. Also, the age breakdown of the UK construction workforce shows a rise in over 55s from 17% in 2018 to 21% in 2020.

- Employees aged under 24 accounted for 2% of the workforce, down from 7% in the previous year.
- The black and minority ethnic (BAME) accounted for 5% of the industry's workforce, unchanged from the previous year. Considering that 11% of the UK working population is from an ethnic minority background, these results suggest that not only is the industry underrepresented of the communities in which it operates but that firms are also missing out on a large pool of potential talent.
- Regarding accidents, the official HSE statistics have reported a continued improvement in the industry's Accident Incident Rate over the last decade. However, a change in reporting requirements created a break in this series between the 2012 and 2014 results. Organisations now report all over-7-day injuries, compared to over-3-days previously. This effectively lowered the reportable accident incident rate from 550 per 100,000 employees in 2011/12 to 422 in 2012/13. Notwithstanding, these statistical results reveal a continued albeit more gradual improvement in accident rates in recent years as the overall Accident Incident Rate (AIR) rate, at 366 accidents per 100,000 employees during the period covered by the last survey, showed a marked improvement at 366 accidents per 100,000 employees, indicating a 9% drop from the previous year. Likewise, the fatality rate also declined to a new low of 1.6 per 100,000 employees, see Figure 2-15.

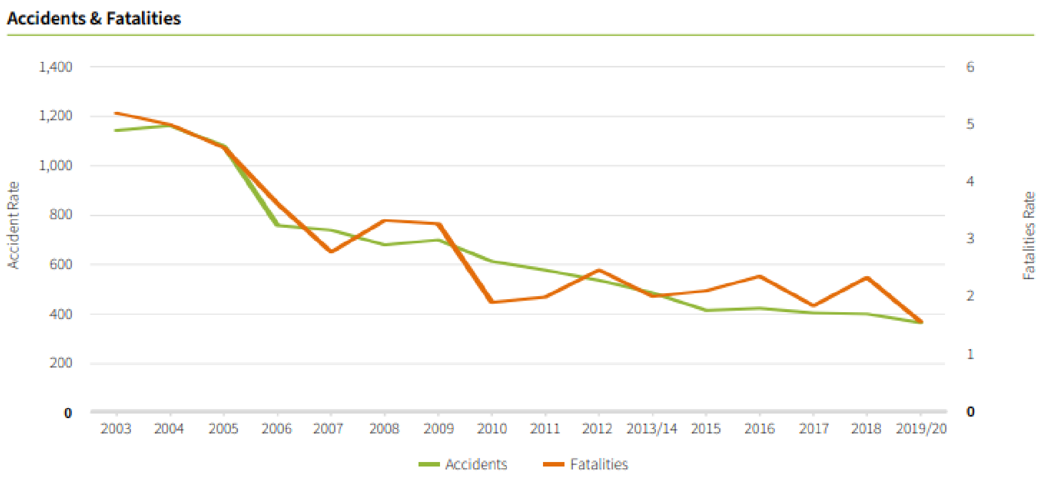

Figure 2-15: Accidents and Fatalities
Source: HSE N.B Break in accident rate series from 2012/13

Table 2-2 provides a summary of the performance of UK construction industry with respect to the KPIs provided by the UK working.

Table 2-2: Summary of the performance of UK construction industry

UK KPIs (2018)	Performance
Economic indicators	Declined, coupled with the impact of BREXIT and COVID-19 pandemic.
Client satisfaction	Overall, satisfactory. However, it declined by 3% compared to the previous year.
Profitability	Sluggish growth in profitability, with only 0.2% increase.
Productivity	Declined by 2.1%
Predictability	Time predictability declined by 3% whilst design predictability remained unchanged.
Environmental indicators	There was an increase in the environmental impacts of the UK construction industry. Wastage increased by 2%, and water usage increased by 2%.
Respect for people	Accidents and fatalities rates declined.

2.4.4 Link Between Construction Project Underperformance and Industry Underperformance

Over the years, the UK construction industry has faced several criticisms for its performance when compared to other industries (Construction Excellence, 2020). The UK working groups on Key Performance Indicators (KPIs) identified ten parameters for benchmarking projects, in order to achieve a good performance, in response to Egan Report (1998). Out of the ten parameters, consists of seven project performance indicators, namely: construction cost, construction time, cost predictability, time predictability, defects, client satisfaction with the product delivered and the client satisfaction with the services rendered; and three industry performance indicators, namely: safety/respect for people, profitability and productivity (Takim and Akintoye, 2002). Most of the indicators above seem to be result oriented, save the predictability of design cost and time, and predictability of construction cost and time, which seems to be more procurement orientated, and safety, which is process orientated. Hence, Takim and Akintoye (2002) suggests that construction project performance can be grouped according to their orientation, namely, procurement, results and processes used. Likewise, the performance can be considered as macro (industry performance indicators) and micro (related to the processes used within the project) to achieve the expected outcome (result, e.g., customer satisfaction). Discussions on the industry performance indicators based on macro factors have provided in section 2.4.3, save the micro factors (processes used).

Performance issues in construction projects is a global phenomenon and the UK construction industry is no exception (Mahamid, 2016). Typologically, the UK construction industry is predominantly project-based (Koolwijk *et al*, 2020; Koolwijk *et al*, 2018; Liu and Shi, 2017). The nature of tasks carried out in the industry (projects) are usually heterogenous, infrequent and casually ambiguous, and the unit of production is the project involving different team members who bring the project to reality (Söderlund, 2023). Hence, projects are used purposefully to drive innovation, create a more dynamic organisation, to shake-up traditional rigid structures, improve performance and drive positive outcome (Söderlund, 2023). Borrowing from project management, output can be defined as the end product delivered by a project; essentially it is the end product created by a process and is used interchangeably with deliverable (APM Glossary of Terms, 2019). These same theories would define an outcome as 'the changed circumstances or behaviour that results from the use of an output and leads to realisation of benefits (APM Glossary of Terms, 2019), which would basically constitute the impact (i.e., changed behaviour) created through the use of the output.

The performance of the UK construction industry is heavily dependent on the performance of construction projects, which plays a key role in driving positive outcomes. Söderlund (2023) also agrees and notes that construction projects can be seen as vehicles for strategy implementation. Hence, in the implementation of strategies to improve the performance of the industry, e.g., the Construction 2025 strategy (Department for Business, Innovation and Skills, 2013), one major area of focus has been on construction project performance (e.g., 33% cost reduction, 50% faster delivery and 50% lower emissions on construction projects). Likewise, to improve the performance of construction projects, the focus would be on improving the micro factors (e.g., the processes involved in construction project management) as well as an improvement in the management methodologies for managing the processes.

Considering the delivery of construction projects using the traditional methodologies which is rigid, coupled with the strict requirements of the adopted procurement strategy, it is rather difficult to introduce more innovative processes. However, viewing the same problem from micro processes where there is more flexibility, interactivity and adoptability, construction project managers and their teams are able to make use of innovative processes used in other industries, e.g., Agile. Thus, creating the need to evaluate the current management methodologies adopted in the management of UK construction projects, and to identify its strengths and weaknesses in relation to the management of construction projects. This study will also propose a solution to improve the performance of construction projects, which would also impact on the performance of the industry.

2.5 Summary

The UK construction industry as a project-based organisation is among the most significant contributors to the nation's economy. Findings have however revealed that the complexity of construction projects and the complicated processes associated with managing construction projects, has led to the poor performance of construction projects, thus, also impacting the industry's performance. Over the years, several publications have evaluated the performance of the UK construction industry based on some parameters, including, construction client, collaboration within the industry, fragmentation, training needs, value, quality, and have also proposed suggestions for improvement. However, issues addressed decades ago still to be recurring, posing a major setback on how best to improve the performance of the industry.

In the measurement of the performance of the industry, the UK government has adopted a set of new indicators to remain relevant with the ongoing changes in the industry and the need to provide a balanced performance measurement system all year round. These indicators consists of the areas, such as its economic indicator, client satisfaction, contractor satisfaction, productivity, profitability, predictability. In this chapter, these areas have been assessed and evaluated; and findings revealed that the performance of the industry has remained oscillatory with some key areas (e.g., economic indicators, client satisfaction, profitability, predictability, environment aspects, and respect for people) still facing severe pressure. Coupled with the impact of BREXIT and the global COVID-19 pandemic on the industry. Presently, it is expected of the UK construction industry to perform optimally while providing a safe and fulfilling life for all its employees and those who use its output (Gruneberg, 2018), but this has not always been the case. Hence, the need for improved performance of construction projects, seeing that the industry largely depends on projects and a good number of construction projects still fail to meet the defined needs, while many other projects are not fulfilling their business objectives. Discussions in the next chapter review construction project management and the methodologies applicable for the management of construction projects.

CHAPTER 3 : CONSTRUCTION PROJECT MANAGEMENT

3.1 Introduction

This chapter presents the literature review covering the research objective two which aims to examine the project management methodology used within the UK construction industry, identifying its strengths and weaknesses in relation to the management of construction projects. Before delving into further discussions, a brief overview of project management will be presented. This is followed by discussions on project management lifecycle, elucidating on all the stages that goes on in a typical construction project, as well as discussions on procurement approach. Following these, the traditional and agile project management methodologies will be discussed, highlighting their strengths and weaknesses. Finally, the last section in this chapter provides a summary of the discussions provided.

3.2 Project Management: An Overview

Project management (PM) is a pre-historic practice that has been around for thousands of years and was involved in the planning, coordination, and construction of the Ancient Wonders of the World (Somerville, 2021; Kozak-Holland, 2011). To understand project management, the definition as to what constitutes a project will be presented. Essentially, project is a unique and temporary efforts to create value through unique products, services, and processes (PMI, 2023). Various bodies of knowledge and scholars have proposed several definitions for PM. For example, PMBOK (2017, p.10) defines PM as the "application of knowledge, skills, tools, and techniques to project activities to meet the project requirements." Oberlender (2014) defines PM as the discipline of coordinating people, equipment, resources, and schedules to execute a specific project within its deadline and budget. In view of the above definitions, PM is not only a way of achieving project's scope, time, cost, and quality requirement but also involves the enablement of all the processes required to meet the needs and expectations of the stakeholders (Schwalbe, 2015).

Several projects have been executed in history, which are irrefutably recognised as projects by PMI and other institutions as well as researchers in the field of PM.

Examples include: the Great Pyramid of Giza in the 2570 BC; the Great Wall of China in the 208 BC, which was the world's largest military defence structure; and the pyramids of Egypt (Wazir *et al*, 2019; PMBOK, 2017; Jing, 2015; Watt, 2014; Haughey, 2014). In the early 19th century, PM was simply perceived as a good practice but not necessarily required for the survival of organisation (Kerzner, 2018). Hence, individuals managed their projects by employing tailored methods and planning the processes themselves until a radical idea led to the creation of the Gantt chart by Henry Gantt in the early 19th century (Haughey, 2014). The Gantt chart was recognised as best practice for worldwide innovation in the 1920s (Maric, 2017), and one of its first uses was on the Hoover Dam project in 1931 and still recognised as an important chunk of the project managers' toolkit (Haughey, 2014).

In the 1950s, the two major recessions incited some changes on the perception of individuals on PM (Kerzner, 2018), coupled with the availability of better transportation and telecommunication systems which allowed for higher mobility and speedy communication (Seymour & Hussein, 2014), thus enabling the introduction of systemic tools and techniques for better management of project complexities (Seymour and Hussein, 2014). This era stretched till the modern PM era in the 1960s (Kwak, 2003) whereby huge technological advancements, including the first ever plain paper copier by Xerox was introduced (Seymour and Hussein, 2014). Technological advancements further paved way for the development and introduction of new PM techniques, including the Work Breakdown Structure (WBS), Program Evaluation and Review Technique (PERT), Critical Path Method (CPM) (Maric**,** 2017; Seymour and Hussein, 2014).

Between the year 1980 and 1994, the development of complex software systems to efficiently manage projects' complexities became possible (Seymour & Hussein, 2014). For example, the development of "Projects Resource Organization Management Planning Technique II (PROMPT II) model" became a basis for most of the modern PM programs and was further refined into the Projects in Controlled Environment (PRINCE) model (Seymour & Hussein, 2014; Kwak, 2003). Furthermore, since the hypermodern era (1995 till date), the major driver for the advancement of PM has remained technological advancements (Kwak, 2003). Figure 3-1 presents PM timeline from the year 1910 to 2010.

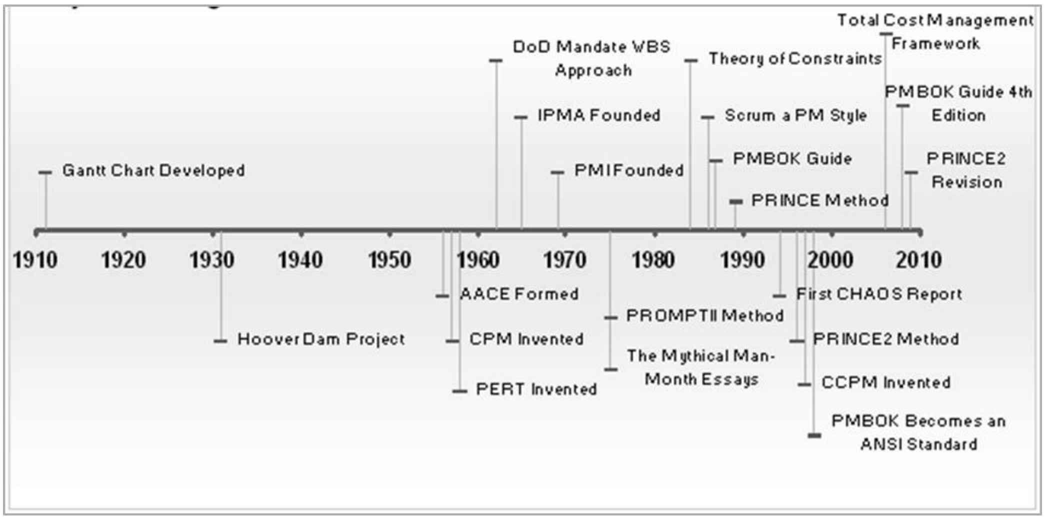

Figure 3-1: Project management timeline from 1910 to 2010
Source: Mohanty (2011)

In the past few decades, PM has considerably evolved from process-oriented to resource-oriented (Seymour and Hussein, 2014). For instance, there exist the upgrade of the PRINCE model to PRINCE2, Critical Chain Project Management (CCPM) method (Seymour and Hussein, 2014), Logical Framework Analysis (LFA) designs, Monitoring and Evaluation (M&E) frameworks, Monitoring-Evaluation-Accountability-Learning (MEAL), project models, Risk Impact/Probability Charts, the Must-Should-Could-Would (MoSCoW) model (Mind Tools, 2016), and so on. Besides, organisations have accepted PM as a scientific discipline due to their continuous need for planning, organizing, and controlling various complex activities of modern industrial and commercial projects (Miller, 2015), coupled with the changes and pursuit of efficiency in organisations. Hence, projects are now expected to be delivered faster, with improved level of trust between the stakeholders and project team. Changes in project requirements are no longer viewed as something entirely bad, and conflicts are managed better (Kerzner, 2018).

One major difference between project management prior to the twenty first century and in the last fifty years is implementation; prior to the twenty first century, organisations focused more on the theoretical aspects of PM whereas in the last decade, PM is now implemented on a company-wide basis with the use of advanced PM tools and techniques (Kerzner, 2018). Project management consists of practicable knowledge in three key disciplines (Figure *3-2*): general management, special knowledge domains, and supporting disciplines, such as computer science and decision science (Hendrickson, 2008). Therefore, its importance in present-day organisation cannot be overemphasised. For instance, amongst all the competitive skills needed for an organisation to survive the competitive market of nowadays, PM is presumably the most crucial (Shou and Yea, 2000; Cook, 1998). Its main goal is to predict as many risks and glitches as possible while effectively planning, organising, staffing, directing, monitoring, controlling, innovating, and representing the project goals (Miller, 2015; Shenher and Dvir, 2007; Packendorff, 1995). Hence, in a bid to successfully implement new strategies, organisations are compelled to select the best PM methods as well as the most innovative and creative skills in delivering value to clients (Kumar, 2012).

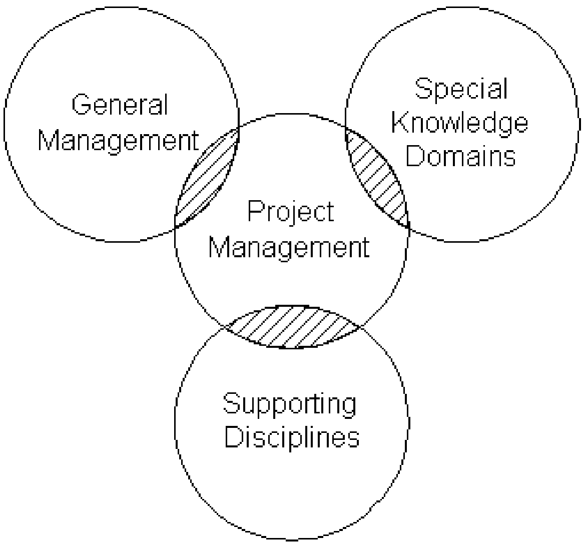

Figure 3-2: Components of project management
Source: Hendrickson, 2008

Even though PM is primarily concerned with creating an environment where people can work together to achieve mutual goal and to deliver a successful project (Seymour and Hussein, 2014), without an appropriate application and implementation of the PM processes, failure is inevitable. Therefore, in response to the fluctuating economies of the world, the fast-paced business environment, the evolving technologies, and emerging business trends (Brownlee, 2019), organisations tend to adopt best practices for project management by determining what it takes to make people work collaboratively to achieve a common goal (Kerzner, 2018). Construction projects follow the generic life cycle of a project: initiation, planning, execution, monitoring and control, and the project close-out stage. In the next section, construction project management life cycle (i.e., all the phases involved in managing a construction project) is discussed.

3.3 Construction Project Management Life Cycle

Every project, not just those in the construction industry, goes through a series of recognisable phases wherein the idea is conceived, developed deconstructed (Bennett, 2003). A software project for example might go through initial proposal, process engineering - requirement analysis, process engineering - specification, design, development, testing, deployment and support. Likewise, every project that generates a new product follows similar series of phases, even though there might be some overlap, the project phases generally flows from the first phase to the last phase (Bennett, 2003). Construction project management life cycle describes everything that goes on in a construction project from its inception, including everything in-between to the end of the project (Biggins, 2016). In the early years of PM development practices, it was a common practice to plan, schedule, and manage each phase of a project (over-the-fence method) from start to finish (Archibald *et al*, 2012). Over-the-fence method was adopted because each phase of a project required a new project manager who carried on from where the previous manager stopped, thus resulting to various issues associated with clarity since the new project manager had very little opportunity to communicate with the previous manager in order to fully understand the preceding phase of the project (Archibald *et al*, 2012).

Studies have demonstrated that the life cycle of a construction project depends on the viewpoint of the participants. For example, from a client's perspective, the life cycle of a construction project begins after a formal recognition of the project objectives, generally referred to as the project inception, when a project team is developed through to the final completion of the project wherein the objectives of the project are delivered (Fewings and Henjewele, 2019). Also, activities relating to the conception of a construction project usually takes an extended period of time before the project actually starts, and at the end of the life cycle of a construction project, there is a commissioning process to ensure everything is working effectively (CIOB Code of Practice for Construction Project Management, 2014). Furthermore, the phases in the life cycle of a construction project are defined differently (Fewings and Henjewele, 2019). Table 3-1 summarises the stages in the life cycle of a construction project as identified across the industry.

Table 3-1: Phases in construction project life cycle

<table>
<tr><th>Code of practice for project management (2022)</th><th>RIBA (2020)</th><th>BIM Digital plan of work 2013</th><th>BS 6079-1-2010</th><th>ISO 21500:2012</th></tr>
<tr><td>1. Identify: needs and benefits</td><td>0. Strategic definition</td><td>1. Strategy</td><td>1. Conception</td><td>1. Initiation</td></tr>
<tr><td>2. Assess: options and feasibility</td><td>1. Preparation and briefing</td><td>2. Brief</td><td>2. Feasibility</td><td rowspan="2">2. Planning</td></tr>
<tr><td>3. Define: delivery approach and procurement strategy</td><td rowspan="2">2. Concept design (programming and planning)
3. Spatial coordination
4. Technical design</td><td>3. Concept
4. Definition</td><td rowspan="4">3. Realisation</td></tr>
<tr><td>4. Design: specifications and functionality</td><td>5. design</td><td rowspan="2">3. Implementing</td></tr>
<tr><td>5. Implement: manufacture and construction</td><td>5. Manufacturing and Construction</td><td rowspan="2">6. Build and commission</td></tr>
<tr><td>6. Validate: integrate and handover</td><td>6. Handover and close out</td><td rowspan="2">4. Controlling</td></tr>
<tr><td>7. Operation: use and maintain</td><td>7. Use</td><td>7. Handover and close out</td><td>4. Operation</td></tr>
<tr><td>8. Retire: repurpose or demolish</td><td></td><td>8. Operation and end of life</td><td>5. Termination</td><td>5. Closing</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Adapted from CIOB code of practice for project management for construction development (2014)

Generally, construction projects are carried out in a series of six recognisable phases (Bennett, 2003; Chitkara, 1998) although some of the phases involve iterations to a greater or lesser degree than others depending on the complexity of the project (Matheu, 2005). Evaluating the phases presented in Table 3-1, it is evident that all the stages includes the conception/inception phase, the planning phase, the design phase, the construction phase, the monitoring and controlling phase and finally, the commissioning phase (Bennett, 2003). However, CIOB code of practice for project management (2022) has presented additional phases covering the full lifecycle of a construction project which also accounts for the delivery approach and procurement strategy. Therefore, subsequent discussions on the phases in the lifecycle of a construction project will be presented according to the CIOB code of practice (2022), as shown in Table 3-1. Furthermore, within these, discussions on the delivery approach and procurement strategy will be presented.

3.3.1 Phase 1 - Identify: Needs and Benefits

This phase is of strategic importance to the entire project life cycle since it ensures the clients' needs are clearly understood and the high-level benefits of the projects are defined in clear and measurable terms (CIOB, 2022). In this phase of a construction project, eight key themes are applied and must be agreed and documented before the project moves to the next phase, as shown in Table 3-2.

Table 3-2: Key themes in Phase 1

S/N	Theme	Description
1	Quality	Agree principles and strategies for ***quality***, including safety
2	Sustainability	Agree aims for ***sustainability*** based on legislation and clients expectations
3	Value	Agree desired socio-economic ***values*** ensuring the process of agreeing the value drivers with the client is documented
4	Productivity	Agree strategies for innovation and ***productivity*** taking account of the market and available technologies, and ensuring decision are documented
5	Leadership	Establish governance to create the environment for effective ***leadership,*** agree terms of reference and roles and responsibilities
6	Collaboration	Agree principles for ***collaboration*** and risk-sharing between the client and all contractors and consultants in the supply chain
7	Knowledge	Agree purpose and scope of information as part of a wider ***knowledge*** management
8	Risk	Express appetite and capacity for risk in measurable terms and identify ***risks*** to strategic, regulatory, commercial and reputational objectives

The deliverables of this phase are documents known as the business case which describes all problems/opportunities the project would address, together with the project's goal and objectives, costs, benefits, how the success of the project would be measured, and the potential risks or obstacles that may be encountered during the project life cycle (Albrecht, 2017). Before the project moves on to the next phase, the defined decision makers and the governance board are required to confirm that the deliverables address the key themes of this phase (CIOB, 2022).

3.3.2 Phase 2 – Assess: Options and Feasibility

Once the identify phase is completed, and the stakeholders approve of it, the project then proceeds to the assess phase. The purpose of this phase is to assess the life cycle of the project and ensure the feasibility of thew project (CIOB, 2022). Eight key themes are applied in this phase as shown in Table 3-3, and before proceeding to the next phase, the relevant decision makers must assess and confirm that this phase meets all requirements stipulated.

Table 3-3: Key themes in phase 2

S/N	**Themes**	**description**
1	Quality	Define the ***quality*** criteria of the project based on the client's expectations
2	Sustainability	Define ***sustainability*** design principles in line with legislations and clients' requirements
3	Value	Define the ***value*** drivers based on the client's priorities and expectations
4	Productivity	All assumptions regarding ***productivity*** of the project must be defined
5	Leadership	***Leadership*** should be focussed on long-term objectives
6	Collaboration	Promote ***collaboration*** and early involvement of all stakeholders
7	Knowledge	Promote ***knowledge*** sharing and documentation
8	Risk	***Risks***, threats and opportunities, as well as associated contingencies must be assessed and documented at regular intervals

3.3.3 Phase 3 – Define: Delivery Approach and Procurement Strategy

The purpose of this phase in a construction project is to plan the delivery approach and procurement strategy that best suits the defined needs and benefits of the project (CIOB, 2022). Project delivery approach provides a structure for the relationship between parties involved in a project (typically the owner, the designer, and the contractor contractor) and when/how they will fulfil their responsibilities. Therefore, defining the delivery approach at this phase helps to determine how stakeholders will work together during subsequent phases of the project (Killough, 2023). Various definitions of project delivery exists within the construction industry. For example, Ding *et al* (2018) defines project delivery as the sequence of project phases, parties involved in the project and implicitly assigned roles, and responsibilities to project parties. Darwish (2017): the approach/methodology used to organize the project team so as to manage the entire designing and building process. Design Build Institution of America (2015): a comprehensive process including planning, design and construction required to execute and complete a building facility or other type of project. Based on the above definitions, construction project delivery can be defined as the sequence of phases, parties involved in the project and implicitly assigned roles, and responsibilities to project parties (Ding *et al*, 2018). Also, a number of recognized approaches can be used to manage construction project delivery, each offering distinct advantages and disadvantages, and the common approaches used in the construction industry include: the traditional approach, the design-build approach, the construction management approach.

The traditional delivery approach is where the owner of the project hires a design professional who prepares a complete set of contract documents (Kapsalaki, 2017). Following this, the owner either negotiates a price with a general contractor (who is totally responsible for delivering the completed project) or bids out the work. In this delivery approach, there is no direct formal relationship between the designer and the builder, and changes to the project scope, as well as design errors or omissions can lead to project delays and an increase in the contract price. In the design and build approach, the designer and the builder work together via a joint venture and form an alliance for the duration of the project based on a single contract (Kapsalaki, 2017; Baldwin and Bordoli, 2014). This delivery method is progressive and gradually becoming an industry standard since it promotes faster project completion times, better budget estimates and a better brand (Ellis, 2022).

Construction management delivery approach on the other hand, the owner hires both a design firm and a construction project firm in the delivery phase of the project (Ahmed and El-Sayegh, 2020). Subsequently, the construction manager would then advise the owner on matters regarding design and managing of construction activities. Even though this delivery approach leads to a high level of collaboration between project participants, it also requires high level of involvement from the owner, thus, dictating the need for an experienced owner (Baldwin and Bordoli, 2014; Gould, 2012). In this case, the owner of the project would do much of the programming and designer selection and then contract a construction project manager to execute the work. Notwithstanding, the project manager is responsible for deciding the best methodology for the management of the project (CIOB code of practise, 2022). Accordingly, CIOB code of practise (2022) notes that the two common methodologies are the traditional and agile methods, each of which has their individual strengths and weaknesses.

Procurement is an integral part of construction project delivery (CIOB code of practise, 2022). Construction procurement plays a pivotal role in the successful execution of construction projects. It focusses mainly on the strategic process of how contracts for construction work are created, managed, and fulfilled including defining requirements, buying materials, evaluating bids, hiring contractors and subcontractors, and buying or leasing equipment. (Hughes *et al*, 2015, p. 11). Hence, the adopted procurement strategy plays a major role in the delivery and management of construction projects. Construction procurement is a collaborative effort of various stakeholders working together to ensure the successful execution of a construction project (Gonzalez, 2023). These includes and not limited to, the construction project manager, the owner (or client), the designer(s), contractors, suppliers and regulatory bodies.

Over the years, the construction industry have featured various procurement strategies including Design-Bid-Build (DBB); Design-Build (DB); Construction Management (CM); Design-Build-Operate (DBO); Design-Build-Finance-Operate (DBFO) (Naoum and Egbu, 2016; Bolpagni, 2013; Clamp et al., 2012, p. 31; CIOB, 2010). However, new strategies for procurement that enhance collaboration among the different parties involved in a project are becoming popular in the AEC/FM industries (Bolpagni, 2013). In the year 2012, the Government Construction Task Group report highlighted clear changes in the UK construction procurement strategies that include principles of early supplier engagement, transparency of cost, integrated team working and collaborative working. As well as a reduction in cost, the new methods of construction procurement (NMCP) are anticipated to contribute to a reduction in project risk, improved programme accuracy and an enhanced working relationship between client and the supply chain. The NMCP were based on best practice in public sector construction (Cabinet Office and Efficiency and Reform Group, 2014). These NMCP includes: two-stage open book (TSOB), cost-led procurement (CLP) and integrated project insurance (IPI), each of which features collaborative working at heart to deliver value for money (Atkinson *et al*, 2022). Subsequent discussion will briefly elaborate on them.

3.3.3.1 Two-Stage Open Book (TSOB)

The TSOB is a system of pre-construction phase project processes presided by the early appointment of a full project team (Mosey, 2014). Using this procurement approach, the client is able to invite prospective integrated teams, whether for a single project or under a framework or alliance, to bid for a project based on their ability to deliver an outline brief and cost benchmark (Cabinet Office and Efficiency and Reform Group, 2014). In the first stage of this procurement approach, a number of tier 1 contractors and consultants are invited to bid for the contract, with bidders chosen based on their capacity, capability, stability, experience and strength of their supply chain, as well as their profit/fees/overheads and their other costed proposals as appropriate (Mosey, 2014). After successful selection of bidders for the contract, the second stage commences where the appointed team (contractor and consultants, as well as sub-contractors, suppliers), under a jointly agreed timetable, work collaboratively to develop detailed proposal based on the open-book cost (Atkinson *et al*, 2022). The TSOB procurement approach is beneficial in reducing industry bidding cost, enables faster mobilisation and also provides an avenue for early clients' involvement with a single integrated team (Mosey, 2014).

The flow chart from the Kings College publication (2014), on behalf of the Cabinet Office summarises the TSOB process as shown in *Figure 3-3*.

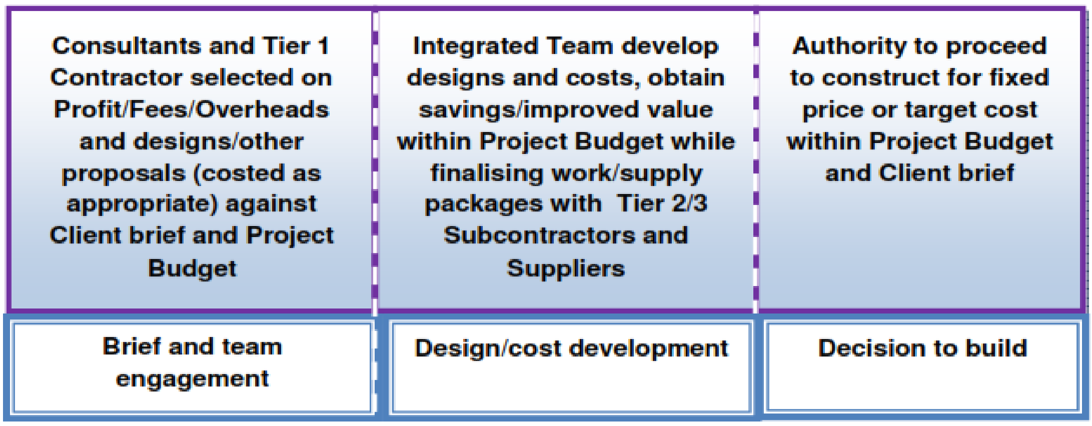

Figure 3-3: TSOB procurement flowchart
Source: Cabinet Office, 2014

Furthermore, Cabinet Office (2014) highlighted some fundamental requirements for the TSOB procurement approach, these includes:

- Client commitment to early creation of an integrated project team
- Verifiable benefits of the processes to all involved in the project
- EU compliance
- Agreed roles and responsibilities for the client, contractor, consultants and suppliers
- Governance and continuity from the client and project team
- Collaborative culture
- Conditional contracts based on the agreed budgets, meeting the brief and any other agreed preconditions
- Open book costs comprising of the agreement of fees, profit and overheads
- Guidance and case studies

3.3.3.2 Cost-Led Procurement (CLP) Approach

CLP is an approach that enables the industry to use its experience and knowledge to develop innovative solutions through leveraging design, materials, subcontracting, direct labour and experience to the advantage of the public sector client (Burnard and Muse, 2014, p. 3). In this approach, the client using their knowledge of costs (Malone, 2017), states clearly the outputs and expected outcomes in a strategic brief and the industry responds by proposing solutions and committing to a price and a set of rules under which that price can be achieved as the final account sum. The client can also collaboratively work alongside the supply teams (preferably, within a framework agreement) early in the project to produce a proposal that is acceptable and matches the cost ceiling (Atkinson *et al*, 2022; Burnard and Muse, 2014; Udom, 2012). This is achieved by a refinement process of the proposal (based on the client's feedback) by a two-stage process with two supply chain teams and subsequently, the submission of a final proposal that is acceptable to the client (Burnard and Muse, 2014). The CLP approach involves five phases: inception, selection of contractor, design and cost development, construction, and operation (Cabinet Office, 2014) as shown in *Figure 3-4*.

Furthermore, it is important to note that the successful team selected will need to demonstrate their ability to meet and even better the cost ceiling (Atkinson *et al*, 2022), prior to their appointment, and then requested to work collaboratively with key client stakeholders to develop the design and cost in parallel (Udom, 2012). The CLP approach works best for projects where costs cannot be exceeded, and where there is a highly functional and historically repetitive aspect to the project (Burnard and Muse, 2014).

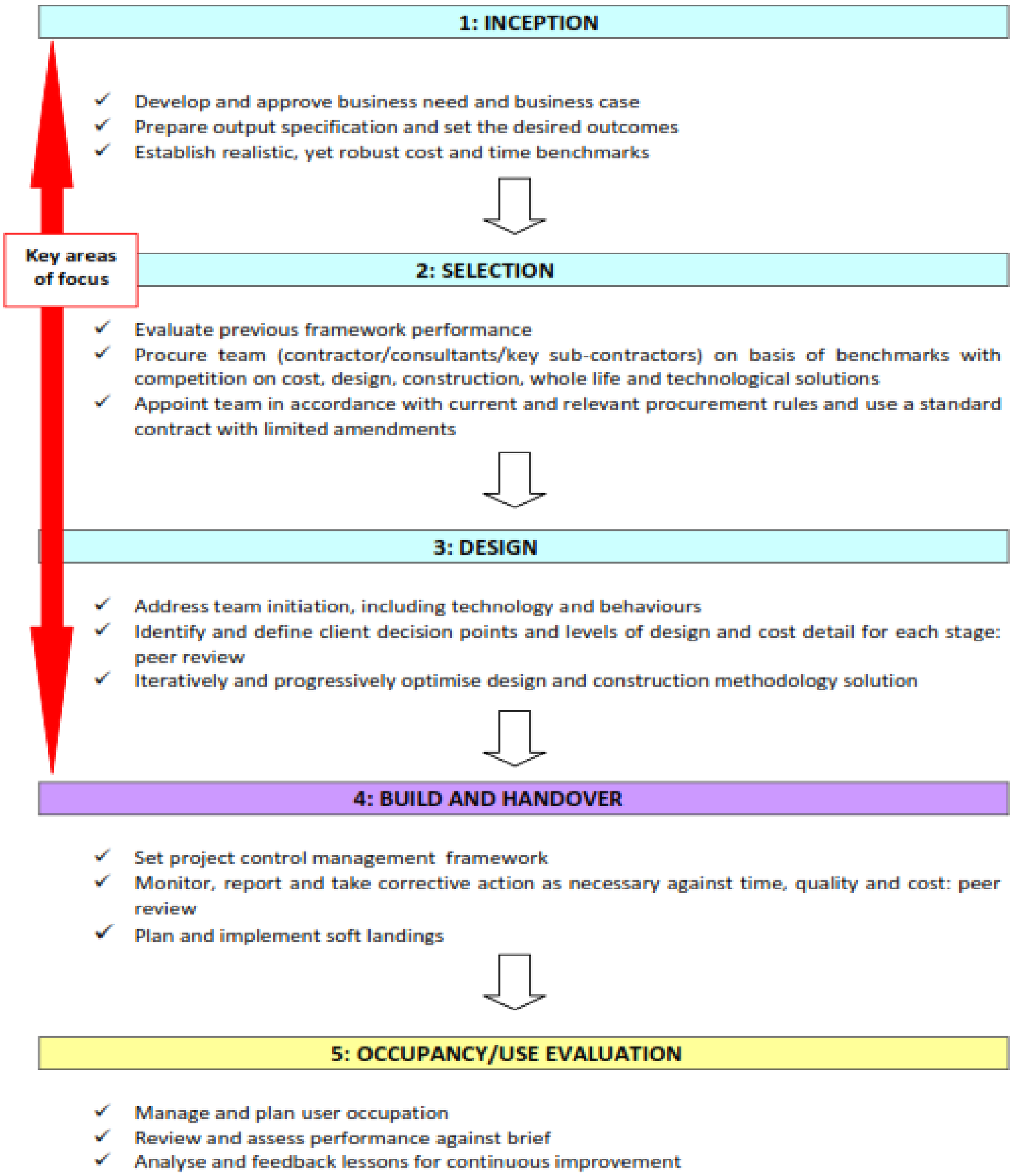

Figure 3-4: CLP procurement flowchart
Source: Cabinet Office, 2014

3.3.3.3 Integrated Project Insurance (IPI)

The IPI is the most unique among the NMCP owing to its insurance-backed partnership that incorporates single-project insurance (Goodfellow-Smith *et al*, 2019). This NMCP unlocks the potential of integrated collaborative working by:

- aligning the interests of the project team with the interests and needs of the client
- assuring solutions are feasible, affordable, and delivered in a culture of full collaboration
- insuring the outcomes including cost overrun and establishing a pre-determined maximum financial exposure for all parties (Cabinet Office and Efficiency and Reform Group, 2014).

The unique insurance policy within the IPI approach covers the design and construction team as a virtual company in a coalition with the client for all risks, including third-party liability, delay in project completion, cost overruns and latent defects (Connaughton and Collinge, 2018). Also, the strategy within this approach is based on a more collaborative culture in the industry (Bolpagni, 2013), wherein the client appoints a project team in the name of an "alliance" based on their track records and capabilities (Udom, 2012). The formed alliance then functions within a limitless collaboration to develop project solutions within the benchmarked cost saving criteria (Atkinson *et al*, 2022).

In essence, the IPI procurement approach promotes a pain-gain sharing (which is widespread and usually where a single project insurance is adopted) and the parties involved are in effect partnering to some degree (Bolpagni, 2013). However, the current framework within the industry does not fully support this approach, and before obtaining insurance cover within the IPI, any solution developed must be subjected through a thorough validation process by an independent expert to ensure the feasibility of the project (Integrated Project Initiatives, 2014). Pending when the IPI approach is fully established and a simplified integrated format can be developed, the IPI policy consists of the following:

- Section 1: Construction All Risks (including Terrorism Extension)
- Section 2: Third Party Liability (including Non-Negligent Liability)
- Section 3: Delay in Completion (resulting from damage under Section 1)
- Section 4: Financial Loss cover (with an agreed cap limit of insurers' indemnity, and its exclusions are limited to 'normal industry exclusions')

As well as,

- Latent Defects cover (for 12 years) - a "no fault" commercial latent defects insurance policy.

Procurement strategies involves a relationship to some extent with the client (or owner) of the project. Accordingly, Sayyed *et al* (2023) explains it as the process relating to the involvement and introduction of service providers or materials to the activities of managing a project, including the management of contracts and aligning the strategy and objectives of sub-contractors within the organisation. The relationship can be transactional, wherein the client (the owner) has a hands-off relationship with the project deliverer (the project design and delivery team), or it can be more hands-on and collaborative wherein the client and the project delivery team collaborate to interpret requirements and how to deliver the project (Walker and Lloyd-Walker, 2014). It is important to note that the adopted procurement strategy has a direct influence on the performance of a project (Sayyed *et al*, 2023; Omondi *et al*, 2017; Ghadamsi and Braimah, 2012). Therefore, Streule *et al* (2016) suggested that in selecting an appropriate procurement strategy, the following criteria should be considered:

- the level of risk involved in the project
- the number of stakeholders involved
- the timeline of the project,
- the extent at which the project cost is achievable.

Consequently, for ease of selection, Akintoye *et al* (2012) broadly classified the procurement strategies into two broad categories: the conventional and collaborative strategies. The conventional procurement strategy is usually driven by contractual obligations after the project is awarded. Therefore, there is limited allowance for flexibility, as well as the cost, time and scope. Also, any changes in the project scope would lead to variation and claims. Whereas the collaborative strategy is based on establishing a framework that aims to increase collaboration and processes to enables the achievement of the project objectives. It is built on trust, and all parties involved in the project share a common desire to achieve best value which reflects positively on their partnership. Consequently, it is evident that procurement strategy serves as a moderator between the level of flexibility and innovation in the management and execution of a construction project. Hence, also plays a huge role in the setting up and management of the project.

For example, the conventional strategy would lead to a rigid project delivery method and gives little allowance for flexibility and innovation. Whereas the positive effects of the collaborative procurement strategies can be seen by the level of improvement in the innovation on a project, which also would lead to an improved project performance. Thus, serving as a tool for the introduction of new management methodologies, technologies and changes in construction project management. The NMCP introduced by the Government Construction Task Group report (2012) discussed in section 3.3.3 were grounded on collaborative working to enhance construction projects performance. Albeit the collaborative strategy may be difficult to implement for reasons including finances, skills, geographical extension, and experiences of the parties involved (Walker and Lloyd-Walker, 2015). Hence, Sayyed *et al* (2023) suggests that organisations would be required to build a system that allows provision for innovative projects to establish improvement in project performance.

Various methodologies can be adopted in the delivery of construction projects (CIOB code of practise, 2022). For example, the traditional (waterfall) method ensures the scope and quality of each preceding activity is achieved before moving on to the next activity. Whereas an iterative agile delivery method where resources are timeboxed allows flexibility and incremental delivery of the project scope and quality to the client (further discussion on project management methodology will be provided in section 3.5). Regardless of the chosen delivery method, CIOB code of practise (2022) suggests eight key themes must be applied in the delivery of construction projects as shown in Table 3-4.

Table 3-4: Key themes in phase 3

S/N	Themes	Description
1	Quality	Incorporate ***quality*** criteria and priorities to plans and construction tender (if any) whilst ensuring clarity and the correct level of detail
2	Sustainability	Incorporate ***sustainability*** design principles to plans, tenders (if any) and contracts whilst ensuring clarity and the correct level of detail
3	Value	***Value*** drivers and priorities in the business case needs to be reclarified
4	Productivity	Incorporate the requirements of ***productivity*** and innovation to design, tenders and contracts.

5	Leadership	***Leadership*** should be focussed on establishing detailed roles, responsibilities, terms of reference, while delegated limits of authority should be agreed and documented
6	Collaboration	Incorporate requirements for ***collaboration*** and risk allocation within appointments, contracts, and future tender, whilst ensuring plans are accessible and updated regularly.
7	Knowledge	Establish protocols for the promotion of ***knowledge*** sharing and learning among stakeholders
8	Risk	Provide a validation of ***risks*** strategy and plans, including the use of financial and schedule contingency, technical redundancy, resilience planning and insurance requirements, whilst ensuring risks are registered and monitored.

3.3.4 Phase 4 - Design: Specifications and Functionality

The purpose of this phase is to establish the specifications and functionality of the asset in details to enable smooth delivery of the project (CIOB, 2022). In this phase, the project team begins by accessing the preliminary sketches from the planning phase and decides whether to do the design within the organisation or outsource the design. In the case where the design is to be outsourced, the team announces the design tender in preparation for bidding process. In this phase, it is vital that design data between the different design disciplines are fully coordinated to avoid issues with the project scope. Hence, appropriate technologies are adopted at this stage, e.g., BIM to ensure quality designs (CIOB, 2022). The output of this phase is the final design of the project. As with the preceding phases, eight key themes must be applied to ensure quality design as shown in Table 3-5.

Table 3-5: key themes in phase 4

S/N	Themes	description
1	Quality	Key decisions and ***quality*** acceptance criteria must be translated into detailed specification, whilst engaging with relevant stakeholders
2	Sustainability	The designs must be in conformance with the agreed ***sustainability*** commitment of the project
3	Value	The design process must conform with the agreed ***value*** drivers and priorities in the business case

4	Productivity	Innovation strategy and ***productivity*** requirements must be translated into detailed specifications
5	Leadership	***Leadership*** should be focussed on engagement with stakeholders and conflict resolution according to the agreed terms of reference
6	Collaboration	Balance ***collaboration*** with efficiency of deliver and ensure design activities optimise the supply chain
7	Knowledge	Design should be done in line with the agreed ***knowledge*** and information management commitments
8	Risk	***Risks*** plans should be implemented through design activities, while focussing on resolving emergent risks.

3.3.5 Phase 5 – Implement: Manufacture and Construction

The main purpose of this phase is to manufacture, deliver, and deploy the planned project deliverables (Zwikael, 2019) in accordance with the chosen delivery and procurement strategy (CIOB, 2022). This phase is very critical in ensuring construction projects are delivered in a sustainable way (Kivilä *et al*, 2017). In addition, the standard of the finished project largely depends on the skilfulness in executing this phase (Ransom, 2019; Goulden, 2017; Sertyesilisik, 2017; Peterman, 2016; Oberlender, 2014). Hence, this phase is probably the most laborious, resource intensive, and most likely the longest phase in the entire life cycle of a construction project (Peterman, 2016).

The construction phase usually begins with organising the team that would be involved in carrying out all the activities for the project (Albrecht, 2017). Therefore, the project manager in this phase is obliged to build the project deliverables (outputs) and monitor/control the deliverables as they unfold by supervising all the project activities to provide tangible results (Peterman, 2016). The steps involved at this phase depends largely on the specific requirements of the project, which are laid out in the execution plan. Eight key themes are applicable in this phase according to CIOB (2022) as shown in Table 3-6.

Table 3-6: key themes in phase 5

S/N	Themes	description
1	Quality	Deliver ***quality*** via manufacturing and execution based on the specification

2	Sustainability	Maintain agreed ***sustainability*** commitments through manufacturing and execution
3	Value	Monitor performance and implement change control to justify the ***value*** and impact of any changes
4	Productivity	Deliver innovation and ***productivity*** requirements through manufacturing and execution of the project
5	Leadership	***Leadership*** should be focussed on engagement with stakeholders and conflict resolution according to the agreed terms of reference
6	Collaboration	***Collaborate*** with the supply chain to ensure quality manufacturing and construction
7	Knowledge	Manufacture and construct in line with the agreed ***knowledge*** and information management commitments
8	Risk	***Risks*** plans and procedures should be implemented throughout the manufacturing and construction activities, while resolving emergent issues.

The project manager primarily monitors and controls the project deliverables (Albrecht, 2017), and is also expected to oversee other management processes such as time management, risk management, cost management, issue management, quality management, procurement management, change management, acceptance management, and communication management, as summarised in Figure *3-5*. Also, considering that the execution phase requires a significantly elevated work process with several tasks, evolving circumstances would mean a deviation from the original work package, hence causing drifts in the project outcome (Zwikael, 2019). Therefore, a collaborative and adaptive approach in keeping the project stakeholders up to date about the project status, procurement and contract administration issues, quality management control, monitoring the project risk is recommend (CIOB, 2022; Pareliya *et al,* 2018). The final output of the execution phase of a construction is the physical structure as described in the design phase of the project.

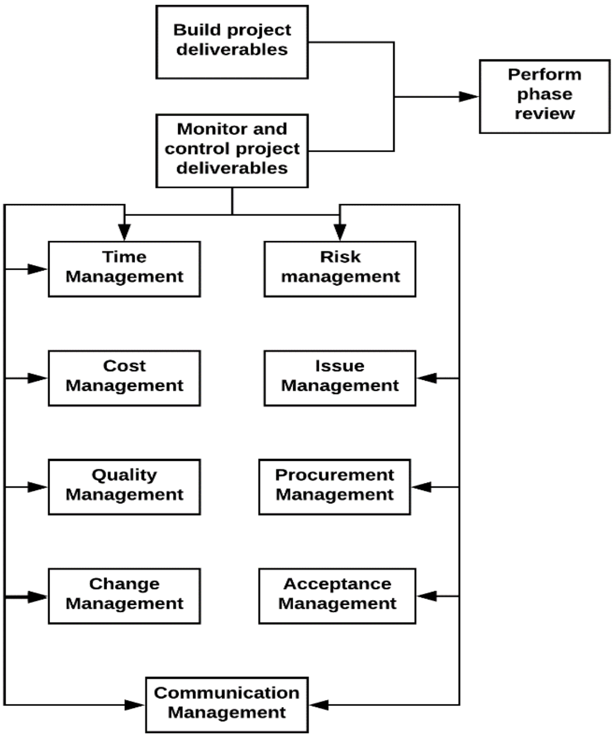

Figure 3-5: Summary of the management processes undertaken in execution phase of a project
(Adapted from Peterman, 2016)

3.3.6 Phase 6 – Validate: Integrate and Handover

The purpose of this phase of the project is to validate the integration of all systems, confirm the specification and functionality through commissioning and also to handover the asset to the owner (CIOB, 2022). Usually, a lot of preparations are carried out prior to this phase, as activities in this phase are usually of high priority since it leads to the project's final deliverables, such as installation and testing, post-implementation evaluation, assembling of the final project report that summarises all the project's progress reports, acceptance of test results, and a brief description of the lessons learnt during the project (The Constructor, 2018; Albrecht, 2017). Hence, eight key themes must be applied as shown in Table 3-7.

Table 3-7: key themes in phase 6

S/N	Themes	description
1	Quality	Validate the ***quality*** of the built asset in terms of specifications, functionality and regulatory requirements
2	Sustainability	Validate that the agreed ***sustainability*** commitments have been met

3	Value	Establish baseline to track performance to ensure that the planned ***value*** will be demonstrated over time
4	Productivity	Ensure innovation and ***productivity*** requirements for operation of the asset are achievable and signed-off
5	Leadership	Operational ***leadership*** should be set up for success before clients take over ownership of the asset
6	Collaboration	***Collaborate*** with the stakeholders to ensure opinions of all is recorded and taken into consideration
7	Knowledge	Document ***knowledge*** and learning from the manufacturing and construction process
8	Risk	Implement ***risks*** plans and procedures through integration, validation and handover activities.

3.3.7 Phase 7 – Operate: Use and Maintain

This phase of the project lifecycle ensures that the constructed asset is used and maintained as designed to meet the needs and benefits of the client and to ensure best value overtime (CIOB, 2022). Eight key themes are also applicable at this phase as shown in Table 3-8.

Table 3-8: key themes in phase 7

S/N	Themes	description
1	Quality	***Quality*** must be delivered by using and maintaining the asset in line with the design and adapting to needs overtime
2	Sustainability	***Sustainability*** commitments must be upheld in use and maintenance of the asset in accordance with the design criteria and end-of-life plans
3	Value	Establish and create additional socio-economic ***value*** through operation, maintenance, monitoring and managing obsolescence
4	Productivity	Ensure ***productivity*** of the asset is delivered via use and maintenance in line with design and innovation to ensure continuous improvement
5	Leadership	Establish clear ownership, governance and ***leadership*** for operation and maintenance of the asset
6	Collaboration	***Collaborate*** with the stakeholders via operation and decision making about the end-of-life plans for the asset
7	Knowledge	Document ***knowledge*** and learning on an ongoing basis
8	Risk	Implement ***risks*** plans and procedures through operational activities

3.3.8 Phase 8 – Retire: Repurpose or Demolish

This is the last phase in the lifecycle of a construction project. The main purpose of this phase is to ensure there is a clear rationale and justification for the end-of-life plans for the asset (CIOB, 2022). Hence, eight key themes must be upheld as shown in Table 3-9.

Table 3-9: key themes in phase 8

S/N	Themes	description
1	Quality	Ensure plans for ***quality*** commitment in line with the original design
2	Sustainability	***Sustainability*** commitments must be upheld in line with the original design
3	Impact	Establish and identify rationales for future steps and net socio-economic ***impact*** the asset creates
4	Productivity	Identify opportunities for innovation to ensure ***productivity*** is delivered at end-of-life stage
5	Leadership	Establish clear ownership, governance and ***leadership*** for transfer of asset from operation into a new project
6	Collaboration	***Collaborate*** with the stakeholders whilst developing retirement plans for the asset
7	Knowledge	Document ***knowledge*** and learning on an ongoing basis
8	Risk	Document ***risks*** associated with transitioning from operation to a new project

Project management methodologies (PMM) has become an essential element in the successful delivery of construction projects (Chin and Spowage, 2012). Likewise, PMM, when applied to a project directly influence the efficiency and effectiveness of the project's outcome (Al Rasch, 2019). According to Gil (2015), PMM's were designed to support project managers in achieving more predictable project success rate, with the goal of standardising, structuring, and organising work methods. It is important to also note that the selection of an appropriate PMM in the delivery of a construction project can lead to the success of the project (Darwish, 2017). Besides, studies have highlighted the relationship PMM's and project success (Joslin and Muller, 2015; Vaskimo, 2011). For example, a cross-sectional study conducted by Joslin and Muller (2015) revealed that the application of a PMM accounted for 22.3% of the variation in project success, and sufficiently tailored PMM's led to higher levels of project success. Joslin and Muller (2016) further conducted a research on the impact of PMM on project success in different project environments and revealed there is a positive relationship between PMM and the characteristics of project success, however, environmental factors and notably project governance influence the use and effectiveness of PMM and its elements with a resulting impact on the characteristics of project success.

One of the difficulties faced by practitioners is in deciding which PMM best suits a project since they all have their advantages and disadvantages, and every construction project is one of its kind (Burgan and Burgan, 2014; Kononenko and Kharazii, 2014). Besides, research is split whether implementing a standardized or customized methodology, say by industry sector, project type, team experience and culture, achieves better results (PMI, 2014). Hence, recent suggestions are inclined towards the development of a unique, customisable methodology based on the integration of traditional and agile methodologies (Lalmi *et al*, 2021). The focus of this research is on construction project delivery and considering the important role PMM's play in the delivery of construction projects, the next section will elaborate on PMM's, with a focus on the traditional and agile methodologies, as well as their strengths and weaknesses.

3.4 Project Management Methodologies

Over the years, several PMM's have been established with the aim of imposing industry standards with tools, techniques, processes, and procedures (McClure, 2019). These methodologies were developed to provide foreseeable outcomes that organisations could leverage on to ensure reliability in the successful delivery of projects and products (Joslin and Muller, 2014). Therefore, it is imperative that any methodological choice adopted in managing a project should define the work process as well as structure how the team members communicate with the clients (Cohen, 2019; Jovanović and Berić, 2018; Hutagalung, 2006). Studies have also established a unanimity that the choice of PMM used in managing any project should be dependent on organisational factors, such as the size of the firm, the type and peculiarities of the project, available human resources, leadership style, and organisational culture (Zavyalova *et al*, 2019). Chin and Spowage (2018) also emphasise that any PMM adopted in managing a project should be unambiguous and flexible while providing guidelines for best practices to ensure project goals are achieved, considering that methodological approaches have a direct influence on the laboriousness and cost of management as well as the risks and success of the project (Kononenko and Lutsenko, 2018).

A survey conducted by PMI (2014) revealed that when no specific PMM was employed in managing a project, projects were only 67% successful; in the case where a PMM was moderately tailored to suit a project, the success rate only increased to 68%; and when a PMM was completely tailored to suit a project's need, the success rate rose to 82% (Whitaker, 2014). This agrees with Chin and Spowage (2018) reasoning and indicates that the methodological approach used in managing projects has a direct impact on project outcomes (Pace, 2019; Joslin and Muller, 2015; Vaskimo, 2011). Also, it is reasonable to expect that when a PMM is effectively tailored to suit the peculiarities of a project as well as other organisational factors, the chances are higher for a successful project. However, studies have revealed that project management practitioners apply these methodologies irrespective of the particularity and type of the project (Jovanović and Berić, 2018). Hence, Chin and Spowage (2018) suggests for project management practitioners to adopt the most suitable methodology, and tailor it to meet the specific project environment that can be adaptable to the dynamic nature of stakeholders' demand in delivering value.

As presented in section 1.1, PMM is the application of a system of methods in executing projects based on a specific way of thinking in order to achieve the project goals. PMM's generally fall somewhere along a continuum; on the one hand is the traditional project management (TPM) methodology while on the other hand is the agile methodology (Tokar, 2018). Likewise, studies have broadly classified PMM's into the traditional and the agile (modern) methodologies (Handzic and Bassi, 2017; Maric, 2017; Wideman, 2006; Charvat, 2003). Each of these methodologies serves as a tool that accentuates on accountability and continual improvement as a project moves through from the initiation phase to the close-out phase. This study will focus on the two broad classifications of PMM - the traditional and agile PMM's and Table 3-10 below presents an overview of the traditional and agile project management methodologies based on the scope, resources, time, and risk.

Table 3-10: Project Management Methodologies

Factors	Traditional PMM	Agile PMM
Scope (Requirements)	Well-known, understood and is not susceptible to change	Full of uncertainties and subject to change
Resources (Money, Infrastructure, People)	Available and approved resources; defined budget and all the required skills available	Funding not readily available; uncertain budget and required skills not readily available
Time	Milestone are clearly defined and assigned	Open/unclear milestones; susceptible to change
Risk	Risk assessed and understood; minimal impact	Unknown risks; new technologies; major impact

Adapted from Hutagalung (2006)

3.4.1 Traditional Project Management (TPM) Methodology

The traditional project management (TPM) methodology, often referred to as the waterfall approach (Kibler, 2019) and reckoned as the wellspring of formality in project management, has been used successfully over the years (Kibler, 2019; Spalek, 2016; Salameh, 2014; Wysocki, 2011). The TPM methodology is a project management approach executed in a linear sequence (University of Rochester, 2022). It involves a very rigid planning and implementation cycle (Initiate - Plan - Execute - Close), with work details structured to avoid unforeseen problems (PMI, 2013; Egan, 2009; Hällgren and Wilson, 2008). The basic model of the TPM methodology includes initiation, planning, execution, monitoring, and closure phases, and it is essential to define the scope and project requirements at the start of the project (University of Rochester, 2022).

The TPM methodology was established in the 1950s, and it prescribes methods and procedures that should be applied to projects in a uniform way (Špundak, 2014). The main idea behind this traditional, structured, normative methodology is that projects are predictable and straightforward with clear scopes (Maja, 2017; Spundak, 2014; Cicmil *et al*, 2009; Andersen, 2006; Boehm and Turner, 2003; Boehm, 2002). Therefore, all activities in this methodology are carried out in a step-by-step procedure, following a pre-designed plan. Once a phase is completed within the TPM methodology, it is rarely revisited, thus resulting to a major flaw in this methodology (Hass, 2008). Traditionally, construction organisations have relied on the traditional waterfall approach in delivering their projects. The waterfall approach has been useful for managing several projects over the years and has served as a standard approach for organisations in delivering successful projects (Kibler, 2019; Spalek, 2016; Salameh, 2014; Wysocki, 2011). The waterfall approach has some unique advantages and specific use cases where it makes more sense even though it requires more time in a lengthy task, which is why organisations are re-evaluating this method.

Some of the strengths of the TPM methodology, as suggested by Tawfik (2022); University of Rochester (2022), include:

Control of unchecked scope and cost creep: Whilst enabling the empowerment of the team is crucial for productivity, there is need for a framework to keep the project team on track with the project. Hence, an in-depth, high-level plan with clear milestones allows the team to remain accountable and focused on the objectives that matter.

Clear expectations: The planning/analysis phase is very important in the TPM methodology because it allows an easier estimation of costs, schedules, and required resources. Also, clear expectations ensure that both the project team and the stakeholders understand the timeline and expected outcome of the project.

Clear responsibilities: In line with the project definition and planning, each member of the project team has a role in the successful execution of the project. Therefore, the project manager in the TPM methodology assigns duties to give everyone unique responsibilities and ensures the team is working as efficiently as possible.

Documentation: In the TPM methodology, every step of the project requires clear documentation. Project documentation serves as a guidebook for everyone involved in the project, and future projects and project managers can also refer to it for guidance. In addition, documentation is useful in providing updates to management and other stakeholders on the outcome of the project.

Accountability: The project manager often endeavours to ensure everyone is reaching their milestones and that they complete the project on time and within budget. This methodology also gives the stakeholders and members of the organisation the right to assess the project manager with any concerns or update requests regarding the project. Thus, redirecting the ultimate responsibility for the successful delivery of the project to the project manager.

Control: Each phase of a project has very specific requirements which must be met before the project can move on to the next phase. The TPM methodology ensures that no deviation from the original plan of the project is considered except for rare occasions wherein the project manager as well as the stakeholders approves any change request after reviewing the potential impact.

Although this methodology has been developed over a long period of time as the main methodology in managing projects (Sid, 2018; Spalek, 2017), it appears that such a homogenous methodology did not put into consideration the robustness and appropriateness of a wide range of projects (Špundak, 2014). Also, studies have identified that some of the characteristic of the TPM methodology also constitute its weaknesses, as shown in Table 3-11.

Table 3-11 Weaknesses of the TPM methodology

Characteristics	**Weaknesses**
Waterfall approach	The traditional methodology follows a waterfall approach where the project is divided in clear stages, each with their own tasks and deliverables (Kibler, 2019).
Predictability	The assumption that projects are foreseeable and straightforward with clearly defined boundaries (Bergmann and Karwowski, 2019; Wysocki, 2007; Boehm and Turner, 2003; Kliem, *et al*, 1997).
Context stability	One key element with the TPM methodology is the assumption that the environment and the project requirements remain stable once the project begins. Within the context of stability, the traditional methodology profoundly emphasise predictability of the project, with the belief that project outcomes and risks of a project can be predicted precisely.
Task breakdown	The traditional methodology also heavily relies on task breakdown. The belief is that if project deliverables are broken down into tasks of cumulative detail, streamlined by the scope, it becomes easier to make correct predictions.
Time and cost	More emphasis on time and cost management, leading to an unrealistic management approach (Kliem, *et al*, 1997), and change in the project requirement is perceived as an abnormality, hence managed and not accepted.

Whilst the TPM methodology may seem applicable for projects with clearly defined scopes and in a predictable environment, recently it has been faced with several criticisms for its flawed speculation that risks and uncertainties are predictable

(Špundak, 2014, Atkinson *et al*, 2006). Moreover, for large and complex projects, the TPM methodology may be inefficient to resolve all the problems associated with projects' complexity due to its rigidity and bureaucracy since requirements are intangible and volatile (Kibler, 2019; Salameh, 2014; Owen *et al*, 2006).

Weaknesses of the Traditional Project Management Methodology

The TPM methodology is implicitly or explicitly based on a "plan-execute-control" paradigm (Depaire, 2019; Biggins *et al*, 2016; Ungureanu and Ungureanu, 2014; Koskela and Howell, 2002). Its strength lies in pre-defining all requirements and processes before commencement of a project (Salameh, 2014); "*… creating a detailed plan, and then executing the project according to that plan"* (Egan, 2009, p. 3). Literatures have highlighted the benefits of adopting the TPM methodology, as well as summarised by Ortloff *et al* (2009), to include: good control of financial, physical, and human resources; short development times at lower costs; higher quality and increased reliability; higher profit margins; improved productivity; and better internal coordination (Handzic and Bassi, 2017). However, these unquestionable success stories of the TPM methodology do not conceal some of its major limitations which are associated with the irrational assumption that there is no task or goal uncertainty, and that there is controllability of actions in project management (Cicmil and Hodgson, 2006).

Consider the PRINCE2 methodology, for example, which is also a *de facto* standard in the UK and other European countries for the management of simple and complex projects. Although this methodology seems reliable, robust on documentation, great on communication, and plan oriented, the PRINCE2 methodology focuses majorly on organisational control over the entire project and insists on meticulous planning prior to the commencement of any project. The rationale behind this normative methodology is that projects are quite simple, foreseeable, and straight forward with clearly defined boundaries (Saynisch, 2010; Collyer *et al*, 2010; Cicmil *et al*, 2009; Shenhar and Dvir, 2007; Leffingwell, 2007; Wysocki, 2007; Andersen, 2006; Boehm and Turner, 2003; Boehm, 2002), coupled with the assumption that projects are isolated from its environment (Cicmil *et al*, 2009; Shenhar and Dvir, 2007). In reality however, the project manager and the project team cannot foresee everything about the project and effectively plan all of its activities at the onset of a project since some aspects of the project are still vague, coupled with the clients' changing requirements.

Thus, making it almost impossible for projects to be effectively planned and executed in a controlled environment as proposed by the PRINCE2 methodology.

Change management is another major limitation of the TPM methodology (Bergmann and Karwowski, 2019). Change in any form is the reality of today's business environment, and changes to the project initial plans are inevitable due to expected adjustments to the unpredictable and dynamic project environments (Špundak, 2014). Managing changes based on the client's needs and project requirements plays a significant role in enhancing the successful delivery of a project (Arefazar *et al*, 2019). However, since the TPM methodology emphasises robust planning, changes most times are not accepted, and in the case where changes are considered, it has to go through several stages of top management considerations as well as several rims of documentations to justify why the changes must be endorsed (Pawar and Mahajan, 2017).

That being said, another key limitation of the TPM methodology is its rigorous documentation. Documentation at every stage of a project increases its complexity of use. Moreover, the TPM methodology does not offer flexibility in catering for the changing needs of the clients, thus exacerbating the rigour of integrating this methodology into modern projects that require various levels of flexibility. Furthermore, the TPM methodology emphasises robustness as one of its strengths, with suggestion that the same methods and techniques can be applied to all projects homogeneously, irrespective of their size and complexity. Nevertheless, this one-size-fits-all ideology of the TPM methodology has also been identified as its major limitation (Špundak, 2014).

The stage-gate systems of the TPM methodology (i.e., the key points in a project where a formal review of the project's current state is performed) (Frijns *et al*, 2017) has been criticised as one of its limitations. Although the concept of gates and project gate review is meant to provide key communication channels as projects move through the project processes as well as a formal means of controlling project risk, monitoring scope changes, and maintaining stakeholder interest (Infrastructure and Projects Authority, 2021; Stratton, 2003). However, the stage-gate system is considered a limitation of the TPM methodology due to its rigidity, vulnerability to bureaucratic creep, and the fact that most of the learning is acquired at the end of the project stage or after the result is delivered to the customer. In view of these, Koetzier *et al* (2012) argued that the stage-gate system can actually kill innovative ideas in project management.

Additionally, sustainability has been a growing concern for scholars and researchers in the field of construction project management, considering that every project has an impact on the environment in which it is executed, ultimately contributing to the changes in the environment (Armenia *et al*, 2019). However, the TPM methodology does not necessarily emphasise or encourage the incorporation of every aspects of sustainability in the planning and execution of projects (Toljaga-Nikolic *et al*, 2020). According to Morfaw (2014), a sustainable project management methodology should be able to efficiently fit into any changing environment and accommodate innovative changes with respect to all dimensions of sustainability. Meanwhile, due to the rigidity of the TPM methodology, most of the non-sustainable practices are still upheld and based solely on the project manager's prerogative. An example is the huge documentation processes of the TPM methodology wherein rims of papers are used. Handzic and Bassi (2017) also summarise some of the limitations of the TPM methodology as follows:

- Project plans are hardly updated (because of the huge time taken to pre-plan the entire project, and no one is assigned the responsibility of refreshing the plans; therefore, any need for change is just annotated at the margin, and results in minor adjustments).
- There is no distinction between those who make the project plans and those who execute the project plans (i.e., the overlapping roles between the controllers and the controlled can result in misleading situations and conflicts).
- Even when the distinction is clear, the ambiguous mode of communication from the project planning committee to the project executors can lead to misconceptions because the project executors have no idea or knowledge on how the plan was formulated.
- Despite the vast number of metrics that are used in measuring performance in the TPM methodology, "quite often, maybe for the sake of simplicity and cost-effectiveness," the control over projects is performed just on a substantial "go/no-go basis" (because most of the performance measurement metrics provided by the TPM methodology are difficult to use in practice.

Several methods and techniques are classified under the TPM methodology, including the waterfall methodology, critical path project management (CPM), critical chain project management (CCPM), program evaluation review technique (PERT), projects in controlled environment2 (PRINCE2), commonly used in a structured project environment where the project scope, resources, time, and risks are well understood. However, subsequent discussions in this section review the PRINCE2 and the waterfall methodologies, considering that the PRINCE 2 methodology is the approved methodology by the UK government for all the project it commissions (Siegelaub, 2020; PRINCE2, 2018; AXELOS, 2018; Matos and Lopes, 2013; The National Health Service, 2003) whilst the waterfall method is the most common form of construction project management techniques, alternatively known as traditional project management (Burger, 2016).

3.4.2 Agile Project Management (AgPM) Methodology

The Agile methodology originated in the software development industry as a new way to manage software development (Edeki, 2015). Prior to the development of the agile methodology, many software development projects were failing or taking much too long to complete, which led to the realisation of industry leaders for a new, innovative methodology in the management of software development projects. The agile methodology was introduced to minimise problems with the TPM methodologies (Ghimire and Charters, 2022). Even though there has been a bit of controversy in the field of agile as whether it is a methodology or a framework, either way, the AgPM methodology offers a fast and nimble way to manage projects and was first benefited by the software development industry before expanding its reach to other industries (Hughes, 2019).

In the last two decades, the AgPM methodology has gained considerable attention from scholars (Žužek *et al*, 2020; Conforto *et al*, 2016; Salameh, 2016; Koskela and Codinhoto, 2014; Owen *et al*, 2006), and 'agility' as a concept that incorporates the ideas of flexibility, responsiveness, adaptation, and coordination has also become widely used across various disciplines when conversing on competitiveness and improved performance in project management (Han and Bogus, 2013; Sull, 2009). However, the definition of agility in project management still remains inconsistent without much clarity (Azanha *et al*, 2017; Conforto *et al*, 2016). Therefore, before proceeding in this discussion, it is worth looking at the definitions of the term ‘agile’ or ‘agility.’

Highsmith (2004) describes the agile methodology based on five key objectives: continuous innovation, product adaptability, reduced delivery times, people and process adaptability, and reliable results. Augustine (2005) explains agility, derived from the agile methodology, as the ability to deliver value whilst attending to the inherent project unpredictability and dynamism by recognising and adapting to change. Conforto *et al* (2016) define agility as the “project team’s ability to quickly change in the project plan as a response to customer or stakeholders’ needs, market or technology demands in order to achieve better project and product performance in an innovative and dynamic project environment.” Cooper (2016) defines AgPM as “a microplanning or project management tool designed to engage a development team, including the customer, in getting to a working end product quickly.” To sum it up, Rowe (2020, p.243) defines the AgPM methodology as “a way of dealing with and ultimately succeeding in an uncertain and turbulent environment.”

Drawing on the above descriptions and definitions, the AgPM methodology can be defined as an iterative approach that promotes direct customer inclusion, adjusts to change, and develops a working product (PMI, 2017). This methodology supports projects in rapidly changing environments which are characterised by innovation, global competition, accelerated lifecycles, and customer demands (Stavru, 2014). Thus, the focus changes from managing tasks and schedules to developing the best solutions with faster delivery under conditions of continuous change. The AgPM methodology was developed on the premise that everything about a project is uncertain (Nerur *et al*, 2005), and the ability of this methodology to respond to change has resulted in a widespread interest in the agile methodology (Dingsøyr *et al*, 2012). Furthermore, based on its contribution to rapid development and adaptive systems (Rasnacis and Berzisa, 2017; Nerur *et al*, 2005), the AgPM methodology has transcended to projects outside the confines of the software domain to marketing, management, or engineering (Conforto and Amaral, 2016; Pope-Ruark, 2015).

This methodology reduces, or in the very least manages (minimises) complexities in projects (Sohi *et al*, 2016). Furthermore, studies have revealed that the AgPM methodology has a positive impact on project efficiency and stakeholder satisfaction (Serrador and Pinto, 2015). Based on the above, it is important to note that the agile development team members are not just quick and flexible for the sake of it. Rather, the focus is on the fact that the reason for any project is the development of working deliverables and value addition (Hunt, 2006). Therefore, the complete definition of agility with respect to AgPM is hinged on the fact that agility should be thought of as the project team members' interactions, their performance, their collaborations and flexibility rather than a methodology, and that the core elements of agility are continuous customers involvement and the flexibility of the project plan with respect to the project's changing requirement (Conforto *et al,* 2016). In addition, even though the AgPM methodology has appeared under several different names and with different definitions, its emphasis has been on its distinction to the TPM methodology (Azanha *et al,* 2017). Also, while almost the same idea and approach behind AgPM can be found under the names, such as lean approach, extreme approach, and adaptive approach (Špundak, 2014), the term 'agile' is sometimes mistaken for 'lean.' The basis for lean in project management is to manufacture products that are fit for purpose without wastage and delays (Aziz and Hafez, 2013) whereas AgPM was developed in response to the complexity caused by change in project life cycle (Sanchez and Nagi, 2001, cited in Owen *et al*, 2006).

In the AgPM methodology, basic project outcomes are defined, preliminary goals are established while the project deliverables are constantly revisited and further refined using adaptive processes (Gemino *et al*, 2020). This is possible because the AgPM methodology is designed to deliver value iteratively and incrementally to the customers (Žužek *et al*, 2020) as a result of collaborations between the self-organising and cross functional project teams (Rowe, 2020). Furthermore, the AgPM methodology allows the distribution of project responsibilities between the project team and stakeholders, ensuring collaboration, in both formal and informal communications around the project (Drury-Grogan, 2014; Haas, 2007; Aguanno, 2004; Highsmith and Cockburn, 2001).

Another vital feature of the AgPM methodology is its adaptability to changes during the project life cycle and to different project environments. Since change is inevitable in a project, the AgPM methodology does not believe in the possibility of pre-planning all the details as with the TPM methodology without effecting some changes in the later stages. Hence, it embraces adaptability even more than predictability (DeCarlo, 2004). The Agile Manifesto (a document that sets out the key values and principles behind the agile philosophy) helps project development teams work more efficiently and sustainably whilst using the AgPM methodology. Hence, the following section briefly consider the agile manifesto, its values, and principles.

3.4.2.1 Agile Manifesto: Values and Principles

Generally, any good movement has a manifesto which is a public declaration of the movement's policy and intention (Hughes, 2019). There have been manifestos for art movements, political movements, and just about anything you can think of. Likewise, in accordance with project management is the Agile Manifesto. This manifesto provides core values for the agile methodology. It states thus: "We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- individuals and interactions over processes and tools
- working software over comprehensive documentation
- customer collaboration over contract negotiation
- responding to change over following a plan

That is, while there is value in the items on the right, we value the items on the left more" (Agile Alliance, 2001, p.1). Although the agile values focus on software development projects, its principles are applicable to other types of projects. Accordingly, Tarne (2007) interprets the agile values for a typical project as follows:

- The project team members and their relationship outweigh the processes and tools they choose in executing a project.
- The project team should concentrate more on the project deliverables than focusing on robust documentation.
- Clients should be involved in every step of the project rather than just agreeing to a compromise.
- Since the project and its deliverables is expected to evolve, creating and following an effective project plan is not feasible. Hence, the project team should respond to adaptive changes as they unfold.

The AgPM methodology consists of 12 principles which help in developing the agile mindset of a project team. These principles state thus:

1. Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2. Welcome changing requirements, even late in development. Agile processes harness change for the customer's competitive advantage.
3. Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4. Businesspeople and developers work together daily throughout the project.
5. Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done.
6. The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
7. Working software is the primary measure of progress.
8. Agile processes promote sustainable development. The sponsors, developers, and users should be able to maintain a constant pace indefinitely.
9. Continuous attention to technical excellence and good design enhances agility.
10. Simplicity - the art of maximising the amount of work not done - is essential.
11. The best architectures, requirements, and designs emerge from self-organising teams.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behaviour accordingly.

3.4.2.2 AgPM Processes

AgPM follows the software developmental life cycle which includes requirements gathering, analysis, design, coding, testing, and followed by partial delivery while waiting for feedback from the customer (Sharma *et al*, 2012). Therefore, continuous improvement is ongoing in every stage of the project. Throughout the agile process, customer satisfaction is prioritised, followed by the speed in developmental time (Akanksha *et al*, 2013). The agile processes consist of many iterative and incremental developmental processes (Figure *3-6*) that enable adaptive planning, iterative development, constant evaluation of short-term deliverables/ subsequently fine-tuning to fit users/stakeholders' desire and lessons learnt in the process (Bergmann and Karwowski, 2019; Sharma *et al*, 2012).

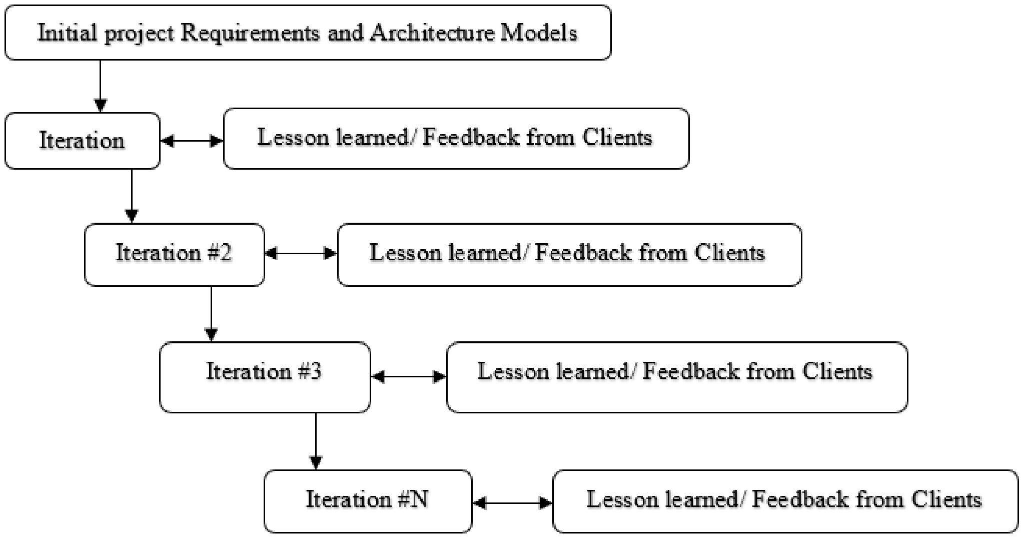

Figure 3-6: Agile processes

Agile processes may potentially be the most important advancement in innovation in the past decades (de Borba *et al*, 2019; Cooper 2016), considering that the rigidity of the TPM methodology seems to weaken the management of innovative ideas in project management (Lichtenthaler, 2020). Accordingly, Pisano (2019) asserts that structured approaches like the TPM methodology would usually prescribe a detailed sequence of steps and activities. However, if the right steps "cannot be predicted in advance, creative synthesis demands a fluid innovation process rather than the more structured processes that have become popular over the past decade" (Pisano 2019, p. 142). Therefore, the goal of the agile iterative processes is majorly to satisfy the customer, with faster development times and lower defects rate (Sharma *et al*, 2012). The next discussions briefly elucidate the characteristics of the AgPM methodology, thereby further elaborating on the processes of the AgPM methodology.

3.4.2.3 Characteristics of The AgPM Methodology

One distinguishing characteristic of the agile processes is that it requires less planning at the initial stage of the project, considering that the project is planned and delivered iteratively, and tasks are divided into small incremental processes (Akanksha *et al*, 2013; Sharma *et al*, 2012). Besides, agile projects follow the software developmental life cycle (Figure 3.10), wherein changes and new features can be added easily by using multiple iterations based on the needs of the customer. Akanksha *et al* (2013) as well as Sharma *et al* (2012) summarise the characteristics of agile processes as follows:

Iterative/Incremental: The major goal of the agile software processes is customers satisfaction; therefore, the agile methodology focuses on single requirement of a project at a time with multiple iterations. These small releases (increments) in the agile processes are delivered on a schedule based on iterations that continue for a specified period, say, between one and four weeks each. Therefore, plans, requirements, design, code, and tests are created initially and updated incrementally as needed to adapt to project changes.

Modularity: Modularity is a very crucial element of any good process (Pahuja, 2014). Modularity is the element of the AgPM methodology that allows components of a project to be broken down into manageable iterations known as modules (activities) (Nissa, 2021). Consequently, it enables the project team to envision and manage change easily since it breaks down a project into components that contain functionalities that are independent and interchangeable.

Time Boxing: In an agile project environment, time box refers to a set duration of time an iteration or activity lasts (Stellman and Greene, 2014; Sutherland, 2014). Based on the iterative nature of agile processes, time box is required for each module with respect to the project life cycle. In a typical software project, time box for an iteration would usually last two weeks to enable the development team members to complete the user stories they are assigned. Meanwhile, time box for a non-software project refers to any set duration of time to complete some activity (Hulshult and Krehbiel, 2019).

Parsimony: Due to the iterative nature of agile processes, parsimony involves a gradual formation of the systems, wherein each increment is independent on others, and eventually all increments are fused into the whole system (Akanksha *et al*, 2013; Sharma *et al*, 2012). In agile processes, parsimony is provided by a minimum number of modules to moderate project risks and achieve the desired goals (Parul and Singh, 2016). In addition, parsimony in the development process of a project enables the reduction of all unnecessary activities (Ehlers, 2011).

Adaptive: Due to the iterative nature of agile processes, new risks in the project life cycle are likely to occur. Therefore, the adaptive nature of agile processes tolerates adapting the processes to accommodate the new risks, and consequently allowing changes in the real time requirements (Akanksha *et al*, 2013; Sharma *et al*, 2012). This equips the project team in dealing with the higher chances of unknown risks they may be exposed to (Nissa, 2021).

Convergence: The AgPM methodology takes on a convergent (and incremental) approach to minimise the risks in a project (Ehlers, 2011). That means the risks associated with each increment in the agile processes are converged by means of its iterative and incremental approach. Oliveira (2021) notes that convergence in the AgPM methodology is not about implementing an extensive methodology but all about the context of the team members, their values, and practices.

Collaborative: The agile processes enable a very practical approach for communication that is face-to-face whether it is with the customer or with the team members (Nissa, 2021). Since the processes in an agile methodology are modular in nature, good communication is required amongst the software development team, and it plays an important role in the success of the project (Akanksha *et al*, 2013; Sharma *et al*, 2012). Hence, different modules in the development process are integrated at the end of the software development process.

People Oriented: The AgPM methodology is known for its priority towards the people over process and technological tools (Nissa, 2021). Studies have also demonstrated that the people aspect is crucial to the implementation of agile methodology in project management (Todorović *et al*, 2018). The AgPM methodology emphasises that no process will ever make up the skill of the development team, and therefore, believes that the role of a process is to support the development people in their work.

3.4.2.4 Phases of the AgPM Methodology

The phases of the AgPM methodology are really no different from those of any other project as the project manager must still define and initiate the project, plan for the project, execute the plan, monitor, and control the project deliverables. However, the approach to accomplishing these phases in the AgPM methodology is slightly different and requires the project manager to substitute what they know about the TPM methodology to a new way of thinking (CC Pace, 2011). Generally, the AgPM methodology consists of five phases: envision, speculate, explore, adapt, and close, see Figure *3-7* (Sakikhales and Stravoravdis, 2017). Nonetheless, different names and terminologies have been used in describing the phases of AgPM. For example, Gustavsson (2011) terms these phases as feasibility study, planning, implementation, handing-over, and closing. All the phases in an agile project are shaped according to the product's life cycle stage to add value to the success of the project (Altunel *et al*, 2017). These phases of AgPM methodology can also be seen in projects that are not agile, with differences only in the way they are executed. For the purpose of this study, envision, speculate, explore, adapt, and close phases are considered and discussed in the following sub-sections.

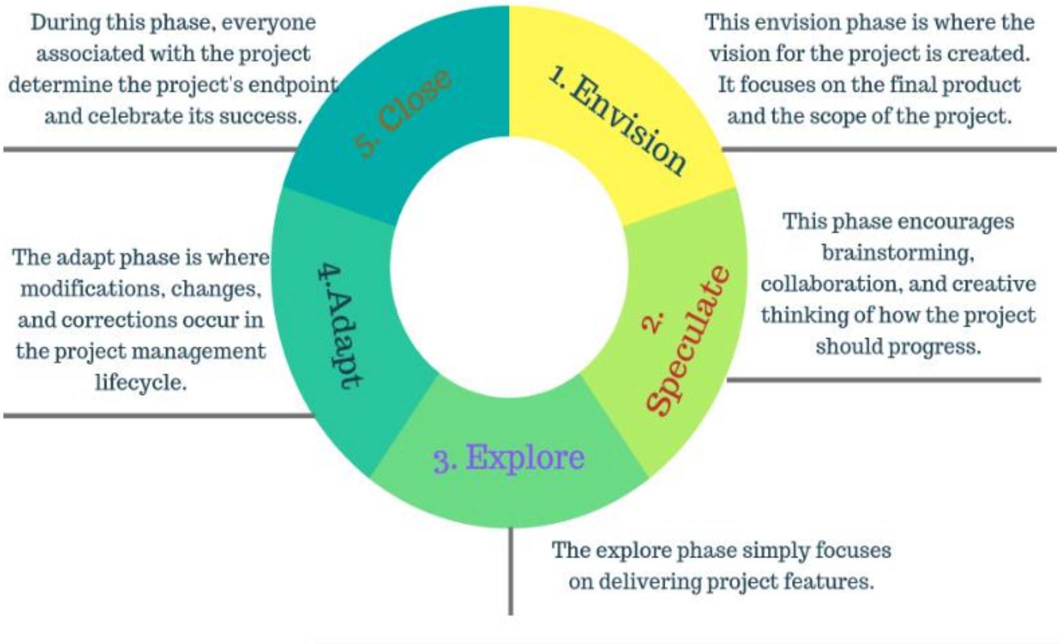

Figure 3-7: Phases of agile project management
Source: ProofHub (2021)

3.4.2.4.1 Envision

This is the first phase of agile project management, and it corresponds to the initiation phase of the TPM methodology. As the name suggests, this phase is designed to create a vision for the project. The project team and the clients collaborate at this phase to brainstorm as well as outline the scope and overall vision of the project (Parziale, 2017). According to Gustavsson 2011, this first phase of an agile project covers three important steps: 1. A detailed stakeholder analysis. This step is carried out to map out the 'whos' in different organisations that would be able to answer different kinds of questions with respect to the project (Yllén, 2012). At this step, stakeholder analysis focuses more on communication rather than heavy documentation as with the TPM methodology. 2. Establishment of a visually and distinctive documentation for the visions of the project with explanations. Details of this documentation also include the project scope, time frame, and budget. Generally, documentation in an agile project is as short as possible, with all the project specifics preferably, consisting of both texts and pictures (Yllén, 2012). 3. A communication plan is developed to establish the mode and terms of communication (Gustavsson, 2011). To fulfil and establish the first value of the Agile Manifesto (communication over documentation), there is need to establish some ground rules on how the project information should be transferred. Hence, key proficiencies needed for the project are outlined, goals and objectives detailed, and participants and stakeholders identified (Parziale, 2017). Agile project management encourages physical meetings, wherein the project stakeholders can meet face-to-face to minimise the risk of misunderstandings and to enhance continuity (Gustavsson, 2011). Simply put, the envisioning phase of agile project management covers the "what, who, and how" of the entire project.

3.4.2.4.2 Speculate

This is the phase where the project team develop a dynamic backlog of the existing workload for the project, which is then broken down into several smaller iterations (Parziale, 2017). Due to the liberal nature of AgPM, compared to TPM methodology, most traditional organisations assume the speculate phase in AgPM disregards effective project planning. Nonetheless, during the speculate phase, the project team leader helps in creating a timeline for project deliverables, which incorporates risk mitigation plans and an estimation of the project cost (Parziale, 2017). Every project, whether traditional or agile, needs to be planned (Yllén, 2012). However, the bone of contention is how far into the future should the project be planned for (Gustavsson, 2011). The only difference between the TPM and AgPM planning method is the timespan. The TPM planning method details the plan for the entire project from the onset whereas the AgPM (speculate) has different levels of plans, and with each level the plans become increasingly more detailed and cover a shorter time into the future, considering also that the customers' requirements are changing.

3.4.2.4.3 Explore

The explore phase of an agile project, also known as the implementation phase, concentrates on how to completely implement the features for every defined iteration (Parziale, 2017). Every project follows a work process—how the work is carried out and the list of tools that support the process (Yllén, 2012). One of the most essential tools in an agile project is the project board (Gustavsson, 2011). The goal of the project board is to visualise the progress of the project by engaging the different activities in one of the three columns, such as: not started, started, or finished (Yllén, 2012). At the onset of every project cycle, all the project's activities are placed under the "not started" column, and every member of the project team then prioritises the project activities and moves them to the "started" column (Gustavsson, 2011). The use of project boards can be expanded to include, for instance, red 'post-its' to explain why an activity has not been completed, in the case where an activity encounters problem (Yllén, 2012). Also, another column may be included in the activities of the explore phase of an agile project, which is the "ready for testing" column. This fourth column specifies the activities that are completed but needs to be reviewed or tested (Yllén, 2012).

Every day, the team members meet averagely for about fifteen minutes to discuss what they plan to achieve and what they need to meet their objectives (Parziale, 2017). The origin of these agile meetings is from the Scrum methodology (Gustavsson, 2011), and it is within this methodology that practices, such as the stand-up meetings, daily scrum are originated. In an agile meeting, three questions are meant to be answered. These include: 1. What has been accomplished since the last meeting? 2. What will be done before the next meeting? 3. What obstacles are in the way? (Schwaber and Sutherland, 2011, pp.10). Furthermore, another meeting, known as the review meeting, which is between 30 to 60 minutes, is held at the end of each cycle, where the team presents result of a specific activity that is completed in the meeting (Yllén, 2012).

3.4.2.4.4 Adapt

The adapt phase of an agile project is perhaps the most distinguishing phase, wherein developers compare results from project features delineated in the explore phase with the plans originally defined during speculate phase (Parziale, 2017). This phase, most importantly, presents an avenue for the clients to provide feedback on the product as well as provide valuable suggestions that can improve the functionality of the product. Therefore, the ability of an agile project to adapt to different project situations enables the project team to be prepared for anything that gets thrown at them. Also, the adapt phase is the time the project team determines if the project went according to plan or required some form of modification to meet performance expectations (Parziale, 2017).

3.4.2.4.5 Close

The closure phase of an agile project happens after all the project iterations are completed (Parziale, 2017). Gustavsson (2011) explains that the handing-over and closure phase of an agile project is not dissimilar to the traditional methodology. The only difference is that in an agile project, results are constantly delivered in parts, reviewed, and approved whereas with the traditional methodology, handing-over and closure phase of the project is more complicated because all of the project deliverables from the start to the finish of the project are presented at once (Yllén, 2012), thus giving room for flaws in this phase due to the cumbersomeness of number of results delivered at once since feedback is critical at this phase. Furthermore, the project team at this phase collaborates to compile lessons learnt throughout the project, that can be carried on to future projects (Parziale, 2017).

3.4.2.4.6 Weaknesses (Limitations) of the AgPM Methodology

Even though the AgPM methodology has been accepted by the software and other industries, it cannot be overruled that the AgPM methodology also has some weaknesses. In fact, studies have revealed that some of the key strengths of the AgPM methodology also constitute its weaknesses. For example, Hassanein and Hassanien, 2020; Tarwani and Chug, 2016; Flora and Chande, 2014; Sharma *et al*, 2012 believe that the active participation (collaboration) with the customer (client) throughout the development life cycle of an agile process can lead to a major weakness. Although some proponents of the AgPM methodology consider this as a merit, in reality it may become a weakness in some circumstances where the customer might not find enough time to spend with developers, or if the key customer is one of the high-level managers (Mohammad and Alwada'n, 2013). Also, change management might sometimes constitute another major limitation with the AgPM methodology. The application is not simple because it is a change in the change; change in the AgPM methodology is usually accompanied by processes of change, and therefore it is necessary to combine technological change with a management change (Isetta and Sampietro, 2018). Furthermore, Tarwani and Chug (2016) notes that since requirements can be added at any time in the AgPM methodology, this sometimes would lead to a never-ending project.

Another limitation with the AgPM methodology is that it requires strong and heavy teammates for a successful application, thus also increasing the need for management overhead and a great responsibility on the project manager's shoulders to remain vigilant in a dynamic perspective (Sohail *et al*, 2021). Furthermore, project team members are expected to be co-located throughout a project life cycle due to the need for face-to-face communication as well as daily and weekly meetings, and human interactions have a critical role in the success of such processes. However, this principle of AgPM can get difficult as it is sometimes not possible for the project teams that work on different projects, and are far away from each other, to come together and work at the same physical location, thereby making coordination difficult (Tarwani and Chug, 2016; Mohammad and Alwada'n, 2013; Shahir *et al*, 2008).

Insufficient and unclear requirements within the AgPM methodology constitutes another weakness of the AgPM methodology. Agile requirements are usually insufficient and unclear at the start of a project since requirements are clarified and specified during the development phase just in time and documented in much less detail due to the timeliness of conversations (Flora and Chande, 2014). This provides limited information to new starters in a project team about product features and how they should work. Besides, the frequent delivery, due to short iteration of the AgPM methodology, can be quite time consuming even though it helps drastically to ensure a quality product that meets user expectations.

McCormick (2012) also adds that if the project is smaller in nature, then adopting the AgPM methodology is certainly profitable, but in the case of a large project, it becomes increasingly difficult to reckon the efforts and time required for the project development life cycle. Also, since the requirements are prone to change, the chances of the project going off the track easily become high. Lynn (2021) also adds that poor resource planning could be another demerit of the AgPM methodology due to the challenge in predicting the efforts like cost, time, and resources required at the beginning of a project (and this challenge becomes even more pronounced as projects get bigger and more complex). Finally, Kurup *et al* (2015) suggest that inefficient customer feedback process seems to constitute another major weakness since this methodology thrives on a feedback process, then it should also be required of the team to know who the real customers are (business/user groups), who are usually represented (in some cases) by product manager. Table 3-12 summarises some of the limitations associated with the AgPM methodology.

Table 3-12: Limitations of the AgPM Methodology

S/N	Limitations	Implication	References
1	User involvement	• Active participation of the customer or user throughout the development life cycle can lead to major weaknesses. • Sometimes customers do not have the time to interact.	Hassanein and Hassanien (2020); Tarwani Chug (2016); Mohammad and Alwada'n, (2013); Flora and Chande (2014); Pandya *et al* (2014); Sharma *et al* (2012); Shahir *et al* (2008).
2	Small teams	• Can sometimes make it challenging to complete large projects.	Tarwani Chug (2016); Flora and Chande (2014); McCormick (2012)
3	Co-located team	• Team members need to be at the same location throughout their work, but this can get difficult as it is not possible for those teams that work on the different projects, and are far away from each other, to come together and work at the same physical location, thus making coordination difficult.	Tarwani Chug (2016); Flora and Chande (2014); Mohammad and Alwada'n, (2013); Shahir *et al* (2008)
4	Changing Requirements	• Could lead to a never-ending project	Lynn (2021); Isetta and Sampietro (2018); Tarwani Chug (2016); Flora and Chande (2014); Pandya *et al* (2014); Shahir *et al* (2008)
5	Frequent testing	• It requires the testers to be at the same place during the lifespan of the project development, which would unnecessarily increase the resources of the project and increase the overall cost. • This can also be time consuming.	Sohail *et al* (2021); Tarwani Chug (2016); Flora and Chande (2014)

6	Lack of long-term planning	▪ This will result in problems when several components of the project are assembled.	Mohammad and Alwada'n, (2013)
7	Weak documentation	▪ Since this methodology is based on a verbal communication with customers, there is the issue of weak documentation.	Lynn (2021); Flora and Chande (2014); Pandya *et al* (2014); Mohammad and Alwada'n, (2013); Sharma *et al* (2012); Shahir *et al* (2008)
8	Face-to-face communication	▪ Since the prevalent type of interaction in this methodology is face-to-face, lack of models and documented design leads to insufficient references in case disagreements occur or a state of oblivion develops.	Kurup and Sidhardhan (2015); Shahir *et al* (2008)
9	Frequent delivery (iteration)	▪ This can be time consuming but helps drastically to ensure a quality product that meets user expectations.	Lynn (2021); Flora and Chande (2014)
10	Time consuming and wastage of resources	▪ This occurs due to constant changing requirements.	Sharma *et al* (2012).

3.4.3 Comparison of TPM and AgPM Methodologies

Over the years, the TPM methodology has been heavily criticised due to some of its limitations, including linearity of its approach, its rigidity in changing requirements, highly formal processes irrespective of the size of the project, and assumption that projects are foreseeable with clearly defined boundaries (Marle and Vidal, 2016; Salameh, 2014; Awad, 2005; Klien *et al*, 1997). Studies have also presented comparisons between the TPM and AgPM methodologies (e.g., Ahimbisibwe *et al*, 2017; Wysocki, 2011; Highsmith, 2010; Boehm and Turner, 2003; Charvat, 2003), and suggested that the TPM methodology is suitable for managing less complex projects whilst the AgPM methodology can be used for more complex projects where requirements are expected to change as described in Figure *3-8*.

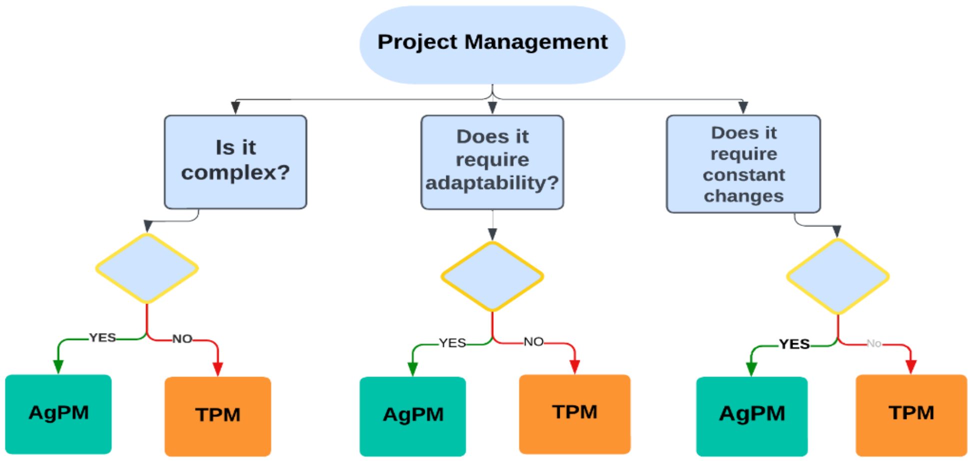

Figure 3-8: Comparison between TPM and AgPM

One of the rationales of the TPM methodology is that project requirements are clearly spelt out at the initial stage, with little changes allowed, thus, making it prescriptive and heavy weight in nature (Sheffield and Lemétayer, 2013). In a study that involved 10,000 project managers, Wysocki (2009) reports that less than 20 percent of all projects fits into the TPM methodology. Besides, statistics shows that from the year 2015 to 2018, software developers worldwide have adopted the AgPM methodology and continuous integration (CI) practices, and as of early 2018, 91 percent of respondents indicated their organisations had adopted an agile development methodology (Statista, 2022). Notwithstanding, project managers in the UK construction industry have continued to adopt the TPM methodology irrespective of the characteristics and peculiarities of the projects.

The AgPM methodology responds to the dynamic aspects of the project environment (Ahimbisibwe *et al*, 2017) and is more suitable for complex projects due to its flexibility and short iterations that allow the project team to respond better to complex project structures. Furthermore, several studies have revealed that the AgPM methodology can enhance customers satisfaction, with less rates of defective projects and quicker developmental time to the rapidly changing project requirements (Vinekar *et al*, 2006). This is majorly because of the AgPM methodology's high propensity for changes and feedback, coupled with the customers involvement and consequently enabling error detection at every stage whilst minimising defective project deliverables, thereby reducing waste.

Over the years, the AgPM has gained approval as a new and modern methodology (Madanian *et al*, 2021; Ruk *et al*, 2019; Setor and Joseph, 2019; Salameh, 2014; Stare, 2013). Unlike the TPM methodology, the AgPM methodology is based on iterative (or adaptive) life cycle, and it is developed to accept change (Wysocki, 2011; Cohn, 2011). AgPM is value driven and makes use of tacit knowledge in place of heavy documentation (Ramesh *et al*, 2012). Also, major advanced planning process (as with the TPM methodology) is replaced by an iterative and adaptive series of just-in-time tasks, which is executed only when needed (Ahimbisibwe *et al*, 2017). Thus, creating room for flexibility and adaptability, whilst allowing the project team to cope with change requests. Table 3-13 presents a summary of the comparison between the TPM and AgPM methodologies, with their strengths and weaknesses identified in green and yellow respectively.

Table 3-13: Comparison between TPM and AgPM methodologies

Methodology	**TPM**	**AgPM**
Processes	Heavyweight. Hence, it is plan driven, linear, and predictive.	Lightweight. Non-linear, adaptive, and incremental in nature. Hence, plans are made throughout the project life cycle.
Team composition	Big teams with strictly defined rules.	Rather small than big teams. Co-located rather than distributed
Documentation	Well-documented prior to any developmental process. Every process must be documented.	Little or no documentation. Focused on tacit knowledge – sharing between the team
Workflow	TPM follows a rigid sequence of the pre-planned phases which cannot be violated.	Mutual interactivity and dependence on phases – design, implementation, and testing, which must be competitive and iterative.
Requirement	Requirements are identified during the planning phase, and they are rarely revisited.	Pays special attention to the process of defining the user's requirements
Knowledge transfer	Requires documentation which must be carried out once a developmental phase is completed.	AgPM allows knowledge transfer between the project team and stakeholders. Therefore, frequent communication with the stakeholders is encouraged.
Change management	The level of change allowed in this methodology is controlled and minimised. Thus, change is controlled or avoided.	Change management is an important skill in AgPM as changes are necessary for any project's success. Hence, AgPM embraces change.

Approach to risks	Reactive	Proactive adaptation
Planning and monitoring	The use of Gantt chart which indicates the project start and finish dates, including all the activities involved. Hence, it is process centric.	Creates a task list at the beginning, which is permanently kept during the developmental stages of the project to control the quality of the project deliverables. People centric.
Nature of planning	Sequential and comprehensive	Delayed decision on planning
Communication	Formal	Informal
Project cycle	Guided by tasks and activities	Guided by product features
Development model	Life cycle model (waterfall, spiral or some variation	The evolutionary-delivery model
Management style	Command and control	Leadership and collaboration
Management structure	Close and hierarchical	Flat and team-based
Customer's role	Important	Critical
Attitude to customer involvement	Irritating obstruction	Key to organizational leaning
Desired organisational structure	Mechanistic (bureaucratic with high formalisation)	Organic (flexible and participative, encouraging cooperative social action)

(Source: Fertalj and Katiü, 2008; Tumbas and Matković, 2006)

It is important to note that despite the benefits of the AgPM methodology, no methodology is perfect and guarantees success every time (Boehm and Turner, 2004). Both the AgPM and the TPM methodologies have their strengths (highlighted in green) and weaknesses (highlighted in yellow) as indicated in the Table 3-13.

3.5 Summary

Over the years, projects have been successfully managed using the TPM methodologies. The major strength of the TPM methodology lies in creating a detailed plan and properly defining all requirements and processes before the commencement of a project. Some other strengths as highlighted by studies include good control of the project processes, clear expectations from the clients, clear responsibilities for the project team, documentation, accountability, higher profit margins, improved productivity, and better internal coordination. However, these strengths do not negate the impact of its weaknesses associated with the assumption that there is no task or goal uncertainty, and that there is controllability of actions in project management. Apart from these weaknesses, project complexities have also granted a means for the embrace of vital changes in project planning, development, and execution. In addition, the rising demand for continuous improvements, cost reduction, and flexibility in project management has necessitated the need for project managers to be equipped for uncertainties in a project environment. Thus, resulting in the introduction and embrace of new methodologies like AgPM for the development and management of projects.

Findings gathered so far have demonstrated that the AgPM methodology offers a more flexible and adaptive methodology for managing projects based on its acceptance of change as an inevitable component of project management process. The AgPM methodology also allows the possibility of uncertainties in projects by enabling the project teams to look out for any form of ambiguity in projects in order to minimise the likelihood of being affected in the later stages of the project. Furthermore, the AgPM methodology reinforces a self-organised project team, which allows flexibility. Studies have revealed that the strengths of the AgPM methodology can be appropriated in the management of construction projects.

The AgPM methodology benefits from its collaborative, integrated, and productive teams comprised of project participants guided by principles of trust, transparent processes, and open information sharing (Ozorhon *et al*, 2022). Hence, provides new opportunities for management based on the acceptance of change as an obvious element in the management of construction projects (Arefazar *et al*, 2022). Effectively managing changes in construction project is essential to the delivery of a successful project (Mohammed and Chambrelin, 2020). However, implementing an all the agile solution in the management of construction project would require a tremendous amount of initial investment. Hence, construction practitioners have persevered with the TPM methodology in the management of construction projects, with little or no integration of the AgPM methodology and its associated benefits, thus impacting on the construction projects' performance and other project elements that can benefit from the strengths of the AgPM methodology (Moriel, 2017).

Also, neither the TPM methodology nor the AgPM methodology is perfect in resolving all the issues associated with construction project management, however, integrating these two methodologies in the management of construction projects proposes to yield greater performance, maximising the benefits from both methodologies. Therefore, discussions in the next chapter will focus on the need for the integration of the TPM and AgPM methodologies for the management of UK construction projects, whilst presenting its benefits in managing construction projects.

CHAPTER 4 : INTEGRATION OF TPM AND AgPM Methodologies

4.1 Introduction

This chapter satisfies the research objective three: to evaluate the contribution of agile project management to the UK construction industry and the extent to which agile elements can improve the performance of UK construction projects, with a focus on the need for integration of the TPM and AgPM methodologies. Discussions begin with the nature of construction projects, then an overview of construction project management. This is followed by discussions on the need for the integration of TPM and AgPM methodologies, highlighting all the benefits and contributions of AgPM in managing construction projects, and supporting it with literature findings. A framework for the integration of TPM and AgPM in managing UK construction projects and its components is proposed. Finally, there is discussion on the barriers to the adoption of AgPM in the UK construction industry.

4.2 The Nature of Construction Projects

Construction projects are at the core of the UK construction industry and are typically defined by a contract, uniqueness of tasks, a specific organization, an estimated budget, and a given construction period (Brockmann and Kähkönen, 2010). Construction projects are dynamic in nature and appears to be a system where their complexity is interlinked to uncertainty of different actors and factors forming the actual system (Shafiei et *al*, 2023). Over the years, scholars have widely criticised the nature of construction projects including Latham (1994) and Egan (1998), and have described it in the following ways:

- Complexity: due to the complex nature of construction projects, a multitude of risks relevant to different stakeholders are also involved in its management (Qazi and Simsekler, 2021).
- Unique: due to the unique nature of the work in construction projects, planning, timely delivery, and performance of construction projects have always been a subject of concern (Dixit, 2020).

- Dynamic: construction projects are dynamic in nature coupled with its complicated behaviour, uncertainties, and dependencies (Bokor *et al*, 2019).
- Labour-intensive: the dynamic nature of construction work sites has made the construction industry one of most hazardous industries in the world (Bou Hatoum *et al*, 2021).
- Resource driven: construction projects requires a great deal of time and resources; hence, close management control is required for the project is to be completed within the established time and cost constraints (Sears *et al*, 2015; Nagaraju and Reddy, 2012).
- Temporary: the temporary nature of the construction project means that new resources including team members, materials, technologies and working methods are required to manage a project (Hai *et al*, 2012). Likewise, the temporary and ever-changing nature of supply chains from project to projects imposes the project team to engage in new learning curves (Riazi *et al*, 2020; Egan, 1998). Furthermore, the involvement of multi-disciplinary entities and numerous stakeholders throughout the life cycle of construction projects, coupled with affiliation of all participants sometimes leads to fragmentation (Riazi *et al*, 2020).
- Risky and uncertain: due to the risky and uncertain nature of construction projects, an increased focus is given to construction projects predictability, estimation and overcoming overruns and delays. Hence, new techniques and procurement strategies are developed to enable construction project managers to contractually complete projects within cost and time constraints (Issa et al, 2019).

The main aim of any construction project manager is to deliver full satisfaction for a viable project in terms of its functionality and budget, regardless of its complexities. Therefore, the degree of or the identified nature of a construction project usually serves as an important criterion in classifying the anticipated challenges in its management. Consequently, the management of construction projects as a complex endeavour requires knowledge in different areas, including finance, business, law, mediation, and more (Kukhnavets, 2019). The following sections will discuss briefly on construction project management and the need to integrate the traditional and agile methodologies for the management of UK construction projects.

4.3 Construction Project Management

In the management of construction project, various delivery method can be used to execute a project. Regardless of the variabilities in the delivery methods, one party assumes responsibility for the management of the project (Sears *et al*, 2015). On account of the increasing complexities and uncertainties, construction project management has become more challenging (Hasan *et al*, 2021). Hence, the management of construction project is carried out on an individual basis with the project manager responsible for all aspects of the project.

The UK construction industry has been under pressure to improve performance, efficiency, infrastructure value, and sustainability as well as to reduce cost via effective alliance and communication with stakeholders (Arayici and Aouad, 2010). Pierce (2013) opines that the pressure on the industry is due to the equivocal perception that construction project management procedures and documentations are not in fact requisite since a project manager can effectively manage a project without all the bureaucracy involved. Also, the recurrence of project failures in the industry is sadly another reason the traditional construction management methodologies are deemed ineffective since they cannot effectively cater for the complexities of today's construction projects (Mokhtariani *et al*, 2017; Sears *et al*, 2015; Pierce, 2013).

Various approaches and standards for the delivery and management of construction projects have emerged. However, the outcomes has not always produced the best value for clients (Fewings, 2012) due to the diversity and complexity of construction projects and the intricacy in the management process (Sears *et al*, 2015). Even though construction a project differs significantly from other projects, its life cycle follows a similar pattern (Fewings, 2012). In exploring all the processes that occur in each phase of a construction project, beginning from the client's idea, to cost estimation, through to the designs and drawings that follow, to the bidding and contracting stage, through to the physical construction processes, until the project's closure, Klinger and Susong (2006) attribute the management of construction projects to be more of an art than a science, considering that it requires specific skills to be used depending on the situation, including (and not limited to) communication and resource management, day to day scheduling, requirements analysis, design, escalation processes, implementation planning, resource fluctuations whereas the aspect of science in project management is to build a model of reality.

In theory, a typical construction project plan should be detailed and robust enough to capture all issues of delays and overruns that may arise (Glenn, 2015). However, this may not be possible, especially for large and complex construction projects (Salameh, 2014). Indeed, some construction projects contain more elaborate models with multiple phase gates and bids phases that make it difficult to fully appropriate and plan all the details at the beginning. Besides, the design phase of a construction project usually faces more uncertainties with detrimental effects due to the inability of the client to correctly produce the design briefs with partial or unclear requirements (Karantani, 2020). Thus, resulting to changes in the project design, leading to delay related consequences. Therefore, there is need for an effective management methodology that would accommodate the complexities, challenges, and changes associated with the management of construction projects. This study has also established that neither the TPM nor the AgPM is fully sufficient in resolving all the issues associated with the complexities of construction projects. Hence, the need for integration of the TPM and AgPM methodology in order to appropriate their collective strengths is discussed in the following section.

4.4 The Need for Integration of TPM and AgPM

Over the years, the manufacturing, IT, and other industries have realised drastic improvements in performance with the use of agile methodology in responding to the changing needs of their clients while reducing lead times and cost (Han and Bogus, 2013; Rao *et al*, 2011). Studies have also revealed similarities between construction and manufacturing projects, especially in managing complex operations as well as a rapidly changing market and dynamic customers' requirements (Krimi *et al,* 2017; Lim *et al*, 2012; Zozaya-Gorostiza, 2012; Vrijhoef and Koskela, 2005). Manufacturing projects deals with the processing of raw material or parts into finished goods through the use of tools, human labour, machinery, and chemical processing. Change has been the sole motivator for the adoption of the AgPM methodology since the idea was originally developed to respond to the changes in project requirements in software development projects. Likewise, in managing construction projects, change exists, and is anticipated throughout the project's life cycle since the project manager cannot effectively foresee every aspect of the project and its expected outcomes due complexities of the project (Yeganeh *et al*, 2019). Therefore, change will inevitably disrupt the planned schedules of construction projects and lead to issues, such as delays, overruns, clients' dissatisfaction, and subsequently poor performance of the project.

Scholars have attested to the effectiveness and suitability of adopting the AgPM methodology in managing construction projects (Sinha and Sinha, 2020; Jørgensen, 2019; Codreanu, 2016; Serrador and Pinto, 2015; Stavru, 2014; Conforto *et al*, 2014; Bennett and Lemoine, 2014; Špundak, 2014; Dingsøyr *et al*, 2012; Baskerville *et al*, 2011). For example, a study conducted by Karantani (2020) reveals that AgPM holds a high potential for improving the performance of construction projects due to its ability to swiftly respond to projects' changing requirements. Kumar and McArthur (2015) also report that the structure of short iterations in the AgPM methodology improves the team's productivity as well as the client's engagements throughout the project. Hence, minimal changes at the latter stages of the project is expected since the project's priorities are jointly decided between the client and project team.

Change in construction project's life cycle could be internal or external changes (Han and Bogus, 2013). Arefazar *et al* (2019) categorise these changes to include client related changes (which seem to be most common), change related to the contractors and consultants, and changes due to external factors. In addition, the change in a construction project can result from several other factors: a). shortage of materials and tools, which may be as a result of supplier's backlogs, delays in shipment, funding restrictions; b). inadequate work packages (which may be caused by unfinished or flawed design and documentation, interruptions in decision making or directives, or changing scope); c). labour shortages, which may be due to the inability to find the right trade persons, scheduling problems with vendors or contractors; d). external factors such as weather conditions and other events such as contractor claims and counterclaims (legal issues), which can affect the performance of a construction project (Glenn, 2015).

Even though the TPM methodology emphasises robustness as one of its advantages and prescribes that the same waterfall methods could be applied to projects uniformly, it is increasingly argued as one of its major disadvantages. Researchers have also stressed the fact that “one size does not fit all” in managing construction projects (Pareliya, 2018; Burgan and Burgan, 2014), particularly with respect to managing changes in the project requirements due to the complexity of construction projects. No matter how extensive the planning process may be for a construction project, changes to the initial plan is almost inevitable due to adjustments to unpredictable and dynamic changes in the project environment or within the project itself (Spundak, 2014). Therefore, in managing the complexity of construction projects and the issues emanating from its complexity, an integrated methodology is required to address and resolve the issues related to changes as well as improve the performance of construction projects (Han and Bogus, 2013).

One major challenge construction projects face, which also affects performance is uncertainty (Halamzie, 2013). The ultimate goal of the TPM methodology is optimisation and efficiency in following a detailed project plan (Wysocki, 2007; Shenhar and Dvir, 2007; DeCarlo, 2004). However, the idea behind this methodology is that projects are relatively simple, predictable, and linear with clearly defined boundaries, making it easy to plan in detail and follow that plan without deviations (Spundak, 2014). Besides, the planning process in a construction project is very extensive, and in some cases, before the actual construction project begins, the plan might need revision as a result of changes in the project environment that might affect the project scope (Streule *et al*, 2016; Cervone, 2011). These modifications and changes in project requirements, coupled with some unforeseen glitches from improperly defining the project requirements, undoubtedly results to issues leading to poor performance of the construction project (Cervone, 2011). Seeing that the process involved in managing construction projects of nowadays is far more complex than it was in the past.

This study recognises that both the TPM and AgPM methodologies have their strengths and weaknesses, making it impossible to homogeneously assert that one methodology is better than another. Some studies have claimed that the TPM methodology seems more appropriate for projects where the clients’ requirements are clear, with clear project goals and very low level of uncertainty (Matovic, 2020; Salameh, 2014; Spundak, 2014). Consequently, such projects are expected to have a very low rate of changing requirements at its later stages and may not necessitate the involvement of clients (Matovic, 2020). Therefore, in cases like these, emphasis are on planning, based on the initial plan, on predictable and linear outcomes of the project plan with goal of optimisation of project activities and efficiency in their execution (Burgan and Burgan 2014).

The AgPM methodology, on the other hand, is noted to be more suitable for innovative projects characterised by high level of uncertainty, unclear project goals or incomplete and unpredictable requests, for which it could be assumed that there would be significant changes during the course of the project (Jiménez *et al*, 2020; Fragkaki, 2016; Shenhar and Dvir, 2007; Williams, 2005; Wysocki, 2007). Hence, due to the need for constant change requests, projects within the AgPM methodology are organised in an iterative, non-linear approach, with allowance for modifications and updates of the project plan and require close and frequent collaboration with the clients (Fragkaki, 2016). Thus, enabling quick and flexible implementation of changes due to timeline constraints.

Over the years, studies have proposed ideas to improve the performance of construction projects in the UK. A good example of such initiatives is the lean construction, which was pioneered by Ballard and Howell in 1997 to develop and share information on how to improve the performance of construction projects. Also, the agile construction and the integrated project management (IPM) or integrated project delivery (IPD) was introduced, which share many core principles in common (Glenn, 2015; Halamzie, 2013). Langford and Murray (2008, p. 181) also proposed the need for agility in the construction industry, asserting thus: "we wish to emphasise that we are not inviting UK construction to look at what it does already and do it better; we are asking the industry and government to join with major clients to do it entirely differently; what we are proposing is a radical change in the way we build."

Even though some scholars still believe that construction projects are poor candidates for the AgPM methodology due to their sequential nature, coupled with the exorbitant cost of effecting changes (Glenn, 2015). However, due to the high demand for change in construction projects, and even a higher demand for construction projects to be innovative and completed rapidly (Villanova University, 2020), the AgPM methodology is gradually gaining recognition as an alternative and more efficient methodology in managing construction projects (Halamzie, 2013). For example, Zender *et al* (2020) suggests that the versatility of the AgPM methodology in construction projects would lead to:

- a reduction in construction time and more value to the customers
- flexibility for the inclusion of changes (induced by the client or by the complexity of the context in which the project is developed)
- risk control in high uncertainty scenarios and general satisfaction for all stakeholders.

John (2018) also agrees that introducing the principles of the AgPM methodology in the management of construction projects can be effective in tackling the issue of change management. Likewise, Ahmed and Mohammed (2018) opines that implementing the AgPM methodology in construction projects would result in profits effectiveness procedures and a lower duration of process, as well as ensuring value of quality planning and control inputs of the project, describing further that the major advantage of the AgPM methodology is its simplicity. However, despite the benefits highlighted by scholars that the principles and practices of AgPM have the potential to benefit the UK construction industry, its implementation has remained an apprehension for many. For instance, Owen and Koskela (2006) had to review the strength of agile manufacturing in construction before agreeing that the construction industry might as well benefit from AgPM with its proactive approach in responding to the changing needs of the clients.

Indeed, the AgPM methodology is not the holy grail in project management, and no one can guarantee that changing requirements will not suffice even at the tail-end of a project. Also, the claim for or against the implementation of the AgPM methodology in the construction industry appears to be based on subjective evidence rather than objective evaluations and evidence (see Table 4-2). Nevertheless, the integration of the strengths of TPM and the AgPM methodologies in the management of UK construction projects provides a safe way to closely monitor the progress of the project together with the clients (Karantani, 2020), owing to the AgPM's core values and principles that encourage short iterations and customers collaboration.

Contrary to the TPM methodology, the impact of the human factor, and especially communication between project team and stakeholders, is accentuated within the AgPM methodology (Boehm, 2002; Cockburn, 2000; Cockburn & Highsmith, 2001;

Coram and Bohner, 2005; Highsmith, 2004). Moreover, the core principles and practices of the AgPM methodology centre on its responsiveness, flexibility, embracing change, and a focus on delivering value to the customers (Iqbal 2015). Therefore, agility provided by the implementation of the AgPM methodology would enable construction projects to enhance transparency while addressing the changing needs of the clients (Villanova University, 2020). Furthermore, unlike the TPM methodology that focuses majorly on accuracy and precision, AgPM does not only focus on accuracy or precision but also on flexibility and adaptability in response to the needs of the clients (Arefazar, 2019).

Considering the impact of organisational structure and the culture within the UK construction industry in the introduction of a pure AgPM methodology, coupled with the apprehensiveness for change from the believers of the TPM methodology, this study focuses on developing a framework that integrates the strengths of the both the TPM and AgPM methodologies. Subsequent discussions will highlight the benefits associated with the integration of TPM and AgPM methodologies. Figure 4-1 shows a conceptual framework for AgPM in construction (taking into consideration the principles (drivers) of agility in manufacturing and how it can be applicable to construction projects).

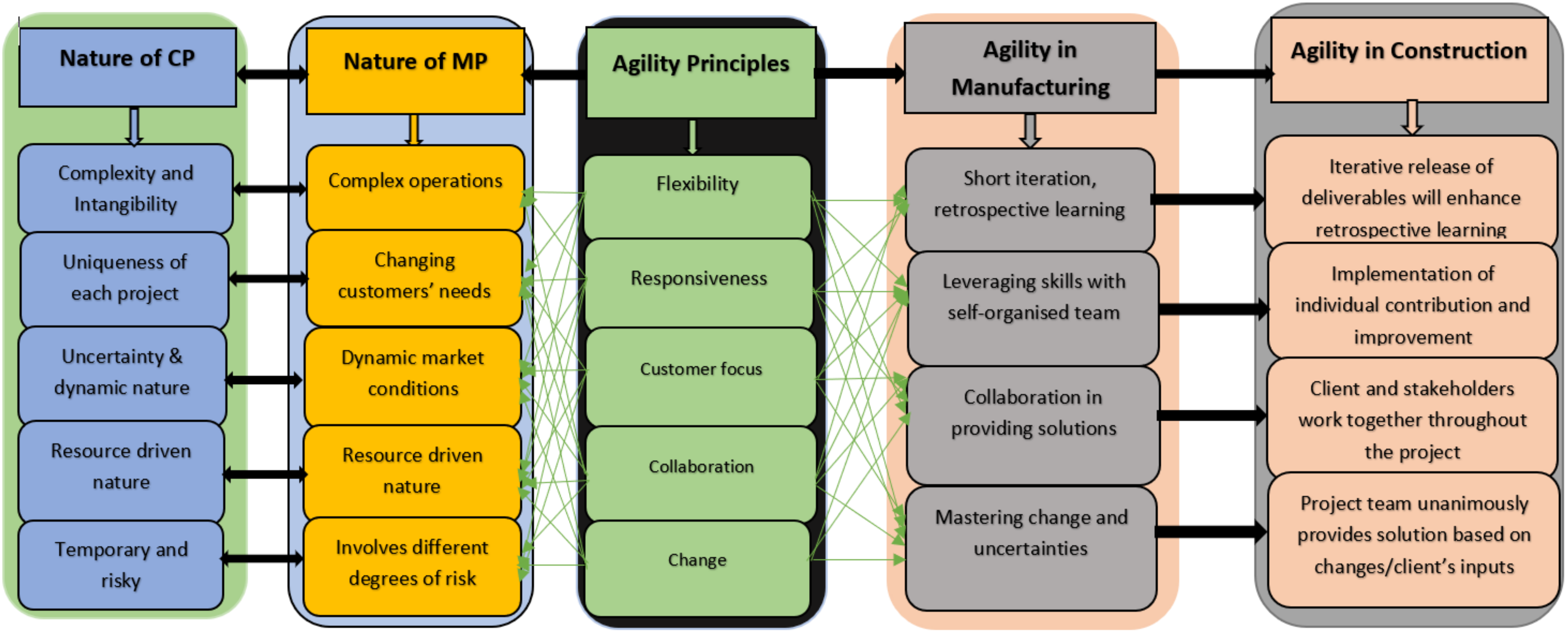

Figure 4-1: Conceptual framework for Agility in Construction
Key: CP – Construction projects
MP – Manufacturing projects

4.5 Benefits of Integrating the TPM and AgPM Methodologies

For so many years, the TPM methodology was successfully adopted in the management of construction projects. However, due to the increase in demand for innovativeness in construction projects, coupled with the changing requirements of the clients, the TPM methodology seems to have become inefficient in delivering the required solutions, hence the rising interest in the adoption of the AgPM methodology. According to Zucker (2017), integrating the AgPM methodology would enable organisations thrive in the face of fast, continuous, unanticipated changes and uncertain market conditions, while relying on its key features like flexibility, speed, leanness, learning, and responsiveness. Before elaborating further on the benefits of integrating TPM and AgPM methodologies in managing construction projects, some AgPM adoption statistics will be considered to further corroborate the benefits of integrating TPM and AgPM for the management of UK construction projects.

- VersionOne (2017) reports that the adoption of AgPM methodology has enabled the improvement in performance of about 98% of companies.
- In an exploratory study conducted by Azanha *et al* (2017), the results show that the use of AgPM yielded a 75% reduction in development time, compared to the TPM methodology, due to its potential to increase the team's motivation, enhanced clients' satisfaction, control of requirements, and higher quality of deliverables.
- Harvard Business Review (HBR) (2016) reports that 60% of organisations that adopt AgPM experiences a growth in revenue and an increase in profit.
- According to Business Wire (2012), 92% of their survey participants agrees that agile management tools improve ability to manage changing priorities; 85% notes that agile management tools improve project visibility; while 77% indicates using agile tools enhances software quality.
- According to the Standish Group (2012), AgPM methodology is three times more effective and 42% more successful compared to the TPM methodology.
- Likewise, in a study comparing the success factors of project management methodologies on a scale of -10 to 10, Scot Ambler and Associates (2010) concludes that AgPM retains higher success rates compared to the TPM

methodology because of its time/schedule, cost, functionality, and quality advantages.

- Rico *et al* (2009) also report that over 80% of global and public firms that adopt AgPM strategies on projects with high level of uncertainty and complexity attests that AgPM does not only yield measurable return on investment (ROI) but also a significantly larger ROI than TPM (Rico *et al*, 2009) as shown in Table 4-1. Findings in Table 4-1 reveal that projects managed with AgPM yield an average ROI of 1872%, which is 20 times more (Benefit/Cost Ratio of 20:1) when compared with TPM methods.

Table 4-1: ROI for project managed using APM approach

	Total Cost	Benefits	B/CR	ROI%	NPV	BEP	ROA
ISO 9001	$1,73,000	$5,69,841	3:1	229%	$3,20,423	$11,96,206	$5,03,345
CMMI®	$11,08,233	$30,23,064	3:1	173%	$15,09,424	$5,45,099	$26,33,052
SW-CMM®	$3,11,433	$30,23,064	10:1	871%	$23,06,224	$1,53,182	$28,28,802
Agile Methods	**$217,712**	**$4,292,285**	**20:1**	**1,872%**	**$3,498,958**	**$11,043**	**$4,125,209**

Source: (Rico et al, 2009).

- Maurer and Martel (2002) also agrees that agile shows productivity gains between 66 percent and 302 percent based on hard metrics.

Studies have also proposed that the AgPM methodology is suitable for the design and execution phases of construction projects, Table 4-6. For example, Mnqonywa *et al* (2018) via a systematic literature review suggest the adoption of AgPM methodology in the design stage of a construction project to enhance efficiency and transparency, thereby limiting the shortfalls associated with the design stage, noting also that the AgPM methodology would enable the team to better manage risks by continuously adapting to the changes necessitated by the project. Likewise, Streule *et al* (2016) in a case study revealed that the AgPM methodology is suitable for the design phase of a construction project with benefits, such as transparency, effective communication, collaboration, and faster development. Pareliya (2018) and John (2018) also suggest the possibility of implementing the AgPM methodology in the execution phase of a construction project, drawing strength on AgPM's ability to effectively accommodate changes in project requirements during a project's life cycle. They also noted that the execution stage of a project requires the largest workforce of people who are least trained and therefore might pose a barrier to effectively adopting AgPM. However, Mohamed and Moselhi (2019) argue that the AgPM methodology has been used successfully over the years in managing complex and time sensitive projects, especially when it comes to adapting to changes and meeting up with the project deadlines and budget constraints. Therefore, rather than considering the integration of the AgPM only during the execution stage of a project as suggested by Kibler (2019), Pareliya (2018) and John (2018), the AgPM methodology can be adopted in two ways:

- by adopting a formal agile approach, whereby the entire team learns and understands agile project management and its methodology
- by implementing changes in such a way that suits the project context (PMBOK, 2017).

Regardless of the phase in which the AgPM methodology is implemented, studies have demonstrated that the AgPM enhances the identification and analysis of the project stakeholders at the early stages in a project to map out who and who can answer all the questions relating to the project (Yllen and Johansson, 2012). Early identification of stakeholders enables the project team to develop a communication plan, establish related rules on how information can be shared, and identify related information that is meant for each person so that everyone knows exactly what to expect at the course of the project (Senouci *et al*, 2017; Gustavsson 2011). The developmental planning of the AgPM methodology requires full participation of the entire project team in planning and controlling activities of the project (Augustine, 2005; Boehm and Turner, 2004; Highsmith, 2004). Therefore, the clients/stakeholders' participation at all stages of the project life cycle enables the project team to meet the changing requirements of the project by encouraging more cooperation between suppliers and establishment of trusted relations (Ribeiro *et al*, 2010), thus enhancing the clients' satisfaction.

Furthermore, the short iterative planning and developmental cycles of the AgPM methodology also allows the team to continuously assess the quality of deliverables while collating immediate feedback from the clients, thereby enabling a learning process among the project team members, which leads to improved performance (Hass 2007). Hence, part of the project results is delivered incrementally with the use of a product break down structure (PBS) that shows the deliverables at every stage of the project, which is then reviewed and approved (Canty 2015; Hass 2007). AgPM allows flexible flow of work by means of flexible project delivery, contract, and developments of repetitive cycles, which can adapt to new project conditions (Han 2013; Yllen Johansson 2012).

AgPM enhances communication by defining the details of tasks collaboratively to avoid unfavourable changes in the plan or scope of the project (Senouci *et al,* 2017; Han 2013; Yllen Johansson, 2012). This enables the obtainment of project requirements throughout the life cycle using incremental planning, which provides the team with the latest piece of information needed, thereby enhancing changes (Owen *et al*, 2006). AgPM enables early return on investment (ROI) by delivering projects overtime to deliver business value for the clients (Arefazar *et al*, 2019), and the monitoring and evaluation process of AgPM is considered as one of the essential tasks since it enhances periodic reports of materials and working hours as well as daily measurements of productivity fluctuations (Cohn 2005; Augustine 2005; Highsmith 2004; Boehm and Turner 2004), consequently allowing the project managers know the exact resources needed to complete a task and to provide more accurate support to the project team (Han 2013). Time management in AgPM helps to avoid delays through timely deliverables as well as a consideration that time is of importance. Therefore, AgPM employs cycle planning approach, whereby more work is assigned to the team if the tasks are ahead in the current cycle while items in the task which are behind schedule are conducted in subsequent cycles (Gustavsson 2011).

Accordingly, Villanova University (2020) summarises the benefits from the adoption and integration of AgPM in the construction industry as follows:

- more attention given on the specific needs of customers
- reduced waste using minimal resources
- higher level of flexibility, thus enabling the teams to easily adapt to change
- improved control of projects
- faster project completion times
- faster uncovering of issues or defects
- enhanced collaboration and feedback
- enhanced development process
- enhanced success rates
- rapid implementation of solutions to issues.

Table 4-2: Studies on the integration of TPM and AgPM

S/N	Author	Method	Conclusion	Remark
1	Ingle (2019)	Mixed method	The adoption of scrum meetings and roles in construction can reduce time and cost. However, one major challenge with executing this idea is the apprehensiveness for change because most construction practitioners are used to the traditional (waterfall) approach and may find it difficult to switch to a new approach.	For AgPM to be applicable to construction, there should be changes in organisational culture and changes in the mindset of the project team. According to Kislik (2018), the introduction of changes in an organisation can be daunting. Therefore, one of her suggestions to aid the team's transition is adequate training. In addition, retaining the existing approach (TPM) while gradually introducing AgPM could minimise their apprehensiveness for change and aid easy transition.
2	Mohamed and Moselhi (2019)	Literature review	Construction projects managed in a waterfall approach are usually planned carefully before execution. However, despite the planning process, uncertainties cannot be avoided during the execution stage of a project. Thus, the authors propose a framework that would utilise the iterative concepts of AgPM in managing the construction phase of a projects.	AgPM approach has been used successfully over the years in managing complex and time sensitive projects, especially when it comes to adapting to changes and meeting up with the project deadlines and budget constraints. Rather than introducing AgPM only in the execution stage, PMBOK (2017) suggests AgPM adoption in two ways: 1. by adopting a formal agile approach, whereby the entire team learns and understands agile project management and its methodology 2. by implementing changes in such a way that suits the project context.
3	Kibler (2019)	Extended literature review	The author suggests that TPM approach be used for planning and scheduling the project phases while AgPM be used for execution as well as monitoring and controlling strategy.	Instead of applying TPM for planning and AgPM for execution, their integration and application in all stages of a construction project would provide the team with a broad spectrum of tools and options that can drastically reduce the cost and time of a construction project, thereby enhancing customers satisfaction.

4	Mnqonywa *et al* (2018)	systematic literature review	The authors suggest the adoption of AgPM in the design stage of a construction project to enhance efficiency and transparency, thereby limiting the shortfalls associated with the design stage. This would also enable the team to better manage risks by continuously adapting to the changes necessitated by the project.	The AgPM approach was created to suit changes associated with the entire project environment and are easily adaptable. With the rapid changes and innovations ongoing in the world of construction, it is important for the construction team to holistically integrate AgPM techniques in their processes to add value to their customers.
5	Burmistrov *et al* (2018)	Extended literature review	To become flexible to the increasing uncertainty and complexity of the buildings project, it is useful to decompose the whole large-scale project and to split it into the "project chain."	AgPM is an iterative approach to planning and guiding project processes. One advantage of AgPM, when compared to the TPM, is the use of small deliverables. This approach gives room for regular adjustments and reconciliation (changes) in the project processes, thus allowing the client's input at every stage of the project.
6	Pareliya (2018)	Mixed research method	The author suggests the possibility of implementing AgPM in the execution phase of a construction project, drawing strength on AgPM's ability to effectively accommodate changes in project requirements during a project's life cycle, but notes that the execution stage of a project requires the largest workforce of people who are least trained and therefore might pose a barrier to effectively adopting AgPM.	A change in the organisational culture is very crucial. It is high time top management embraced the fact that 'one size does not fit all' in managing construction projects and imbibe new methods/approaches. Also, construction practitioners need to constantly improve on their skills by acquiring new skills as the world is evolving and new technologies are taking over.
7	John (2018)	Unstructured interview and data collection method	He suggests that AgPM can alleviate the issues associated with construction such as time-cost overruns in the execution phase of a construction project. Since AgPM encourages collaboration with clients, it would reduce the need for changes in project requirements as the clients would be closely involved throughout the project stages.	Despite constant development in the construction industry, projects are still plagued with time-cost overrun during the execution phase of a project. The introduction of agile project management (or change management) in the execution phase of a construction project would improve performance in the execution phase. However, the benefits of AgPM can be applied to all other phases of a construction project.

8	Rasnacis and Berzisa (2017).	Case study	The implementation of AgPM can be likened to the improvement of a development process, which implies less bugs, faster deliver, effective ways of communication, better quality, better risk analysis, and less cost. However, findings reveal several challenges associated with this idea, especially with the team.	Team preparation is very important before implementation of AgPM. Instead of introducing a drastic change, Gustavsson (2016) and McBreen (2002) suggest dropping some parts of TPM, changing some parts, and introducing the best practices of AgPM
9	Streule *et al* (2016)	Case study	The findings from this study show that scrum (agile method) can be effectively implemented in the design stage of a construction project. However, one major setback they experienced was the lack of knowledge on scrum roles and duties although the team overcame that setback overtime and was able to effectively implement scrum with great results.	Some of the benefits of implementing scrum practices in the design stage include transparency, effective communication, collaboration, ease of flow of information, faster development, etc. Overall, the only disadvantage associated with the implementation of scrum was the lack of knowledge as regards scrum. Hence, they did not fully understand their duties and roles at the start of the project, so more time was needed.
10	Spalek (2016)	Literature review and questionnaire-based survey.	Traditional approaches seem ineffective in resolving project challenges, hence the need for agile project management approach. However, there are limitations in the application of agile approaches.	The major limitation to the adoption of AgPM in construction is the inability to change the organisational culture, which has lowered its level of adoption while projects continue to underperform (Padalkar *et al*, 2016; Boehm, 2002).
11	Serrador and Pinto (2015)	Large-scale empirical data analysis	AgPM has a positive impact on all dimensions of project success. Further research is suggested.	Since AgPM has significant impact on all dimensions of construction projects' success, how can it be introduced and made acceptable in the construction industry?
12	Špundak (2014)	Extended literature review	Both the traditional and agile methods have their advantages and disadvantages when compared to different project characteristics. Therefore, when integrating, approach selection should be handled with care, considering the organisation and the project characteristics.	There is need to create a unique, customisable approach based on the integration of TPM and AgPM.

13	Papadopoulos (2014)	Case study	Since TPM approaches are not flexible and fail to respond to aggressive customer needs, adopting AgPM framework on large, distributed projects would improve project quality by allowing requirement changes throughout the project. Also, it would enhance satisfaction of both the client and project team.	Adopting a new method might not be easy. Therefore, careful planning and training should be done before the adoption process to avoid issues.
14	Ribeiro and Fernandes (2010)	Interpretative case study and grounded theory	The construction industry is organisationally complex, highly fragmented, and generally faced with the challenge of thriving in a competitive environment.	How do we break through these hurdles (the organisational culture, the mindset of the team, etc.)?
15	Owen *et al* (2006)	Extended literature review	AgPM does indeed offer significant improvements to the construction industry. However, further research should explore the underlying rationales so that AgPM can be better understood. Such rationales include the manner with which agile deals with emerging requirements and how individuals are better motivationally organised to produce value.	The contemporary construction industry and its sub-contractual risk avoidance practices is a powerful preventive factor to the successful adoption of AgPM.
16	Owen and Koskela (2006b)	Extended literature review	Adopting the concept of AgPM requires the construction industry to focus on a long-term outlook for learning.	The concept of continuous learning and personal advancement must become a fundamental operating concept within organisations at every level and throughout every project and business process.

Despite the benefits associated with the integration and adoption of AgPM in the construction industry (Table 4-2), especially in improving the overall client relationship by creating better communications and collaborations, there are questions that still linger: Has AgPM really made impact in construction? Has it changed the organisational culture and behaviour of the industry? Have the claimed benefits of AgPM been realised yet? Are partnerships, integrated development teams and excellence in project planning agile or just a good modern practice? In fact, the PMI's Pulse of the Profession Report (2016) suggests that most organisations are twice as likely to still adopt the TPM methodology rather than the AgPM due to several inhibiting factors (Zucker, 2017). Therefore, the next section will discuss and evaluate the barriers that hinders the adoption and integration of AgPM in construction.

4.6 Barriers to the Adoption of AgPM in Construction

There is an increased awareness that upon implementation, the AgPM methodology offers considerable benefits for the management of construction projects as discussed in the previous section. However, several barriers have limited the adoption and integration of the AgPM methodology for the management of UK construction projects. These barriers include (and not limited to) the rigid or inflexible organisational structure, poor management support, organisational culture, management control, cost of transition, lack of confidence in their ability to scale, communication, apprehensiveness for change, predominance of the traditional methodology, see Figure *4-2*. State of Agile Report (2022) also reveals no fewer than ten barriers to the adoption of AgPM in non-IT sectors, namely the inconsistencies in processes and practices, cultural clashes, general organisational resistance to change, just to mention a few.

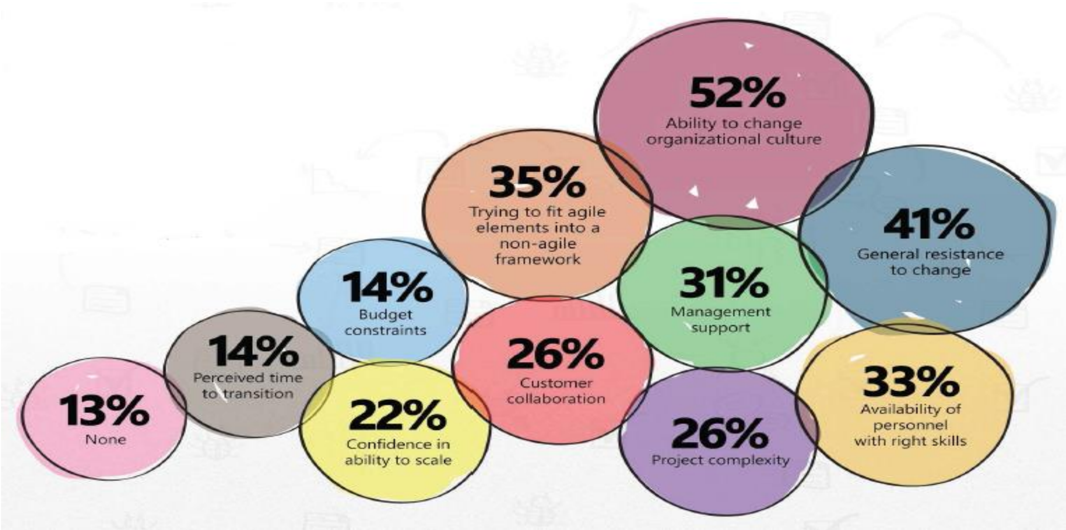

Figure 4-2: Barriers to Agile Adoption
Source: Agile Transformation Inc, 2019

Studies have also pointed that some of the major barriers to the adoption of AgPM in construction are typically associated with HRM-related issues, including shortage of skills, daunted communication systems, inconsistencies between the team's responsibilities and their actual competencies, inefficient leadership styles, and apprehensiveness for change (Dhir *et al*, 2019; Dromey *et al*, 2017; Rasnacis and Berzisa, 2016; Hoda and Murugesan, 2016; Koch and Turk, 2013; McAvoy and Butler, 2009; Cockburn and Highsmith, 2001). Paterek (2016) also identifies five major barriers to the adoption of AgPM, including the organisation and their methods of project management (the waterfall methodology), leadership (or management support), training (lack of skills), strategy (resistance to change) and the complex organisational culture, and apprehensiveness for change. Discussion in this section elucidates on the some of these major barriers.

4.6.1 Organisational Structure

Organisational structure is the pattern in which organisational activities are divided, organised, and coordinated (Ahmady *et al*, 2016). The rigid organisational structure of the UK construction industry has undoubtedly posed a barrier to the adoption of new innovative methodologies. Poor management support also has been a contributing barrier to the adoption of AgPM in construction and other sectors (Shankarmani *et al,* 2012). Hussain (2012) explains that the hardship associated with creating stakeholder involvement, which is a major requirement of AgPM, has posed a major hindrance for management in transitioning to and eventually adopting AgPM. Moriel (2017) also notes that another major challenge that contributes to poor management support is the challenge in managing the team through long distances, especially when the project team members are scattered across different locations.

4.6.2 Organisational Culture

Another major barrier to the adoption of AgPM in the construction industry is organisational culture (Bui and Sjölenius, 2018; Zucker, 2017; Shankarmani *et al,* 2012). Reports from VersionOne reveal that 55% of organisations attests that the inability to change the organisational culture is a barrier to agile adoption whereas 46% also alludes to the conflicts with the existing culture as the cause of project failure (Zucker, 2017). In lieu of agile values and principles, the traditional organisational culture is threatened by the AgPM methodology due to the possibility of relinquishing management control in so many ways. For example, the power and authority assigned to the top management team in most traditional organisations is disregarded by the AgPM methodology since the project team members are empowered to make decisions in response to clients' needs without necessarily following traditional bureaucracies and protocols with the TPM methodology (Zucker, 2017). Therefore, this inability to change the organisational culture the heavy-weight, rigid traditional methodology and to try out new ideas, methods and techniques has significantly lowered the level of adoption of AgPM in the management of construction projects (Padalkar *et al,* 2016; Boehm, 2002; Transformation Inc (2019). According to Pareliya (2018), it is high time top management embraced the fact that 'one size does not fit all' in managing construction projects and imbibed new methodologies/approaches.

4.6.3 Challenges with Transitioning

The challenges associated with transitioning from the TPM methodology to a fast-paced iterative methodology constitutes another major barrier with the adoption of AgPM in construction industry (Wells *et al*, 2015; Hussain, 2012). Even though the transition process might be difficult in practice, Rubin (2013) notes that for an effective transitioning to occur, the project team needs to be motivated, open-minded, be able to improvise to become flexible, and upgrade to generalists instead of specialists. Moriel (2017) also adds that the agile team is not just like any other project team which gets assigned to daily tasks, achieves them, and waits for additional tasks from the project manager. The agile team is dynamic, the members get tasks modified (self-governed), and adapt quickly to changes. Besides, issues related to the re-configuration of the conventional workspace to suit the AgPM methodology has further exacerbated the challenges associated with transitioning since the cubical arrangement in many construction organisations refutes the spirit of agile that encourages face-to-face communications and team members' interactions (Moriel, 2017).

4.6.4 Communication Issues

The fifth principle of the Agile Manifesto states thus: "*The most effective method of conveying information to and within a development team is face-to-face communication*" (Agile Alliance, 2001). However, communication and ineffective collaboration has been a major barrier to the adoption of AgPM in construction projects (Zucker, 2017; Hussain, 2012). Communication and correspondence within the TPM methodology is basically formal and documented whereas the AgPM methodology requires a more informal approach in communication to accelerate the flow of information, thereby enhancing speed and accuracy. Accordingly, Hussain (2012) agrees that communication differences and other procedures might be problematic for the employees and organisation at large, hence the general resistance to the adoption of AgPM. Even though construction professionals seem to have developed personality and behavioural traits that favour indirect communications, such as emails, texts, chats, detailed documentation, the benefit of face-to-face communications has been substantiated by various studies. For example, the study by MIT's Human Dynamics Laboratory demonstrates this phenomenon. Changing work patterns to increase casual and social interactions significantly improves team performance (Zucker, 2017).

4.6.5 Procurement Strategies

Construction procurement strategies have been defined differently in literature. For example, Chan (2007) defines procurement strategy as the system that represents the organizational structure adopted by clients for the implementation of project processes and eventual operation of the project. Molenaar *et al*, (2009) on the other hand defines procurement strategy as a comprehensive process by which designers, constructors, and various consultants provide services for design and construction to deliver a complete project to the client (Ghadamsi and Braimah, 2016). The definitions however suggests that a wide range of processes (which are often connected and sequential in nature) are involved in a procurement strategy.

The adoption of agile methodology in construction projects has been faced with barriers related to the business conditions of construction projects (Chan and Liu, 2012). These barriers emanates from the practices carried out by construction organisations due to the variety of stakeholders that needs to be satisfied with the project outcomes (Aouad *et al*, 2010). For example, the procurement and contractual arrangements of the project usually acts as a moderator between the level of innovation (which allows the adoption of new methods) and project performance (Sayyed *et al*, 2023). Hence, the allowance for the adoption of innovative methodology in the project delivery of a project largely depends on the adopted procurement strategy for the project. Studies have also revealed that procurement is one of the main factors that influences an organisation's attitude to innovation (De Valence, 2010; Dulaimi *et al*, 2006; Blayse and Manley, 2004; Van der Panne *et al*, 2003), as well as other aspects such as the organizations' internal and external relations, investments, and strategies which are considered as some of the main factors for successful implementation of innovation (Ling *et al*, 2003).

The nature of procurement in construction is generally project-based, accompanied by a seemingly lack of trust and collaboration with subcontractors (Linget al.2003). Hence, the appropriate procurement strategy is chosen based on several criteria such as the amount of risk involved in a project, the number of stakeholders involved, the timeline required to complete the work, and the extent at which the project's cost is accurate or achievable (Streule *et al*, 2016). However, a collaborative procurement strategy can be used as a feasible tool to introduce new methodologies, technologies, innovations, and changes in the management of construction project (Sayyed *et al*, 2023). Thus, requiring a supportive, collaborative and motivating organisational structure as one of the main pillars. In other words, construction organisations would need to build a system that allows innovative projects in order to test different variances that make procurement capable of designing or executing new systems/processes that would help to upscale the performance of construction projects (Sayyed *et al*, 2023).

Shankarmani *et al* (2012) have summarised these barriers to the adoption of AgPM in the construction industry as follows:

- the project team members as novices to agile practices and the challenge of taking on all the agile practices in one swoop
- some constraints (e.g., the procurement strategy) being enacted by the organisation, thus inhibiting the adoption of certain agile practices
- apprehensiveness to let go of the old ways of managing projects, that is, being half-hearted about agile adoption, or wrongly adopting agile practices
- ack of personnel with the right skills
- general resistance to change
- the complexity of construction projects
- lack of confidence in their ability to scale
- customer collaboration.
- perceived time to transition
- budget constraints.

On the other hand, these barriers also constitutes the enablers for the adoption and integration of the AgPM methodologies in the UK construction industry. Agile enablers simply refer to those internal or external factors to an organisation, which are directly or indirectly related to the implementation of the AgPM methodology and may impact on the performance and use of a given practice, technique, or tool (Almeida *et al*, 2012). Over the years, several agile enablers have been reported by scholars, including enablers of the organisation (its structure and culture), processes used in the organisation, project team, skills, and technical factors, of which most are applicable to construction projects, considering each project as a temporary endeavour (Han and Bogus, 2013).

Table *4-3* presents the key agile enablers and their components.

Table 4-3: Agile enablers

Agile enablers	Components
Organisation	Organisational structure; Organisational culture; Entrepreneurial culture; Learning organisation; Agile-style work environment; Acceptance of agile methodology; Adequate reward for agile use; Emphasis on speed; Performance measuring; Knowledge management systems; Multidisciplinary teams; Resource competition; Strong executive support; Decentralized decision making
Process	Capability of reconfiguration; Process automatization; Process modularity; Easy access to information; Formalization; Frequent development milestones; Process concurrency; External integration
Project Team	Self-direct teams: Team autonomy to make decisions; Team leadership; Team dedication; Team knowledge about agile; Team experience/expertise; Project manager experience; Team size; Team location; Multidisciplinary team
Project Type and others	Product succession planning: Urgency to complete the project (pace); Goal clarity; Project complexity; Project newness; Support systems, computer-aided design (CAD); computer-aided engineering (CAE); Customer involvement; Collaborative work; Suppliers' involvement

Aside from these barriers, studies have demonstrated that the AgPM methodology has the potential of addressing issues that lead to poor performance of construction projects (Senouci *et al*, 2017; Azanha *et al*, 2017; Spalek, 2016; Singh, 2016; Yllen Johansson, 2012; Gustavsson 2011). Likewise, State of Agile Report (2022) suggests that broadening the adoption of the AgPM methodology is a way to achieve critical business outcomes. Therefore, as a way of broadening the adoption of the AgPM methodology in the UK construction industry, this study adopts the ideas of Gustavsson (2016) and McBreen (2002) in integrating the strengths (best practices) of the existing methodology (TPM) while dropping some of its parts, changing some parts, and introducing the best practices (strengths) of the AgPM methodology in a framework for the management of UK construction projects. Further discussions on the integration of the TPM and AgPM methodologies will be presented in chapter six.

4.7 Summary

Despite the adoption of several traditional methodological approaches in the management of UK construction projects, performance has remained a critical issue in the industry. Studies have attributed this issue of performance to the complexity of construction projects and the intricacies required to effectively manage the customers' changing requirements. Also, the gap between the concepts dominating the TPM methodology adopted and its practicality in a real, dynamic project environment has been a major issue in the context of construction projects (Ekanayake, 2019). Considering that in reality, construction projects are not necessarily sequential in nature, changes can easily erupt (Collyer and Warren, 2009), hence an ongoing call for studies to address the incessant performance issues and provide suggestions on how to move the industry forward.

Studies have suggested that when integrated into the management of construction projects, the AgPM methodology has the potential of considerably improving the performance of construction projects. Some of the benefits of integrating the AgPM methodology into the management of construction projects includes and not limited to:

- enhanced communication
- improved performance
- improved flexibility
- reduced development time
- collaboration and improved feedback system
- enhanced motivation of the team
- enhanced clients' satisfaction
- rapid implementation of solution by virtue of clients' collaboration and improved feedback system
- improved project visibility
- improved productivity

Nevertheless, despite all the benefits of the integration of the AgPM methodology in the management of UK construction projects and in addressing the weaknesses associated with TPM methodology, its adoption has met with several barriers, including the rigid organisational structure of the UK construction industry, organisational culture, challenges with transitioning, communication issues, shortage of skills in the use of the AgPM methodology, and the general resistance to change from the believers of the TPM methodology. Studies have revealed that these barriers could also constitute the enablers for the effective adoption and integration of the AgPM methodology in the management of UK construction projects when addressed effectively. However, rather than proposing for the adoption of a pure AgPM methodology, this study is proposing for the integration of the strengths of the TPM and AgPM methodologies in a framework in order to improve the performance of UK construction projects. Considering that neither the TPM nor the AgPM methodologies are perfect in resolving all the issues associated with construction project management. The next chapter in this study expounds on the methodological approach adopted in carrying out this research.

CHAPTER 5 : RESEARCH METHODOLOGY

5.1 Introduction

This chapter outlines the research methodology and the research methods adopted in this study. The research methodology outlines the strategies and approaches employed in identifying, choosing, developing, and analysing knowledge about a subject, including the research philosophies, epistemology (theory of the knowledge), and paradigm, which concern a set of assumptions about how the research should be carried out. The research methods cover the range of techniques chosen for this research and their rationales based on the expected outcomes of this research. This research consists of four stages as follows: an extensive literature review in the first stage; an explorative open-ended questionnaire was adopted in the second stage; the third stage was a questionnaire survey approach; and the final stage focused on developing a framework for the management of UK construction projects. This chapter discusses each of the stages in-depth, including the methods used to analyse the data collected.

5.2 Research Design

Generally, research is a term for describing activities that involve finding out, to some degree, in a systematic way, subjects that the researcher had little or no prior knowledge about (Walliman, 2017). Research is not only a set of skills but also a way of thinking, within which the researcher questions what he/she observes, explores further to aid understanding of the observation, and comes up with conclusion and inference that would enhance skills and knowledge (Kumar, 2019). According to Creswell (2008, p. 5), “Research designs are plans and the procedures for research that span the decisions from broad assumptions to detailed methods of data collection and analysis.” In other words, research design is an exclusive working document prepared by the researcher, which contains every information the researcher needs as well as justifications for all the technical decisions involved in planning the research (Blaikie and Priest, 2019; Akhtar, 2016). Therefore, for a research design to be effective, all its components must work harmoniously in promoting the efficiency of the research (Maxwell, 2013).

This study falls under the category of social research, which seeks to answer the 'what,' 'why,' and 'how' questions of this research. Accordingly, Blaikie (2009) (cited in Oyebanji, 2014) emphasises that in social research, the 'what' questions require answers that describe the state or status of a concept; the 'why' questions are concerned with understanding or explanation; and the 'how' questions are concerned with intervention. This research intends to answer the 'what' questions that are concerned with knowledge in construction management, such as, 'What are the major factors that lead to the poor performance in UK construction projects?' The 'why' questions are concerned with, 'Why is the traditional project management methodology prevalent in the UK construction industry? 'Why is there need to integrate the traditional and agile methodologies into the management of UK construction projects?' Lastly, the 'how' questions are concerned with, 'How can the barriers to the adoption and integration of the traditional and agile methodologies (if any) be addressed?'

Over the years, various research design models have been proposed, with step-by-step procedures to arrive at a valid research. Examples include the research onions model by Saunders *et al* (2009), the nested model by Kagioglou *et al* (2000), research choices by Blaikie (2007), research design framework proposed by Creswell (2009). Whilst these proposed research design models are brilliant and easy to adopt, researchers are betwixt to either adopt an existing design appropriate for data collection, synthesis, and analysis or design a new methodological design suitable for the study. Since research is a product of several developmental processes involving iterations and changes, guided by the research questions, aims and objectives (Blaikie and Priest, 2019; Bilau *et al*, 2018), Wilkinson and Birmingham (2002) therefore argues that it is the sole responsibility of the researcher to design or tailor an existing design to suit his/her research goals since research is based on the reflection of the researcher's ideas (Hakim, 2000).

For this study, the research design framework by Creswell (2009), Figure 5-1 is adopted and tailored, and it serves as a road map that guides how the study is conducted from the initial set of research objectives to be achieved (Section 1.4) to the conclusions. In the research design framework, Creswell (2008) identifies three types of research designs, namely the quantitative, qualitative, and mixed methods, each of which is based on the interrelationship between the researcher's philosophical worldviews, strategies of enquiry, and research methods. Therefore, to arrive at a suitable research design, the researcher needs to first determine the relationship between the philosophical worldviews, strategies of inquiry, and specific method in relation to the research problems, given that without prior nomination of the chosen worldview (paradigm), there is no justification for the chosen methodology, methods and techniques used in carrying out the research (Myers and Avison, 2002). Therefore, discussions on the philosophical worldviews, selected strategies of inquiries, and adopted methods in this study are presented subsequently.

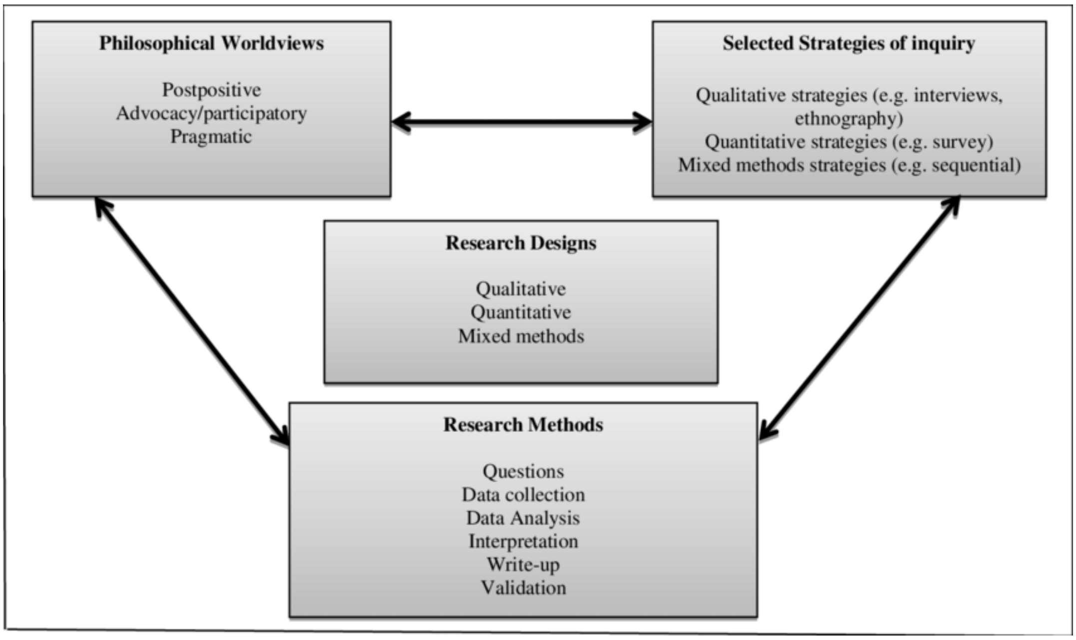

Figure 5-1: Creswell's framework for design
Source; Creswell, 2009

5.3 Research Philosophical Worldviews and Paradigms

Research philosophy is generally concerned with the creation of knowledge, nature of knowledge, how it comes into existence, and how it is communicated (Hürlimann, 2019). It also refers to the belief and assumption that explains how the world is perceived (Saunders, *et al*, 2019; Neuman, 2014; Bryman, 2012). Research philosophy provides a general basis for theoretical thinking, which is a method of cognitive, perspective, and self-awareness of the researcher in obtaining knowledge about reality and the approach in which the research will be designed, conducted, analysed, and interpreted (Moon and Blackman, 2017). Even though philosophical assumptions may seem concealed, their impact in the field of research cannot be overlooked since they underpin the researcher's choice of methodology, methods, and how the researcher interprets his/her findings (Kivunja and Kuyini, 2017; Flick, 2015; Saunders *et al*, 2009; Crotty 1998). Therefore, the understanding of research philosophy is very important in research since research can only be meaningfully interpreted when there is clarity about the decisions that affect the outcomes of the research (Moon and Blackman, 2017).

The classifications of research philosophy and their conflicting applications to the quantitative-qualitative debate have been a major source of dilemma to researchers in establishing their relevance to subject areas and disciplines. Over the years, a number of studies have used different descriptions, categorisations, and classifications of research philosophies and paradigms in relation to research methods with overlapping emphasis and meanings (Mkansi and Acheampong, 2012). Generally, research philosophy is classified into ontology, epistemology, and theoretical perspective (Bilau *et al*, 2018; Salma, 2015; Thakurta and Chetty, 2015; Mkansi and Acheampong, 2012). These classifications enable researchers to decide which approach to be adopted and why, which is derived from research questions (Saunders, Lewis and Thornhill, 2009).

5.3.1 Ontology

This is the first branch of research philosophy (Moon and Blackman, 2017). Although the precise meaning of the term "ontology" remains vague and is (resultantly) used in different ways (Holt and Goulding, 2017), several definitions have been given. Ontology, by way of explanation, is the philosophical study of being (Berryman, 2019). In the most basic science, Crotty (2003) describes ontology as what can be known. Ontology reinforces the assumption that there is reality, and it also deals with the nature of reality and assumptions we make about reality (Bilau *et al*, 2018). Ontology deals with the questions whether social entities need to be perceived as objective or subjective; how things really are; and how things really work (Bilau *et al*, 2018). Ontologically, every researcher is either a realist or an anti-realist. Hence, a researcher either accepts that facts are real and independent of human mind (realists), i.e., objective, or that reality is only subjective (anti-realist) (Igansi, 2014). Therefore, a researcher's ontological position refers to the researcher's relationship with the reality of the study in question. For example, does the researcher consider reality to be independent of his/her knowledge, or does the researcher need to participate in the construction of that reality? (Benmerikhi, 2014).

Holt and Goulding (2017) also recognise that ontologies can support or inform taxonomies in encouraging explicit understandings and facilitating specific context communication (e.g., knowledge representation, sharing and distribution). In other words, if all knowledge is subjectively constructed, then the "true" nature of reality doesn't matter because we can never get outside our socially based constructions. Crotty (2003) on the other hand argues that ontological positions are of little consequence in a research as long as the researcher has a clear epistemological position he/she is working on, thus invalidating the realist positioning of a researcher. In contrast however, Varpio and MacLeod (2020) claims that ontology is the foundational building block of science whilst Koskela (2020) further explains that there are two basic ideologies associated with the ontological worldview; first, the possibility of separating a phenomenon from others, and second, that things and substances are stable and inseparable.

5.3.2 Epistemology

This is the second branch of research philosophy that deals with the nature and sources of knowledge, and it develops a theory of knowledge (Dew and Foreman, 2020; Moon and Blackman, 2017). Epistemology is the theory of knowledge embedded in the theoretical perspective and thereby in the methodology. It deals with the nature and likelihood of knowledge as well as its scope and general basis. Epistemology provides assumptions in the way an inquiry is made into the nature of a problem (Al-Ababneh, 2020). Crotty (1998, p.8) also explains that 'epistemology provides assumptions in the way an inquiry is made and a philosophical grounding for what kinds of knowledge are possible and how we can ensure that they are both adequate and legitimate.' Furthermore, Saunders *et al* (2009) elucidates that epistemology is generally concerned with the acceptability of knowledge in the field of study. Within the epistemological paradigm, Dew and Foreman (2020) agree that researchers can ask the following questions:

- What does it mean to say we have knowledge of something?
- How do we acquire knowledge of various things?
- What is truth, and how do we know the truth?

- What is epistemic justification, and is this necessary for researchers?
- What are epistemological virtues, and are they helpful for researchers?
- How reliable is the human perception?
- Can certainty be attained?

Also, considering the relationship between a subject and an object of inquiry, Moon and Blackman (2017) explore the idea of epistemology and how it influences research design as follows:

- Objectivist epistemology believes the existence of reality is independent of the individual mind and is useful in providing reliability and external validity of results.
- Constructivist epistemology on the other hand debunks the idea that objective truth exists even though untapped. Thus, constructivist epistemology believes that truth emanates from engagements with the realities of the world and is useful in generating contextual understandings of a phenomenon.
- Whereas subjectivist epistemology is based on the idea that reality can be expressed in an array of symbol and language system that are extended and shaped to fit the purposes of individuals in the pursuit of knowledge. Hence, subjectivist epistemology is useful in revealing how an individual's experience shapes their perception of the world.

5.3.3 Theoretical Perspective; Research Paradigm

A theoretical perspective is a set of assumptions about reality that inform the questions we ask and the kinds of answers we arrive at as a result (Crossman, 2020). In this sense, theoretical perspective in research can be viewed as a lens through which researchers look, serving to focus or distort what is seen (Moon and Blackman, 2017). It describes the philosophical orientation of the researcher, which guides the research actions as well as informs and determines the appropriate research methodology (Al-Ababneh, 2020). Findings have revealed that theoretical perspectives and paradigms go hand-in-hand in research. While theoretical perspective explains a phenomenon based on certain criteria, paradigm provides the background or the frame that allows a theory to be tested and measured (Crossman, 2020). Research paradigm can also be defined as a set of beliefs with assumptions about the researcher's philosophical orientation (ontology, epistemology, methodology, and methods) (Rehman and Alharthi, 2016).

Every research is underpinned by a paradigm or a specific way of “seeing the world and making sense of it” (Mukherji and Albon, 2015, p. 24), and every researcher has a specific understanding on what constitutes knowledge and truth (Chilisa and Kawulich, 2012). This understanding ultimately shapes researchers’ thinking and how they view themselves and other people as much as how they think and perceive the world (Kamal, 2019). Furthermore, it is important to note that a paradigm can have a number of theories within its framework and acts as a reference point for the theory (Shah and Al-Bargi, 2013; Thomas, 2010). Therefore, it is expected of researchers to understand and articulate the beliefs about the nature of reality, what can be known, and how to obtain knowledge, all of which constitute the elements of the research’s theoretical perspective also known as paradigm (Rehman and Alharthi, 2016).

Several paradigms are discussed in literature, including the positivist (and postpositivist), constructivist, interpretivist, transformative, emancipatory, critical, pragmatist, and deconstructivist paradigms (Mackenzie and Knipe, 2006; Kivunja and Kuyini, 2017). However, discussions in this section focus on the four generic paradigms, namely positivism, interpretivism, critical paradigm (advocacy), and pragmatism (Kivunja and Kuyini, 2017; Rahi, 2017). Within these discussions also, the ontological, epistemological, and methodological stances of each research paradigm will be highlighted.

5.3.3.1 The Positivist Paradigm

Positivism, sometimes referred to as ‘scientific method,’ (Rahi, 2017, p. 2; Creswell, 2009, p.7) is built on the rationalistic, empiricist philosophy (Mackenzie and Knipe, 2006). Researchers within this paradigm believe that knowledge can be obtained via observation and experiment (Rahi, 2017). Therefore, facts are gathered to comply with the principle of demonstration, verification, and connections (Shah and Al-Bargi, 2013). The positivist paradigm mirrors a deterministic philosophy of an inevitable consequence of antecedent sufficient causes (Creswell, 2009). Positivism may be relevant in the social world on the belief that "the social world can be studied in the same way as the natural world, and the method for studying the social world is free of value, with the accompanying explanations of a causal nature (Mertens, 2005). After the World War II, positivism was replaced by postpositivism (Mackenzie and Knipe, 2006), representing the traditional form of research which prevails for quantitative research by developing numeric measures of observations and studying the behaviour of phenomena (Creswell, 2009).

Ontologically, positivism is branded as critical realism (Cook and Campbell, 1979), considering the position of its proponents, which suggests that reality must be subjected to the best possible critical scrutiny (Guba and Lincoln, 1994). Hence, reality is opined to exist but not completely apprehended because of human flaws (Guba and Lincoln, 1994). Epistemologically, the positivist paradigm is dualist and objectivist (Shah and Al-Bargi, 2013). This means that the inquirer and the object of inquiry exist independently as separate entities (Crotty, 1998, cited in Pham, 2018; Guba and Lincoln, 1994). Therefore, the inquirer maintains a distant unrequited relationship with the object of inquiry in order not to affect or impede the research procedure (Cohen *et al*, 2007). Methodologically, positivism acknowledges that knowledge can be obtained through observation and experimentation (Rahi, 2017). Therefore, the focus of researchers within this paradigm is on the interpretation of relationships among facts gathered, thereby complying with the principle of demonstration, verification, and connection (Shah and Al-Bargi, 2013; O'Leary, 2004, p.5). Generally, the positivist paradigm is aligned with quantitative methods of data collection and analysis (Mackenzie and Knipe, 2006; Salma, 2015).

5.3.3.2 The Interpretivist or Constructivist Paradigm

Interpretivism (constructivism) believes in the depth of understanding of a concept (Rahi, 2017; Creswell, 2009). Researchers within the interpretivist paradigm aim to understand "the world of human experience" (Creswell, 2009; Cohen and Manion, 2007) with suggestion that reality is socially constructed (Mertens, 2005, p.12). Hence, the goal is to depend as much as possible on the views and perceptions of the research participants (Creswell, 2009; Creswell, 2003) for proper interpretation (Kivunja and Kuyini, 2017), also recognising the impact of their background and experience (Mackenzie and Knipe, 2006). Researchers within this paradigm often address the “process of interaction among individuals” and focus more on the experience of the participants with the intention of making meaning about how their participants view reality (Creswell, 2009, p. 9).

Ontologically, the interpretivist paradigm is relativist (Shah and Al-Bargi, 2013). Reality in this paradigm exists in the form of various abstract subjective constructions, which is based on experience of the persons involved in the inquiry (Guba and Lincoln, 1994). Interpretivists also believe that reality is socially constructed (Mertens, 2005, p.12; Shah and Al-Bargi, 2013). Therefore, reality needs to be interpreted (Salma, 2015) because people make up their own interpretations of social realities as they consciously interact with nature (Crotty, 1998). Epistemologically, this paradigm is aligned with subjective and transactional epistemology (Shah and Al-Bargi, 2013) with a perspective that the inquirer cannot be excluded from the subject of inquiry, such that the human nature and how reality is understood is a focal point of how we understand ourselves, others, and the world (Robert Wood Johnson Foundation, 2008). Interpretivists do not depend on statistical data analysis; rather they employ an investigative, holistic, and inductive approach for data collection (Shah and Al-Bargi, 2013). Hence, qualitative research is conducted on individuals to understand reality from the individuals' perspective (Creswell, 2003, p. 8), or it may be a combination of both qualitative and quantitative methods (Mackenzie and Knipe, 2006; Salma, 2015).

5.3.3.3 The Critical Paradigm

The Critical Paradigm is based on socially constructed entities that are under constant internal influence (Kivunja and Kuyini, 2017; Scotland, 2012). This paradigm disbelieves every culturally constructed meaning of reality because of its perception that reality is created to suit a specific social demographic condition (Shah and Al-Bargi, 2013). Thus, it believes that the positivist and interpretivist paradigms do not sufficiently discuss the issues of social justice and marginalised people (Creswell, 2009). Therefore, in a bid to unveil beliefs and practices that affect human freedom, the critical paradigm challenges both the positivist and interpretive paradigms (Shah and Al-Bargi, 2013). Consequently, the process of inquiry within this paradigm needs to be knit together with politics and a political agenda (Creswell, 2009) and should accommodate an action agenda for reform that is permitted to positively affect the lives of the participants, the organisations which they worked, and the life of the researcher (Creswell, 2009). This paradigm also encourages that the researcher conducts the research collaboratively with the participants to reduce the likelihood of marginalisation. Therefore, in some cases, the participants might assist in designing the research questions, collecting data, analysing the findings, or they might get rewarded for their contribution (Creswell, 2009).

Ontologically, the critical paradigm takes on the historical realism as its ontological stance, which believes that reality has been shaped by social, political, cultural, economic, ethnic, and gender values (Guba and Lincoln, 1994, cited in Scotland, 2012). It also takes on transactional and subjectivist epistemology (Shah and Al-Bargi, 2013) and assumes that we cannot isolate ourselves from what we know. Thus, the inquirer and the subject of inquiry are combined such that who we are and how we understand the world is a central part of how we understand ourselves, others, and the world (Robert Wood Johnson Foundation (RWJF), 2008; Crotty, 2003; Guba and Lincoln, 1994). The method used in this paradigm is more of interrogatory, trying to uncover the truth. Hence, qualitative or quantitative (or a mixed) method of data collection and analysis can be adopted to extensively analyse reality (Mackenzie and Knipe, 2006; Shah and Al-Bargi, 2013), enabling the researcher to acquire greater understanding of diversity and values; stances and positions (Mackenzie and Knipe, 2006).

5.3.3.4 The Pragmatic Paradigm

The pragmatic paradigm is a collection of beliefs and precepts that influence what should be investigated, how the investigation should be done, and how the results should be interpreted (Bryman, 2004, p 453, cited in Armitage, 2007). Early pragmatists argued that social inquiry cannot be done using a single scientific method since reality could be judged by its consequence (Weaver, 2018). Therefore, pragmatism is viewed as a philosophy that allows deep commitment to practice and is characterised by its propensity to accept any thorough method of scientific inquiry as credible when used appropriately (Kalolo, 2015). The pragmatic paradigm is majorly distinguished by its flexibility (Armitage, 2007) and diversity (Delputte, 2013), which has led to “nuanced debates over such issues as the relationship between ontology and epistemology” (Sil, 2009, p. 648). Dewey (2010) also notes that the pragmatic paradigm is a useful lens for proper understanding of debates and discourses in complex situations (cited in Kalolo, 2015).

Even though the pragmatic paradigm might be considered adversarial with reality (Kalolo, 2015) since actions are driven by dialectics (a process of acquiring knowledge through the confrontation of different –views – ‘what works best’), which in turn feeds into scientific inquisitiveness, thereby becoming a drive for inquiry (Delputte, 2013, cited in Kalolo, 2015). However, the central ideology of pragmatism is pivoted on judging the value of ideas based on their suitability and functionality in guiding actions (Pratt, 2002, cited in Kalolo, 2015; Rescher, 2000; Robert, 2000). Also, within the confines of the current philosophical debates, pragmatism has a distinct advantage over its “rivals” because it does not conform to traditional trend of present-day analytic philosophy (Margolis, 2003).

Whilst pragmatism is perceived as a paradigm that supports the philosophical framework for mixed-methods approach (Somekh and Lewin, 2005; Tashakkori and Teddlie, 2010), some mixed methods investigators philosophically align themselves with the transformative (critical) paradigm (Mackenzie and Knipe, 2006 citing Mertens, 2005). The pragmatic paradigm positions the research problem as the focus of inquiry, applying all other methods in a bid to understand the problem (Creswell, 2003). Hence, the choice of the research approach for a study is directly linked to the purpose and nature of the research question (Creswell 2003). Furthermore, as an innovative paradigm in research, pragmatism is not devoted to any single system of philosophy and reality because reality is actively created as individuals act in the world, which is constantly changing (Weaver, 2018; Kivunja and Kuyini, 2017). Therefore, reality is constantly renegotiated, debated, and interpreted with the focus on the 'what' and 'how' (what works best) of the research problem, considering its usefulness in the new unpredictable situation (Creswell, 2003, p.11; Salma, 2015). Figure *5-2* provides a summary of research philosophy and its classifications.

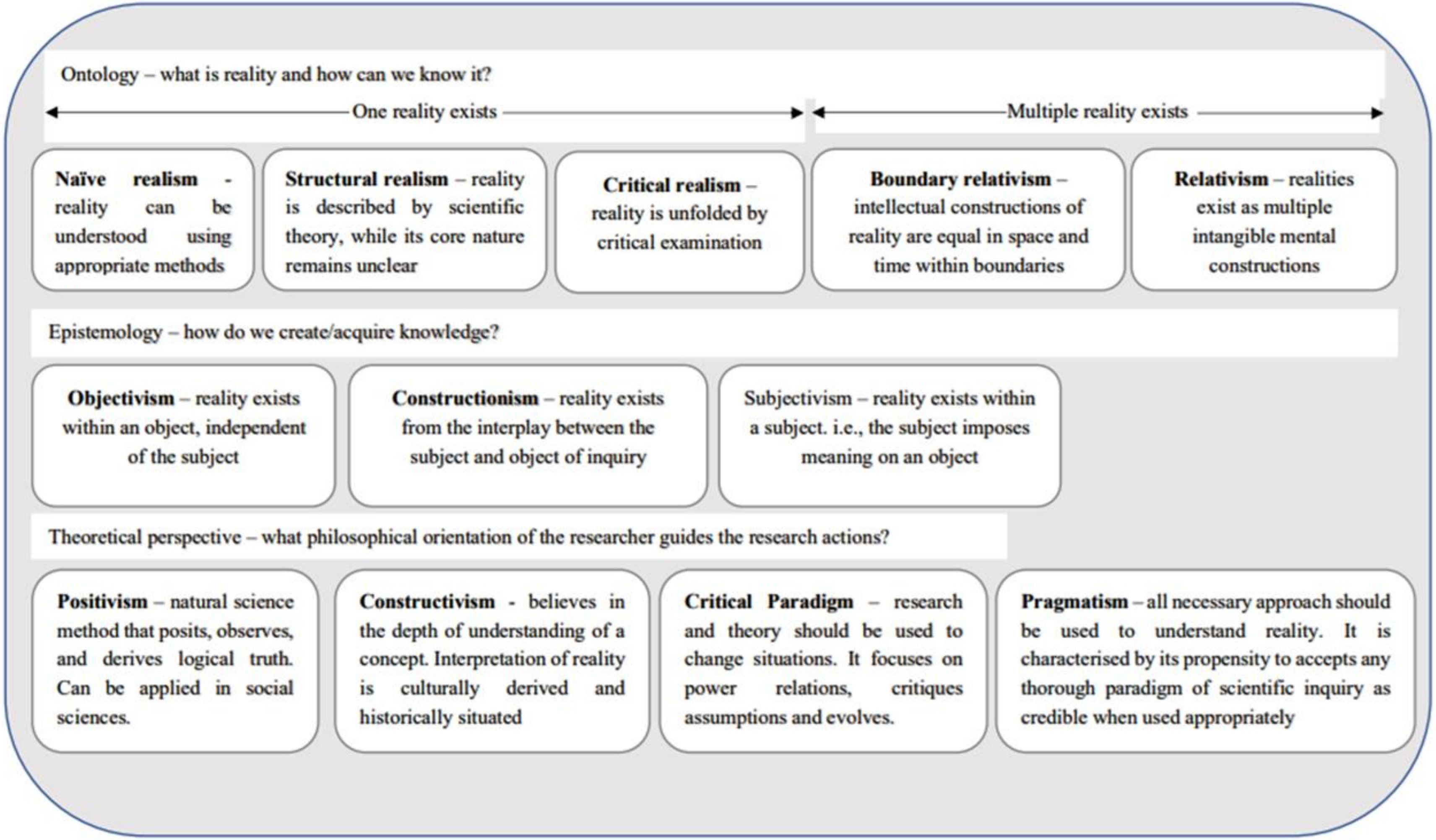

Figure 5-2: Research Philosophy and its classification

5.3.4 Adopted Research Paradigm

Construction management is multi-disciplined, and studies in construction management are usually positioned at the intersection between natural science and social science (Coventry University, 2021; Alsulamy, 2014). Whilst research in natural sciences follows a sequence of facts that are unbiased of human opinions, studies in social sciences depend largely on the opinions and perceptions of humans (Love *et al*, 2002). Over the years, the positivist and the interpretivist paradigms have become dominant in the field of construction management research (Alsulamy, 2015; Dainty, 2008; Love *et al*, 2002). Thus, instigating several criticisms for its inability to build a solid theoretical foundation and a clear epistemological position as well as consequently over-simplifying the nature of research problems in construction management (Rahmani and Leifels, 2018). Therefore, rather than engaging in the ontological and epistemological wars between the positivist and the interpretivist paradigms, it is suggested that construction management research should focus on the interplay between knowledge and action, and researchers in construction management are invited to intervene in the world rather than merely observing it (Goldkuhl 2012). As a result, construction management researchers are gradually gravitating towards the pragmatic research paradigm in order to respond to the objectives of construction research, considering also that construction research generally investigates how people deal with situations and what is to be inferred by their actions (Schutt 2011).

Pragmatism is not based on dualism between reality independent of the mind (as with the positivist and the critical paradigms) and within the intellectual capabilities (as with the constructivist paradigm) but is concerned with the value of the philosophical assumptions (Goles and Hirschheim 2000) and embrace a form of naturalism since the idea of philosophy is continuous with science (Weaver, 2018). Moreover, studies have also suggested that adopting a multi-strategy approach that integrates the quantitative and qualitative research methods is ideal for construction research and provides an alternative perspective for researchers (Bryman and Bell 2003; cited in Knight and Ruddock 2008). This research aims to develop a framework for the integration of the TPM and AgPM methodologies for the management of UK construction projects while also considering the perceptions of the research participants on the use of the AgPM methodology. Also, due to the difficulty in separating the researcher from the research, it means that whatever the researcher in this study accepts as true or assumes about the world and the research will unavoidably add colour and ‘scent’ to the research activities and findings (Klakegg, 2020). Hence, this research is conducted within the pragmatic paradigm, which is congruent with the mixed methods research approach, drawing strength on its intuitive appeal and liberty to investigate areas of interest while embracing methods that are appropriate and utilising findings in a harmonious manner (Armitage, 2007; Creswell, 2003; Tashakkori and Teddlie, 1998). Further discussions on the ontological, epistemological, and methodological assumptions with respect to the chosen research paradigm are presented in the next section.

5.3.5 Philosophical Positioning of the Research

Every methodology rests on the nature of knowledge and of knowing (Gunatilake, 2013), seeking to find that if a ‘real’ world is assumed, then what can be known about it is ‘how things really are’ and ‘how things really work’ (Oyebanji, 2014). The pragmatic viewpoint of this study provides a useful foundation to understand the need for the integration of the TPM and AgPM methodologies. On this premise also, the following assumptions are made. First, with respect to ontology, reality is viewed as complex, fluid, and often ambiguous (Gunatilake, 2013). It is not static, so undergoes changes at every turn of events (Kaushik and Walsh, 2019). Similarly, the world also is not static; it is constantly in a state of becoming through actions which are pivotal in pragmatism (Morgan, 2014a; Goldkuhl, 2012; Maxcy, 2003). This is particularly true in relation to this research subject area (construction management) which is prevalent with complexities and ambiguities while being highly value-laden and context dependent (refer to chapter 2).

Ontology in construction management research allows the development of flexible management methodologies for distributed production of knowledge, proactive research of information, and transparency of knowledge structures while permitting the definition of reusable knowledge objects (Masera, 2007). Furthermore, construction projects involve a broad array of stakeholders, coupled with an intricate management process (refer to section 4.2). Therefore, it is assumed that these stakeholders have varying perceptions, operations, and differing levels of commitment to achieving performance, which in turn leads to different actions, interactions, and responses when it comes to the integration of the TPM and AgPM methodologies for the management of UK construction projects. More so, considering that construction projects are delivered by project teams (made up of individuals from different backgrounds) and interactions arise when they share viewpoints on a particular issue, this also means that on occasions where their viewpoints are varied and not shared, negotiation and compromise becomes necessary.

Ontologically, the researcher believes in the existence of reality in the integration of the TPM and AgPM methodologies for the management of construction projects, which has also been uncovered from literature findings. However, the participants of this study might view and interpret this reality differently because of their different socio-cultural domains and experiences. Considering also, the apprehensiveness of the research participants to accept and embrace change in methodological approach for the management of construction projects, this study investigates and interprets with a focus on the 'what' and 'how' of the research problem. Thus, necessitating an epistemology based on symbolic interactionism, and is therefore the second assumption underpinning this research.

Epistemologically, construction management research has been described as being less clear than those among its explanatory science counterparts (Voordijk, 2009). Voordijk (2009) further explains that studies in construction management are pragmatically typified under three groupings: technological (based on empiricism and deduction); functional (regarded as rule-based actions designed to achieve a desired result); and socio-technological (considering the interrelationships between construction processes). The aim and objectives of this study calls for the need to obtain multiple perspectives on the UK construction industry's performance and the need to integrate the TPM and AgPM methodologies, which in turn necessitates the construction of variation and differences in interpretations into the analytic process. According to Durant-Law (2005 cited in Oyebanji, 2014), the formative epistemological question for a researcher is - "can 'real' or 'objective' relations between social phenomena be identified, and if so, how?" Since pragmatism is flexible in understanding the meaning of reality and insists on communication and shared interpretation to proffer solution to a research problem (Tashakkori and Teddlie, 2003), the "what works" strategy of pragmatism would enable the researcher in this study to respond to research questions that do not completely fall within the positivist or interpretivist research paradigm (Armitage, 2007). This view of reality has facilitated the adoption of a more quantitative method (qual → QUAN mixed methods approach) as discussed in section 5.4.1.

Methodologically, pragmatism is open to investigation of different methods in different aspects of science (Weaver, 2018). Although construction management discipline's methodological tendencies and those of the researcher acting within it tend to dominate methodological judgements (Holt and Goulding, 2016). In addition, the simplest methodological spectrum for construction management researchers extends from qualitative at one extreme to quantitative at the other, with a "mixed methods" paradigm somewhere in the middle, of which Holt and Goulding (2014) describe as "convenient thirds" continuum delineation. Hence, the best method in knowing reality in construction management research is the one that solves the problem while finding out is the means, and change is the underlying aim (Salma, 2015).

Finally, axiology, also known as value theory, includes the disciplines of ethics, pragmatics, and aesthetics (Oyebanji, 2014). Axiology is a branch of philosophy that studies judgment about value, considering that the role a researcher's values play in all stages of the research process is of great importance for making the research results credible (Saunders *et al*, 2012). It is important to note that the researcher and participants in the study have their own values and biases. Therefore, effort was made to minimise biases and increase the trustworthiness of the research findings. Having dealt with the issue of paradigms and philosophical questions, the following sections discuss the research methodology and the chosen method for this study.

5.4 Research Methodology

After a consideration on research paradigm and providing a rationale for the adopted paradigm in this study, it is therefore important to examine the types and nature of problems to be addressed from the mode of enquiry perspective. Research methodology therefore refers to the procedures or approaches a researcher follows in identifying, choosing, developing, and analysing knowledge about a subject (University of the Witwatersrand, 2020). Gounder (2013) also describes research methodology as the science of studying how research is to be conducted, including the procedures used in describing, explaining, and predicting an event. Several approaches and types of research methodology have been proposed by studies, including the descriptive vs. analytical research, applied vs. fundamental research, quantitative vs. qualitative research, conceptual vs. empirical research (Kothari, 2020). Notwithstanding, two common labels are often used for research methodologies within the research paradigms, i.e., the qualitative and quantitative (Liyanage, 2006), comprising three main approaches for researchers. For example, Creswell (2008) opines that research worldviews, methodologies, and methods all contribute to either qualitative or a quantitative (or a mixture of the two) which specifically involves the forms of data collection, analysis, and interpretation proposed by researchers in their studies (Oyebanji, 2014).

Whilst the qualitative research involves the collection and analysis of narratives and/or open-ended observations through methodologies, such as interviews, focus groups or ethnographies the purpose of quantitative research is to generate knowledge and create understanding about the social world through the examination of numeric data (Ahmad *et al*, 2019). Also, the qualitative methodology is based on an interpretative epistemology while quantitative methodology is more impersonal and objective (Kato, 2002, cited in Liyanage, 2006). Mixed methods research involves merging or incorporating the qualitative and quantitative research methodologies and data in a single study. Furthermore, Saunders *et al* (2009) also classified research methodology into the mono and the multiple methods as shown in Figure 5-3. The mono method represents the use of a single data collection method of either qualitative or quantitative method while the multiple method represents the use of more than one method of data collection or a combination of the qualitative and quantitative methods (Demir, 2013).

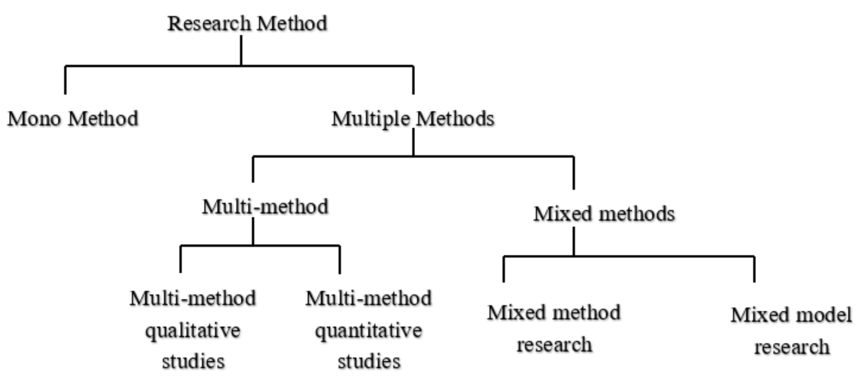

Figure 5-3: Research Method
Adapted from: Saunders et al (2009)

The multiple method is sub-divided into two levels: the multi-method and mixed methods (Saunders *et al*, 2009). The multi-method allows the use of more than one method of data collection; however, data must be inclined to only a qualitative or quantitative direction (Demir, 2013). Whereas the mixed methods allows the use of both the qualitative and quantitative data collection. Mixed methods research will be used in this study. This methodology has been utilised since the 1950s and has progressively gained recognition by a growing number of researchers (Dunning, Williams, Abonyi, & Crooks, 2008; Creswell & Plano Clark, 2007; Creswell, 2003, cited in McKim, 2017). This increase in the practice of mixed methods justifies the perceived value it adds to research compared to using a single method (McKim, 2017). Therefore, in conducting a mixed method research, it important to understand the benefit of integrating two distinct methodologies, given that it would demand more time (Creswell & Plano Clark, 2011), resources, and knowledge to effectively conduct the research (McKim, 2017).

Mixing qualitative and quantitative methods in a research allows the researcher to carry out the research either sequentially or at the same time (Creswell, 2009, cited in Demir, 2013). The sequential mixed method research approach is divided into the sequential explanatory strategy and sequential exploratory strategy (Creswell, 2009). In the sequential explanatory strategy, quantitative data collected and analysed in the first phase of the study are used to further explain the qualitative results obtained from the second phase of the study (Demir, 2013). On the contrary, the sequential exploratory strategy allows the researcher to collect qualitative data for the first phase of the study, followed by the collection of quantitative data for the second phase which is built on the findings gathered from the first phase (Demir, 2013; Creswell, 2009). Table 5-1 further expatiates the distinct practices of the three approaches (Creswell (2009).

Table 5-1: Quantitative, Qualitative, and Mixed methods approaches (Creswell, 2009)

	Qualitative	**Quantitative**	**Mixed Method**
Philosophical assumptions	Constructivist/ advocacy/participatory knowledge claims	Postpositivist knowledge claims	Pragmatic knowledge claims
Strategies of inquiry	Phenomenology, grounded theory, ethnography, case	Surveys and experiments	Sequential concurrent and Transformative

	study and narrative		
Methods	Open-ended questions, emerging approaches, text or image data	Closed-ended questions, predetermined approaches, numeric data	▪ Both open and close-ended questions ▪ Both emerging and predetermined approaches ▪ Both quantitative and qualitative data and analysis
Practices	▪ Positions self in the study ▪ Collects participant meanings ▪ Focuses on a single concept or phenomenon ▪ Brings personal values into the study ▪ Studies the context or setting of participants ▪ Validates the accuracy of findings ▪ Makes interpretations of the data ▪ Creates an agenda for change or reform ▪ Collaborates with the participants	▪ Tests or verifies theories or explanations ▪ Identifies variables to be studied ▪ Relates variables in questions or hypotheses ▪ Uses standards of validity and reliability ▪ Observes and measures information numerically ▪ Uses unbiased approaches - Employs statistical procedures	▪ Collects both qualitative and quantitative data ▪ Develops a rationale for mixing ▪ Integrates the data at different stages of inquiry ▪ Presents visual pictures of the procedures in the study ▪ Employs the practices of both qualitative and quantitative research

5.4.1 Rationale for Choosing the Mixed Method Approach

Prior to commencing a research, the researcher must first answer the following questions as regards the research: (a) What methodologies and methods will be used in the research? (b) How can the choice of such methodologies and methods be justified? (c) What theoretical perspectives are underpinned within the chosen methodology and method(s)? (d) What epistemological position informs the theoretical perspective? (Oyebanji, 2014). Answers to most of these questions have been duly considered in the previous sections of this study, save the chosen research methodology. Although the choice of choosing between the two commonly adopted methodologies (i.e., the quantitative and qualitative methods) has been considered a vital decision for researchers, however, neither of them individually is better than the other, considering that they both have their individual strengths and weaknesses.

Several studies have suggested the use of a single methodology in carrying out research. For example, Le and Schmid (2022) explains the qualitative research method within strategy and management research and notes that the qualitative method can be adopted as an innovation due to its flexibility and diversity. Busetto *et al* (2020) also affirm that qualitative research can be used to answer specific questions which cannot to be adequately answered using (only) quantitative designs. However, due to the multi-disciplined nature of this study, which is positioned at the intersection between natural science and social science (Coventry University, 2021; Alsulamy, 2014), the mixed methods approach, consisting of a combination of opinion-based questionnaire surveys (open-ended) and quantitative questionnaires, is adopted. Also, the qualitative and quantitative methodologies can be used complementarily. This means that a researcher may choose to conduct a focus group first to aid in the development of a survey or conduct quantitative survey in the preliminary stage of a study and choose to look more in-depth at a particular trend or phenomenon that was discovered during the data analysis and/or interpretation phase (Ahmad *et al*, 2019). Furthermore, the mixed methods approach was adopted in this study based on the following reason cited by Şahin and Öztürk (2019):

- **Triangulation:** This deals with testing the validity of the qualitative and quantitative data obtained independently from each other, and thus the validity of the findings. The mixed methods approach adopted in this study enabled the researcher to analyse results of the same study using different methods of data collection, i.e., qualitative method was employed in the first phase of the study while quantitative method was employed in the second phase of the study with the aim of exploring the UK construction industry, the management methodologies available, and the perceptions of construction practitioners on the use of the AgPM methodology. This bridged the gap of using a mono method, thus enhancing the credibility of the findings (Bryman, 2017, p.63; Hashim, 2017; Ritchie *et al*, 2014).

- **<u>Complementarity:</u>** This is the use of qualitative results in order to increase the interpretability of the findings after a quantitative research or vice versa. The mixed methods approach adopted in this study enabled the elaboration of the results of the first phase with the findings from the second phase and provided opportunities for the researcher to compensate for 'inherent method weakness' and neutralise the biases of using a single (mono) method (Hashim, 2017; Almalki, 2016, p. 291).
- **<u>Development:</u>** This refers to the gradual use of qualitative and quantitative methods. For example, in the case where the qualitative method is adopted first and the results are used in the development of the quantitative research process, the mixed methods approach would recompense the frailty of both quantitative and qualitative approaches and eliminate the 'the researcher effect' (University of Portsmouth, 2012).
- **<u>Initiation:</u>** The situation whereby the research study is given a new direction due to the inconsistencies among the findings of the study after using the qualitative and quantitative methods. Thus, yielding greater level of clarity since it would provide the researcher with the four criteria needed for the research, which are the implementation sequence, priority or weight given to either quantitative or qualitative approach, integration of data collected, and theoretical perspective of the research (Creswell, 2003).
- **<u>Expansion:</u>** In the simplest sense, the scope of the research is expanded since the aim here is to examine the different phenomena belonging to the research. It would enhance expansion, thus allowing deeper understanding of the research problem (Hashim, 2017; Creswell and Clark, 2011).

In this study, the sequential exploratory mixed methods approach (Figure *5-4*) involving the collection of qualitative data and analysis (in the first phase), followed by the collection of quantitative data and analysis (in the second phase) was employed (Creswell, 2009). This method is most suitable because it allowed the researcher to first explore the UK construction industry, management methodologies available (TPM, AgPM), and perceptions of construction practitioners before delving into the quantitative phase of the study (Creswell, 2009), thus enabling the expansion of findings from the qualitative study through a quantitative questionnaire survey (Bryman, 2017, p.63; Hashim, 2017; Hashim, 2017; Ritchie *et al*, 2014).

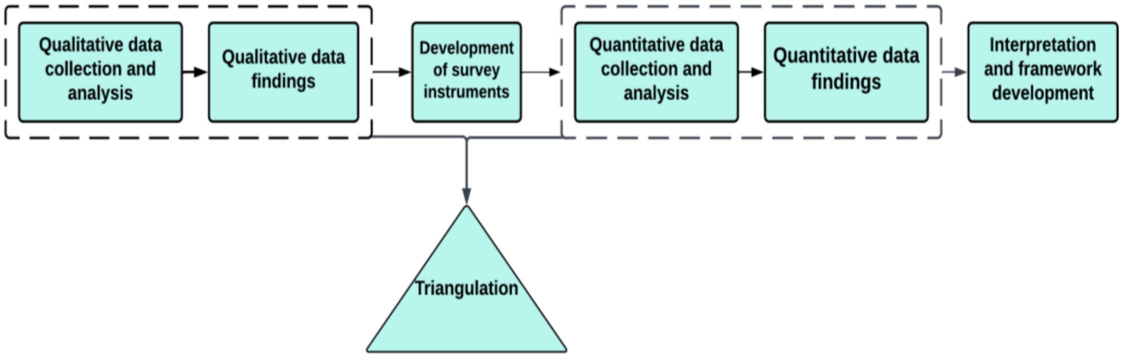

Figure 5-4: Sequential exploratory mixed method research approach

Literature findings also indicates that the TPM and AgPM methodologies are perceived completely differently and were developed to solve different problems. Hence, qualitative findings from the exploratory phase of this study were validated through questionnaire survey in the second phase (Demir, 2013). Following the consideration of the mixed methods approach as the suitable method for this study, another crucial aspect is to determine the type of the mixed method that is appropriate (Şahin and Öztürk, 2019). A comprehensive study on the classification of mixed methods approach was first conducted by Greene *et al* (1989). In that study, they provided a classification system consisting of six types of mixed methods approach by examining 57 articles. However, Johnson and Onwuegbuzie (2004) notes that it is the responsibility of the researcher to decide the dominance (between the quantitative and qualitative methods) and the time of implementation (i.e., if the quantitative and qualitative methods are to be used concurrently or sequentially). Consequently, Johnson and Onwuegbuzie (2004) proposed nine types of mixed methods in their classification based on the dominancy and the implementation time, as shown in Table 5-2.

Table 5-2: Types of mixed method in their classification

		Time Order Decision	
Paradigm Emphasis Decision		Concurrent	Sequential
	Equal Status	QUAL + QUAN	QUAL → QUAN QUAN → QUAL
	Dominant status	QUAL + quan QUAN + qual	QUAL → quan qual → QUAN QUAN → qual quan → QUAL

In Table 5-2, the symbol "+" means that both the qualitative and quantitative studies are carried out simultaneously while the symbol "→" means that two studies are conducted in a sequential order. Also, capital letters refers to priority and weight (i.e., dominance) given to either the qualitative or the quantitative method in the study while the lower case means the opposite. Creswell (2012) also corroborates and emphasised that researchers should consider the following issues when adopting a mixed method approach:

- deciding on which one of the quantitative and qualitative methods is to be prioritised or more dominant. Which type of data is given more importance and emphasis is crucial. However, in some cases, the quantitative and qualitative data sets might be equally important.
- the sequence of execution because of the necessity to determine whether two data types are collected simultaneously or sequentially. If they are collected at different times, it should be noted which one was collected first.
- the process of data analysis intended to be used for the study. It is important to determine whether the data are combined in a single analysis, or the analyses are to be done separately.
- determine which area of the research data that will be mixed since the operation of mixing can be performed during data collection, analysis, or interpretation phase. It is necessary to determine which of these four cases occurs.

Even though Johnson and Onwuegbuzie (2004) suggested nine approaches in carrying out a mixed method study, there is no expectation that a researcher must adhere strictly to them. Rather, it is suggested for a mixed method researcher to be creative in adopting the general principles provided. Notwithstanding, this study has adopted the qual → QUAN mixed method approach, wherein the qualitative method was adopted in the first phase of the study, and subsequently the quantitative method was used. Discussions in the following sections elucidate on the selected strategies of inquiry as well as the data collection techniques adopted in this study.

5.5 Selected Strategy of Inquiry

Educational research sometimes may seem difficult to deal with due to the dilemma of choosing which methods and methodologies best suit the research (Dammak, 2015).

Therefore, research strategy provides the step-by-step plan of action that gives light to the researcher's thoughts and efforts, enabling the researcher to conduct research systematically and on schedule to produce quality results and detailed reporting (Dinnen, 2018). It sets up a layout for data collection, measurement, and analysis, thereby ensuring that all evidence obtained accurately address the problem logically in an unambiguous way (De Vaus, 2006; Creswell and Creswell, 2012). Bryman (2008) also describes research strategy as a general orientation of conducting a research (cited in Alsulamy, 2015).

In developing ideas for a research, it is often useful for the researcher to know the available research strategies and understand when to use them. A suitable research strategy can be adopted based on the research questions, research aim and objectives, researcher's level of knowledge on the subject area, amount of time and resources available, and researcher's philosophical stance (Saunders *et al,* 2009). Yin (2003) also adds that the type of research, the researcher's influence with respect to the overall behaviour of events, and the researcher's propensity to either focus on current or historic events should inform the researcher on the research strategy to adopt. There are seven research strategies within which a researcher can adopt in answering the research questions. These include experiment, survey, case study, action research, grounded theory, ethnography, and archival research strategies (Saunders *et al*, 2009). However, this research adopted the action research strategy.

Studies have emerged on issues relating to the performance of UK construction projects. Indeed, a synthesis and critical evaluation of these studies shows poor project management practice as one of the main causes of performance issues in the UK construction industry (Alsehaimi *et al,* 2013). Despite substantial agreement from researchers and scholars on the issues relating to the performance of construction projects, most published studies fail to make available a clear recommendation for the improvement of project management practice. Rather, in attempting to transform the UK construction industry into a better performing industry, they "[…] envisage alternatives; know of the talk that goes on about 'stabilizing relationships,' 'defragmenting' the industry, the need for attitudes to change and 'get the culture right,' but for the present they have to work out ways of living with it." (Seymour and Rooke, 1995, p. 519). As a result, construction management research tends to take on descriptive/explanatory case study strategy (Sanda *et al*, 2021), making it inadequate for solving persistent performance issues in the construction industry.

It has also been argued that the issues associated with construction management and performance can be mitigated through alternative research strategies, such as the action and constructive research strategies (Alsehaimi *et al*, 2013), since such prescriptive research strategies can assist the researcher in the developing and implementing innovative tools and framework for addressing performance issues in construction management. This helps to connect the research and practice, strengthening the relevance of academic construction management. Moreover, coupled with the dearth of literature in the area of agile construction project management, action research strategy (participatory research or collaborative enquiry), also known as the "learning by doing" enables the identification of research problems while the researcher attempts to solve the problem through an ongoing reflective process (Alsulamy, 2015).

As a strategy commonly used with the introduction of change within a context (Parkin, 2009), the action research strategy begins with systematic observation (exploration) of the subject and data collection for reflective purposes, then moves on to decision making, and finally the development of a more efficient organisational strategy (Koshy *et al*, 2011). Mirroring to this study, which aims to develop a framework for the integration of the TPM and AgPM methodologies, the action research strategy enabled the researcher to first explore and understand the performance of the UK construction industry as well as the concepts of TPM and AgPM methodologies, followed by the identification of their strengths and weaknesses, and subsequently data collection and analysis. In addition, to understand the perceptions of construction practitioners and the need for agility in managing construction projects, qualitative open-ended survey and quantitative data were collected, thereby creating a connection between theory and practice, which facilitates the understanding and description of the "why" questions in this research (Ritchie *et al*, 2014).

Over the years, action research strategy has suffered several criticisms. For example, Jarvis (1981) notes that action research is without academic prestige since research activity within this strategy seems more suitable for experts who have been trained in that capacity. TESOL Research Intersection (RIS) Newsletter (2001) expresses similar sentiment about action research. Besides, some scholars have also criticised the action research strategy for being time-consuming with results that are not generalisable (Alsulamy, 2015). However, this study is conducted in the UK, and none of these limitations was an issue for the researcher.

5.6 The Research Framework

Research framework clearly illustrates the structure of the research plan, and helps the researcher formulate relevant research questions (Mills *et al*, 2010). According to Moullin *et al* (2015), research framework is a graphical or narrative representation of key factors, concepts, and variables to efficiently explain the phenomenon of implementation. It is a tool that allows practitioners integrate skills and competences into a real work situation by synchronising skills, knowledge, experience, data, and responsibility during high level decisions making procedures (Alsulamy, 2015). Research framework is useful for analysing and communicating the rationale of a research as well as for predicting the implications of the outcomes on an existing concept like the proposed framework for this study.

Research framework can also be considered as a factual or conceptual structure projected to aid the development of a concept that expands into something useful. Knowledge contribution (whether in the form of a policy or practice perspective) is generally a key requirement for a research. Research studies are quite firmly cast or framed within the form of a theoretical or conceptual framework (Passey, 2020) since they guide the paths of a research study and provide basis for establishing its credibility (Adom *et al*, 2018). The definition, selection, and formulation of an appropriate framework that can inform a study throughout its various phases and stages is often challenging (Passey, 2020). For instance, Robson and McCartan (2016), Merriam and Tisdell (2016), Anfara and Mertx (2015), and Maxwell (2013) consider the theoretical and conceptual frameworks synonymous. Also, some other authors, including Marshall and Rossman (2016); Miles *et al* (2014), do not provide any discussion on the relationship between the theoretical and conceptual frameworks. Notwithstanding, the theoretical and conceptual frameworks are dissimilar in concept and in their roles in a research inquiry (Adom *et al*, 2018). Table 5-3 presents the differences between the theoretical and conceptual frameworks.

Table 5-3: Differences between the theoretical and conceptual frameworks

Theoretical Framework	Conceptual Framework
Provides a general set of ideas within which a study belongs	Refers to specific or narrower ideas a researcher explores in a study
Founded on prevailing theory/theories from literature which has been tested and validated by other scholars	Based on the concepts which are the main variables in a study
Developed in form of a model that hinges a study, with its components and the results of their studies	It is a researcher's own idea (developed model) that is used to clarify the relationship that exists between the main variables in a study. Similarly, it can be a variation of an existing theory which is adopted to suit a research purpose.
Properly developed, designed, and validated	The design may not be accepted, but rather perceived as a proposal of the researcher's answer to the research problem
Offers a central basis for approaching the unknown research in a specific field of inquiry	The framework logically shows how the research inquiry is undertaken.
Consists of theories that seem interrelated with deduced propositions	Consists of interconnected concepts to explain the relationships between them and how the researcher answers the research problem
Used in testing theories in order to predict and control the situations within the context of a research inquiry	Aimed at encouraging the development of a theory that would be useful to practitioners within the researcher's field of study
Traditionally, may be developed prior or before data collection in quantitative research designs	Usually developed after data collection process from best practices in a research field

More than developing a framework, the principal aim of a research framework includes the following: guide in the identification of problems through the review of literature; provide a base for limiting the scope of the research; and facilitate the process of developing a framework for the integration of the traditional and agile methodologies (Oyebanji, 2014). According to Sinclair (2007), cited in Oyebanji (2014), research is a journey towards an endpoint - to develop new knowledge that will contribute to practice - and a research framework provides a guide." Section 5.4.1 provides a background for choosing the mixed methods approach for this particular study, and section 5.4.2 provides rationale for the sequence in which the researcher adopted the mixed methods approach. In connection with the adoption of the mixed methods approach, Liyanage (2006) also suggests that no matter how inductive and deductive the approach is, there is always a need to have a prior indication of the issues the researcher intends to study, alongside their relationships if any. Therefore, developing a conceptual framework compelled the researcher to think carefully and selectively about the constructs and variables to be included in the study (Miles and Huberman, 1994, cited in Liyanage, 2006).

This research aims to develop a framework that integrates the traditional and agile methodologies. Conceptual framework was useful in securing a coherent management methodology that also served as a valuable technique for the collection, analysis, utilisation, and reporting of data on the integration of traditional and agile project management methodologies. Hence, the developed framework also provided a base for the researcher to limit the scope of the research study to some extent (refer to sections 1.6). The identification of problems, through the review of literature (chapters 2 and 3) and collection of preliminary data (chapter 6), facilitated this process of developing a conceptual framework.

Even though research framework was useful in identifying the key issues to be considered under the area of research study (Liyanage, 2006), there was very little theoretical basis to develop rigid measures or constructs at the initial stage of this study in order to conduct a quantitative methodology. Besides, Kyne (2021) suggests that in exploratory mixed methods research, the qualitative approach should come first, which typically involves a user interview sprint but can also take the form of an online survey with open-ended questions (refer to section 5.4.2). Consequently, the findings of this first stage informed the quantitative research that followed. This illustrates the importance of carrying out a qualitative approach at the first stage of this study, followed by a quantitative approach. In addition, adopting the qualitative methodology in the first phase of a study supports the ontological assumption mentioned in the previous sections since the qualitative methodology allows for an understanding of multiple realities at the outset, followed by a quantitative methodology, with the aim of expanding the breadth, i.e., to generalise the findings (Liyanage, 2006). Based on the abovementioned, the research framework for this study is comprised of four major stages, as shown in Figure *5-5*.

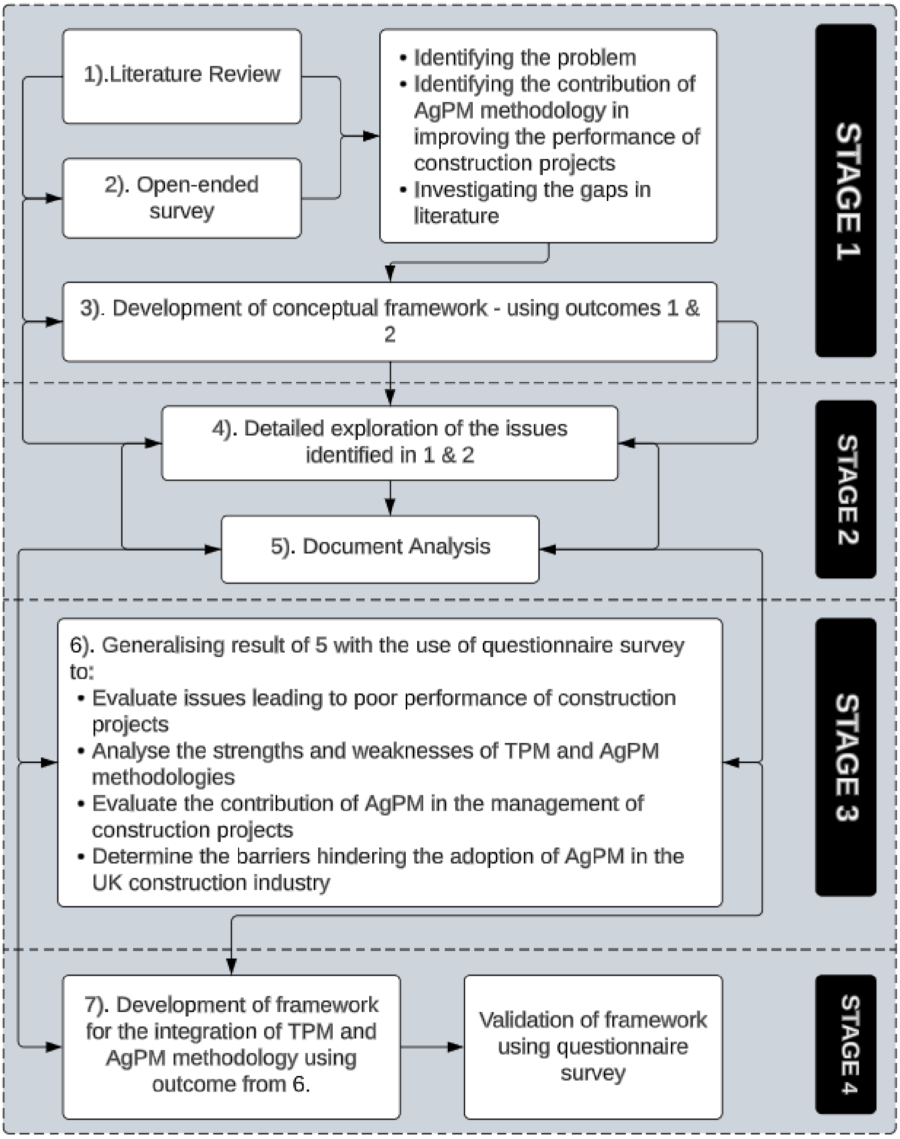

Figure 5-5: The research framework

5.6.1 Stage 1: Literature Review/Open-ended Survey

Literature reviews enable researchers to limit the scope of their inquiry whilst conveying the importance and results of the study to the readers (Creswell, 2009, cited in Oyebanji, 2014). Similarly, Jankowicz (2005) argues that despite the epistemological position of a researcher, research is not done in a vacuum but builds on the ideas of other people who have previously inquired in that field, considering that it provides a framework for establishing the importance of a study as well as a benchmark for comparing the results with other findings (Creswell, 2009). Review of literature was an ongoing process almost throughout the research as this kept the researcher updated on recent developments in the research area. Also, periodic reviews with the supervisory team allowed the researcher to get feedbacks on the progress of the research. Literature search strings carried out for the purpose of this study was based on the research objectives, as shown in Table 5-4 below. The selected articles served as the basis for the identification of practices and enablers related to AgPM.

Table 5-4: Search strings used in ISI Web of Science

	String	**Justification**
1	The UK construction industry	To identify literature that covers the subjects on the UK construction industry
2	AND (Performance of the UK construction industry)	To identify relevant articles on the performance of the UK construction industry
3	Construction project management	To identify and narrow down relevant articles on the management of construction projects
4	(Traditional or “plan-driven” or waterfall or discipline)	To identify the name of the term opposing agile
5	AND (Agile or “Agile project management”)	To identify articles that deal with agile project management
6	NOT (“agile manufacturing” or “Supply Chain” or “healthcare”)	To remove articles on agile manufacturing, supply chain, and healthcare from the search results
7	(Barriers or “hindrances” or “factors” that hinder the adoption of agile project management in construction)	To identify relevant articles on the barriers to the adoption of agile project management in the construction industry
8	AND (Model or procedure or framework or method or approach or methodology or process or practice or technique)	To identify combination proposals for the integration of TPM and AgPM

Findings from the literature enabled the achievement of research objectives one, two, and three. Objective one involved in-depth review of the state of the UK construction industry and the current management practices employed, with the view of gaining thorough understanding of its performance. The result of this stage gave rise to the need to review related topics, such as issues leading to poor performance, UK construction reports, performance measurement systems, performance of UK construction projects, as part of the first stage before moving on to the second stage. Objective two examined the current project management methodology used within the UK construction industry, identifying its strengths and weaknesses in relation to the management of complex construction projects.

In-depth literature review was also employed in achieving this objective, wherein the strengths and weaknesses of the traditional methodology were examined, followed by an assessment for the need to introduce agile project management methodology in the management of UK construction projects. Objective three further evaluated the potential contribution of agile project management to the construction industry and the extent to which agile elements can improve the performance of UK construction projects. Furthermore, open-ended survey (survey) was developed covering areas, including the UK construction industry and its characteristics, current management methodology used within the UK construction industry, and the perceptions of construction practitioners on the use of agile project management methodology. The qualitative data collected in this study is used to gain insights into the participants perceptions and thoughts, which will provide the basis for a future quantitative study and help the researcher to map out survey instruments for use in a quantitative study.

5.6.2: Stage 2: Document Content Analysis

In this study, document content analysis was conducted to review the state of the UK construction industry in order to gain thorough understanding of its performance, and it enabled the establishment of links between the industries performance and the current state of the industry, which is in line with the research objective one. These documents had been produced by a variety of parties with the intention of providing a review of the state of the UK construction industry as well as recommendations to improve its performance. Hence, the researcher reviewed ten UK construction reports from the year 1944 to the year 2018, with the aim identifying and synthesising the recurring issues within the UK construction industry, which also satisfies the research objective 2 of this study.

5.6.3 Stage 3: Questionnaire Survey

A questionnaire, according to Creswell (2012), is “a form used in a survey design that participants in a study complete and return to the researcher” (p.382). The purpose of selecting questionnaire data in this study was to generalise the data from a sample to population (Creswell, 2003). Usually, questionnaires are designed to produce quantitative or numeric description of trends, attitudes, or opinions of a population by studying a sample of that population (Oyebanji, 2014). In the development of the questionnaire for this study, the researcher carried out two main activities which involved the preparation and collection of data. The questionnaire survey stage of this study was aimed at achieving objectives 1 - 5. The process for the design and data collection for the questionnaire is summarised in Figure *5-6*.

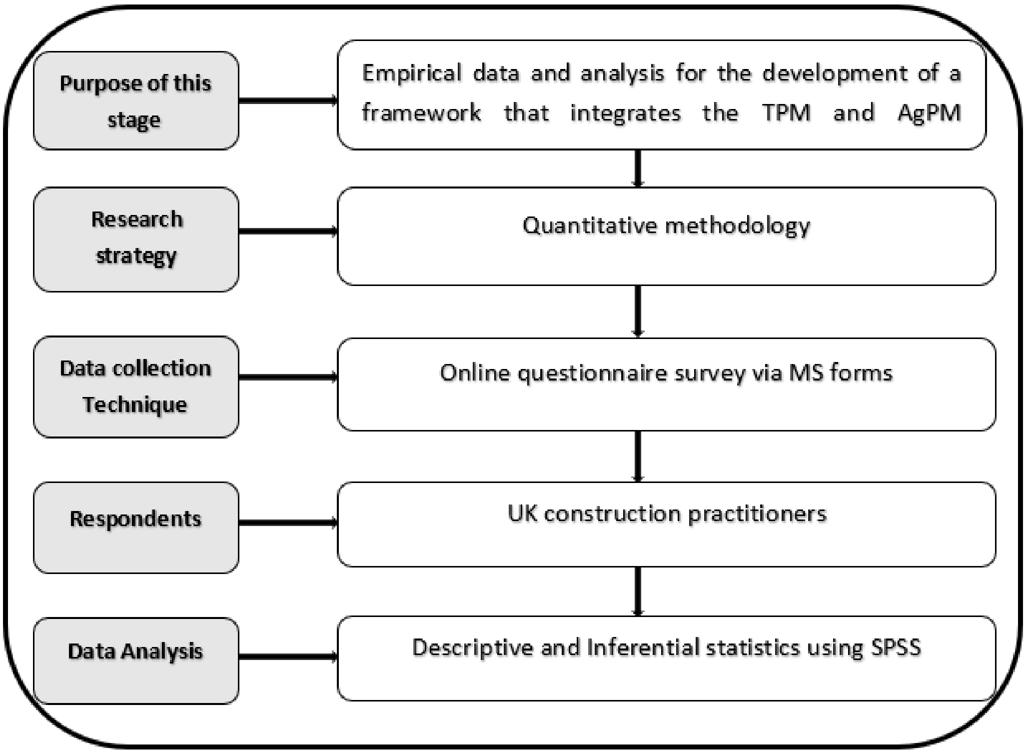

Figure 5-6: Questionnaire survey process

The questionnaire was designed to cover different areas of this research based on the combination of an extensive review of the literature and findings from the qualitative open-ended survey and document analysis. The questionnaire comprised closed-end questions - requiring the respondents to select an answer from a set of choices (Krosnick and Presser, 2010). The questionnaire was accompanied by a self-explanatory cover letter on the first page, indicating the aim and objectives of the research, including assurance that the information to be provided by respondents would be used strictly for research purposes. Also, it contained an undertaking to take measures for ensuring anonymity of respondents concerning the questionnaire survey.

The questionnaire designed in this study incorporated a combination of the nominal and ordinal scales (Guy, 2019). The nominal scale questions in this survey covered the respondents' gender, sector in which they work, their roles, level of experience, and the size of their organisation. The ordinal questions used were based on a 4-level Likert scale. Likert scale is a commonly used method for quantitative research, which shows the extent to which respondents in a research agree or disagree with a statement (Joshi *et al*, 2015), and is used extensively among social scientists (Oyebanji, 2014). Even though there are different levels of Likert scale to use in a study (e.g., 4-, 5-, 6-, 7-point Likert scale), the 4-point Likert scale has been adopted in this study, considering that it allows a researcher include four extreme options without a neutral choice (Hartley, 2013).

Questionnaire Data Collection: Data collection in this study is referred to as the process and the survey technique used for gathering data from the UK construction practitioners in England. Prior to the collection of data for this study, a piloting phase was completed. Piloting is a vital part of questionnaire design that assesses the procedures for participant recruitment, usability of the survey questionnaire, and data collection processes (Fraser *et al*, 2018). Furthermore, piloting a questionnaire survey before sending it out can "help improve the questionnaire design based on the respondents' initial comments and recommendations which can also inspire new ideas, which the investigator did not think of initially and can be integrated into the questionnaire (Oyebanji, 2014). A pilot questionnaire was designed and personally distributed to six UK construction industry practitioners and experienced academia in the field of construction management. The feedback from the pilot study covered the areas of clarity of the questions and the volume of the questions. This enabled the researcher to rephrase some of the sentences with simpler grammar as well as reduce the volume of the questions, considering the time frame to fill out the questions.

5.6.4 Stage 4: Development of the Proposed Framework

It is a known fact that the traditional and agile methodologies were established on different concepts in social science (López-Alcarria *et al*, 2019). However, up till date, there seems to be no logical approach available for the development, customisation, and integration of the traditional and agile management methodologies for the context of construction. Rather, researchers in this field have focused on the applicability and adaptability of methodologies from other industries into the construction industry (Demir, 2013), thus making it difficult in selecting an appropriate method for the development of a framework that integrates the traditional and agile methodologies. Therefore, before delving into discussions on the development of the framework, it is important to establish an effective method of integrating the concepts and principles of the traditional and agile methodologies.

Considering the researcher's background in physics and the fact that construction is interdisciplinary in nature covering a broad range of other scientific disciplines (Koch *et al*, 2019; Ali, 2019; Cho, 2018; Fernandez-Solis, 2012), the development of the proposed framework in this study was constructed from the concept of nuclear physics. Nuclear physics as a subject can be dated back from 1896 (Martin, 2011). The idea of nuclear physics in the development of the framework was selected because nuclear physics is at the heart of our ability to understand the universe since it provides answers and expands our knowledge of both the infinitely small and the extremely large. Nuclear physics is applicable in many fields and ubiquitous in our lives: in detecting smoke in our homes, testing for and treating cancer, and monitoring cargo for contraband and many in more areas. Nuclear physics and its techniques has spawned a difference in our safety, health, and security. This concept was adopted by Demir (2013) in the development of the Agilean framework. However, this study went a step further in identifying the phases of construction projects where the individual strengths of the TPM and AgPM methodologies can appropriately fit. Besides, the concept of nuclear physics in this study was only used as tool for visualising the proposed framework development.

Furthermore, it is pertinent to note that the development of the proposed framework was based on the "notion of discontinuous – thinking - of recognising and breaking away from the outdated rules and fundamental assumptions that underlie operations" (Hammer, 1990). Hence, the principles of nuclear physics were not directly applied in the development of the framework but were used rather as an inspiration for the integration of traditional and agile methodologies for the management of construction projects. Considering the fact that the concept of nuclear physics is not a recognised approach in construction management literature, the following discussion provides some background knowledge about nuclear physics and how it would be translated into this study.

The earth consists of a combination of different elements, which individually in their smallest states are made up of atoms (Pilchin and Eppelbaum, 2012). An atom on its own is made up of electrons, protons, and neutrons (Figure 5-7). Whilst the electrons in an atom are negatively charged, the protons are positively charged, and the neutrons are neutral in nature. The nucleus, which is the core of the atom, houses the protons and neutrons.

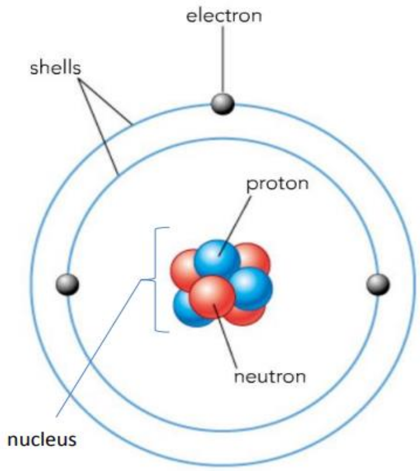

Figure 5-7: An Atom
Source: Office of Nuclear Energy (2021)

In nuclear physics also, there are two main types of reactions known as fission and fusion (Haider, 2019). Nuclear fission is simply the splitting of a large atomic nucleus into smaller nuclei whereas nuclear fusion happens when two small, light nuclei merge together to form one heavy nucleus, Figure 5-8 (Office of Nuclear Energy, 2021).

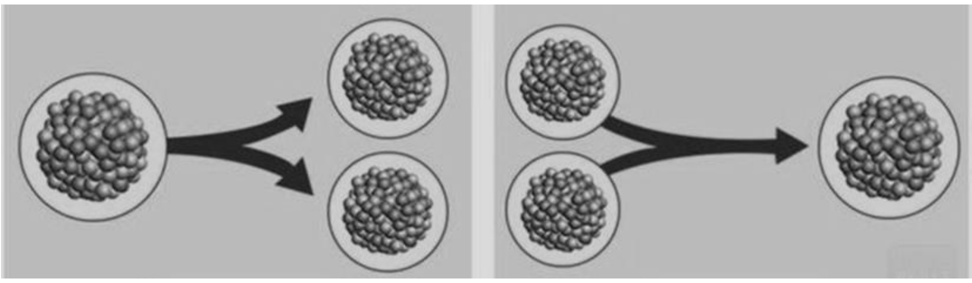

Figure 5-8: Nuclear fission and fusion reactions
Source: Office of Nuclear Energy (2021)

In light of the background knowledge on nuclear fission and fusion reactions, and relating it to this study, the 'atomic' components of the traditional and agile methodologies are defined, and for the purpose of this study, it is referred to as the 'model' atom, which is the given terminology for the traditional and agile methodologies. Foundational ideas are usually made up of concepts, principles, and methodologies/methods (Koskela, 1996), and since the framework is based on the concepts and principles of the TRAditional and AGILE (TRAGILE) methodologies, the 'model' atom can be derived, as shown in Figure *5-9*.

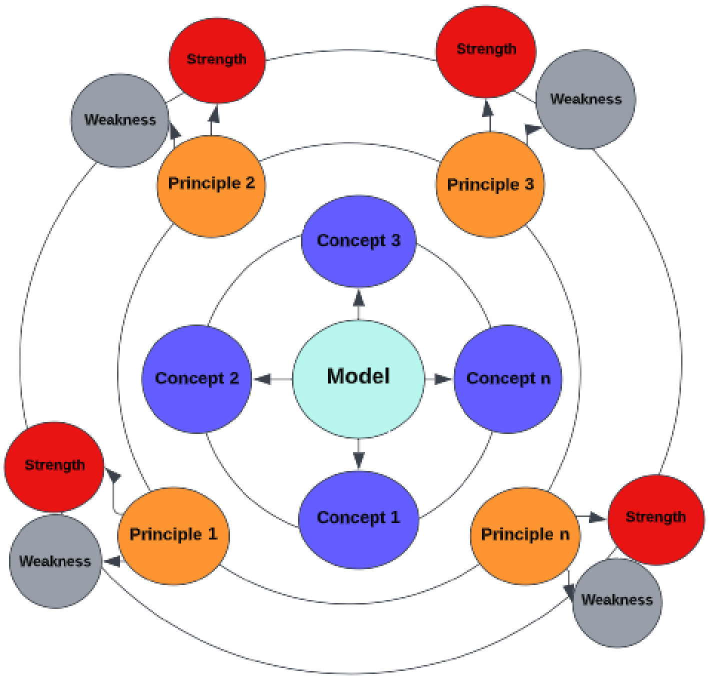

Figure 5-9: The 'model' atom

The model atom above (Figure 5-9) is solely for illustrative purposes and not functional. The reason for the given name 'model' (which represents the traditional and agile methodologies) is for the sake of transparency and to demonstrate that concepts and principles form the nucleus of the 'model' atom. Concepts in this case are not linked to any particular principle, considering that principle is a fundamental assumption while concept is an understanding retained in the mind, from experience, reasoning and/or imagination (Champagne, 2015). Nonetheless, concepts are usually in line with certain principles, which have their identifiable strengths and weaknesses that relate with the inherent characteristics of those principles (Demir, 2013).

Furthermore, each 'model' atom (the TPM and AgPM methodologies) has its individual count of concepts, principles, and characteristic details which have been identified through literature and findings from this study. For example, in the preliminary stage of this study, comprehensive review of literature was conducted to identify the different areas of strengths and weaknesses of traditional and agile methodologies. This was followed by a review on the need and benefits of integrating the traditional and agile methodologies. Also, the questionnaire developed in this study allowed for the identification of the individual strengths and weaknesses of the traditional and agile methodologies. In considering that the strengths and weaknesses of the 'model' atom are related to each of its principles (Figure 5-10), fission (separation) was therefore applied to split the principles of the model atoms into its strengths and weaknesses, resulting to two model atoms, namely one for traditional and one for agile methodologies, with their individual strengths and weaknesses. See Figure 5-10.

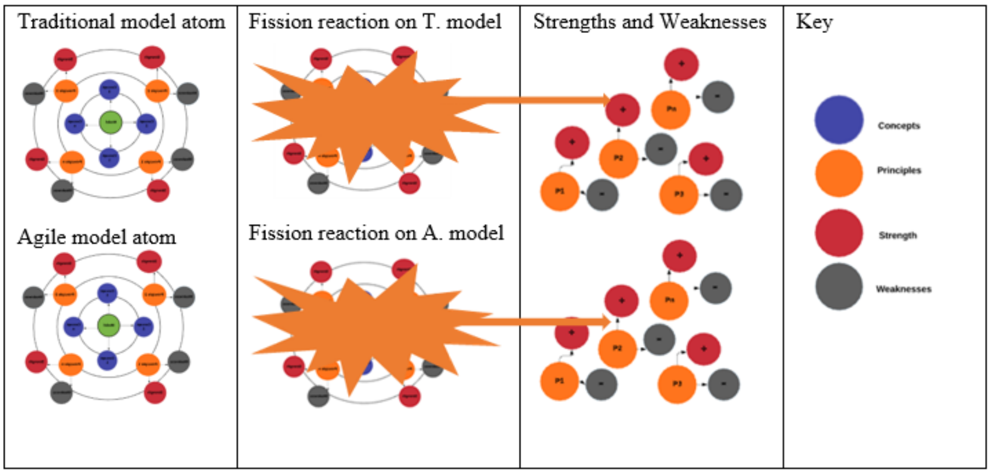

Figure 5-10: Fission reaction for the traditional and agile model atoms

Figure 5-10 shows the separation process of the principles of the traditional and agile methodologies (column 2) to yield their individual strengths and weaknesses (column 3). Furthermore, in line with the suggestions of Gustavsson (2016) and McBreen (2002), wherein the strengths of the traditional and agile methodologies are retained, the application of fusion reaction to the model atom enabled synthesis, and the strengths of the agile model were used to eliminate the weaknesses of the traditional model, and vice versa. On another note, it is important to state that the strengths of a model atom cannot be used in eliminating the weaknesses of the same model atom because, if its strength could eliminate its inherent weaknesses, then this reaction would have happened already and there will not be any recognisable weakness of the model atom (Demir, 2013). So, it is under those circumstances that the strengths of agile model atom were used in eliminating the weaknesses of the traditional model atom, and vice versa. This was then followed by an integration (fusion) of their individual strengths, as illustrated in Figure 5-11.

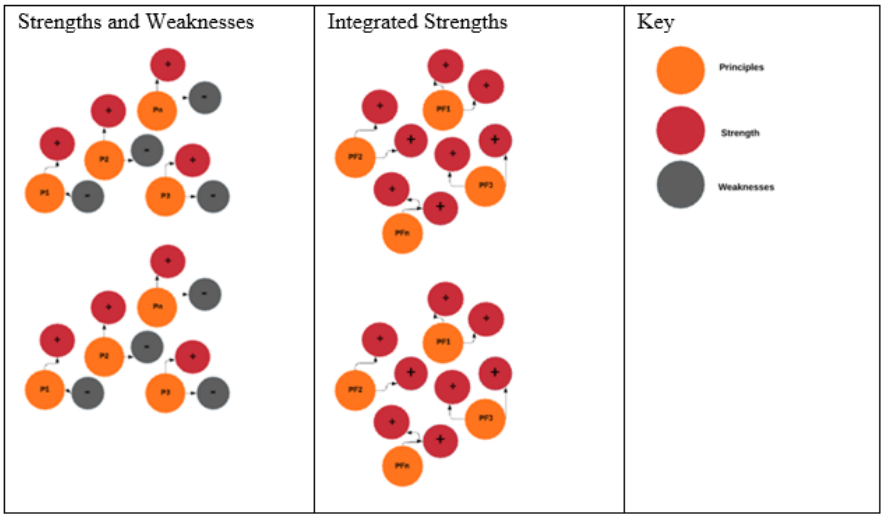

Figure 5-11: Fusion reaction for the traditional and agile model atoms

A re-merger (re-fusion) reaction was also applied in the development of the framework, whereby strengths (or benefits) with similar characteristics were summarised and classified based on the most suitable phases of construction project management. Subsequently, the outcome of applying the fission, fusion, and re-merger (re-fusion) reactions to disintegrate and integrate the strengths of the traditional and agile methodologies would yield the TRAGILE framework which consists of concepts, principles, and their strengths (in theory).

The agile methodology is pretty new and still evolving in the construction industry compared to the traditional methodology, hence a framework is considered most suitable as an intermediate system that connects all aspects of the researcher's interest while explaining the relationships between the key variables of the study (University of Southern California, 2021; Han and Bogus, 2013). Besides, developing a framework that integrates the strengths of the traditional and agile methodologies can be regarded as a problem-solving process. As with this study, it commenced with the identification of performance issues (problems) associated with the UK construction industry, then to solution development (involving theoretical/empirical data), and to result evaluation and lessons learnt (validation).

The TRAGILE framework would also act as a guide for construction professionals in providing clarity to every milestone in managing a construction project. Since the traditional methodology alone is not sufficient in addressing all the widespread and deep-rooted issues associated with construction projects, the TRAGILE framework focuses on improving the agility of construction projects. This would allow room for flexibility, adaptability, customers engagement, team relationships, retrospective learnings, and consequently improving the performance of construction projects.

5.6.4.1 Validation of the Framework

Research in construction management includes a wide range of approaches which contributes in terms of knowledge, understanding, or practical developments (Mingers and Standing, 2016). The measure of any research is ultimately, its validity (are its finding true, or its recommendations, correct?), whereas the purpose of validation is to provide a high degree of confidence that the developed framework is useful in the quest for truth (Mingers and Standing, 2016). After the development of the TRAGILE framework, the next step was to validate it. However, studies have revealed that discussion of validity in research is often weak (Byers-Heinlein *et al*, 2022; Goncalves Filho *et al*, 2021; Ruland *et al*, 2007), and there is no universally accepted criteria to assess validity in construction research (Hayashi *et al*, 2019), within the study of philosophy. Hence, several ongoing debates about the nature of truth: is it correspondence, coherence, consensual or pragmatic (Mingers and Standing, 2016). Besides, current views on the nature of truth and correctness revolve around the idea of a pluralist view of truth, i.e., it is one and many (Kim and Pedersen, 2018; Edwards, 2018; Pedersen and Wright, 2013). Furthermore, in light with the concept of truth and correctness, particularly the necessity for both internal correctness and external correctness, the validation of the TRAGILE framework will encompass two perspectives - the ontology of the framework, and the external validity (practicality) of the framework.

5.7 Research Instrument

Research instruments, also referred to as fact finding strategies (Annum, 2019), are tools used in collecting, measuring, and analysing data relevant to a subject in a research. (Duquesne University, 2019). Various tools and procedures can be used in collecting and analysing data in a research. Quantitative researchers, in most cases, use tests and closed-ended questionnaires in order to collate, analyse, and interpret data while qualitative researchers use interviews, diaries, journals, classroom observations, and open-ended questionnaires to collate, analyse, and interpret data (Zohrabi, 2013). Mixed method researchers tend to use closed-ended questionnaires (numerical data), interviews, and classroom observations (text data), or a combination of any quantitative and qualitative methods, to collate and interpret data (Zohrabi, 2013).

The main instrument used in this study was questionnaire survey administered among construction practitioners across the UK. Questionnaire can be in the form of quantitative and qualitative since each question in a questionnaire seeks to obtain one type of data or the other (Molwus, 2013). Literature review was an ongoing process in this study, and in order to obtain relevant literature for this study, the entire research was divided into two phases, as highlighted in section 5.0 (Figure 3). To assess relevant materials for this study, literature search was carried out from academic journals, relevant articles, published expert reports, books (from various academic databases, such as Scopus, Emerald insight, Sage journals, Google scholar, Taylor and Francis, which are part of the University's online library resources). Key words relating to the theme of the study, such as 'UK construction,' 'construction project management,' 'Agile project management,' 'Agile construction project management', 'Traditional project management,' 'Integration of agile and traditional project management,' were searched for and the results were filtered to most relevant articles which were saved for further review.

After literature was reviewed for the first stage of the research, an open-ended survey questionnaire was developed to collect preliminary data for this research. At this phase of the study (exploratory), the open-ended survey questionnaire provided the researcher with detailed responses from the participants, thereby minimising the researcher's bias (Farrell, 2016). Also, a pilot study was conducted at which point the researcher sent out the questions to six individuals (including a construction practitioner) to examine its feasibility and the ability of the participants to understand and respond to the questions, after which the questions were revised and dispersed to various construction practitioners across the UK via LinkedIn.

Findings from the first phase (exploratory) informed and enabled the development of the closed-ended questionnaire for the second phase of the study. Considering the complexity associated with presenting the questions in a clear and unambiguous manner so that the participants can properly interpret, articulate, and give their opinions, nine steps suggested by Crawford (1997) in developing a research questionnaire were adopted. These include:

1) decide the information required. A good questionnaire should enable the collection of the most complete and accurate data in a logical flow (Abawi, 2017). Hence, the information presented in the questionnaire for this study covered areas of the research aim and objectives.
2) define the target respondents or study population from which the data will be collected.
3) choose the method(s) of reaching your target respondents.
4) decide on question content. Each question should contribute to testing one or more hypothesis/ research question established in the research design, and the questions can be open format (i.e., without a predetermined set of responses) or closed format questions (that take the form of a multiple-choice question).
5) develop the question wording. The following points were considered when writing out the questions: a). clarity (ensuring the questions have the same meaning for all the research participants) b). phrasing (using short and simple sentences with only one piece of information at a time) c). sensitive questions (i.e., questions that could be embarrassing to the research participants were avoided) d) hypothetical questions (i.e., such questions were avoided where possible).
6) put questions into a meaningful order and format. The questions were formatted into categories based on the key themes drawn from the research objectives.
7) check the length of the questionnaire. The questionnaire was assessed to ensure it was not too lengthy but was straight to the point.
8) pre-test the questionnaire to effectively identify and solve the issues of confusion in a questionnaire. During the stage of the questionnaire development, the questionnaire participants were randomly selected from the study population.
9) develop the final survey form based on the evaluations from the pilot study.

In designing the questionnaire, findings from literature review and open-ended survey were used in developing the questions. Subsequently, a questionnaire survey consisting of 17 questions was designed under five sections to draw out responses from UK construction practitioners. Section one collected background information from the participants to establish their role and experience in the construction industry.

Section two collected data on the issues leading to poor performance of UK construction projects. Section three assessed the knowledge of the participants on the traditional project management methodology used within the UK construction industry as well as establish its benefits and major weaknesses. Section four evaluated the potential contribution of agile project management in managing construction projects and the extent to which agile elements can improve the performance of UK construction projects. Section five collected data on the factors that hinder the adoption and integration of traditional and agile methodologies for the management of UK construction projects. In addition, an open-ended question was included in the questionnaire survey to allow an opportunity for the participants to comments in order to extract further information that may have been omitted by the questions and options provided.

According to Osuala (2007, cited in Oribhabor and Anyanwu, 2019), sampling means taking a portion of a population as representative of that population. However, in conducting research, a reasonable portion of the population should be sampled, thus increasing the generalizability of the research findings. The sample size in research depends on five study design parameters: minimum expected difference or also known as the effect size, estimated measurement variability, desired statistical power, significance criterion, and whether a one-or two-tailed statistical analysis is planned (Scott, 2007). Ticehurst (2009) also noted the significance of determining an absolute sample size that is independent of the study population, thus indicating the need for a method of determining a sample size. However, Oribhabor and Anyanwu (2019) suggests that a researcher is not compelled to follow the suggested range of sample size hook, line, and sinker. Another useful suggestion for the determination of sample size for a study is the Taro Yamane Statistical Formula (Yamane, 1967) for finding sample size of a finite population. This method is only applicable when the numerical strength of the population is known. The formula is:

$$n = \frac{N}{[1+N(e)^2\,]}$$

Where, n = the sample size

N = the finite population

e = the level of significance or limit of tolerable error

1 = unit or a constant

According to Statista (2022), it was estimated that construction professionals in the UK was approximately 2.08 million people. With a tolerable limit of 5% error or the level of significance at 0.05 (Chuan and Penyelidikan, 2006), the sample size will result as follows:

$$n = \frac{2{,}080{,}000}{[1+2{,}080{,}000(0.05)^2]} = 399.99 \approx 400.$$

Considering the above formular for deciding sample size, the figure (400) indicates the least number of questionnaires to be distributed for the UK construction professionals. Experienced UK construction professionals, including architects, construction project managers, quantity surveyors, site managers, project managers with a at least two years of relevant professional experience, were targeted to participate in the survey. A minimum of two-year relevant experience in their current job was used in sampling the research participants to ensure they have taken part in the execution of some projects as well as guarantee they have practical knowledge in the management of construction projects. For sampling purposes, the typical response rate for an online survey based on the average responses obtainable in similar studies is between 20 to 40% (Liyanage, 2006).

5.7.1 Sampling Technique

Purposeful sampling method was employed to identify and select a group of individuals who have various years of experience within the field of construction in the UK. According to Creswell (2005), if the aim of a research is not to generalise a population but to develop an in-depth exploration of a phenomenon, then the purposeful sampling method is suitable. Besides, during the sampling process, the availability and willingness of the participants to take part in the study and their ability to effectively communicate their experience and opinion in a coherent and reflective manner was taken into cognisance (Bernard, 2002). Consequently, the questionnaire survey link (Microsoft forms) was dispersed to 400 experienced UK construction practitioners identified on LinkedIn. The following steps were taken to facilitate high response rate:

- A cover/invitation letter was included which provided details about the research and the researcher, encouraging the participants to voluntarily complete the questions with an assurance of anonymity and confidentiality in gathering the findings.
- The questionnaire was divided into five relevant sections, and the questions were designed to be closed-ended with clear options except for the last question that allowed the participants to freely comment.
- Recommendations and suggestions from the pilot study were taken into consideration before the questionnaire was dispersed.
- Reminders were sent out to facilitate the participants, and after three reminders at one-month interval, a total of 85 responses were gathered, representing 21.25% of the total number of respondents. Considering that not all professionals in construction (that make up n = 400) were considered in this study, except those in senior management level. 21.25% response rate can be judged as a fairly satisfactory rate, due to the following reasons:
    - Personal contacts of the researcher
    - Layout of the questionnaire: straightforward and easy to understand
    - The area under study has received lots of attention lately, especially in the UK, due to its severity and impact on the economy of the nation as a whole.
    - The incorporation of a cover letter in the questionnaire which highlighted the importance of taking part in the questionnaire.

5.8 Data Analysis Procedure

Data analysis is a systematic process of applying statistical and/or logical techniques to explain and illustrate, condense, recap, and evaluate data findings from a research activity (The Office of Research Integrity, 2021). Data analysis is a vital ingredient for any research (Ashirwadam, 2014), and it is usually an ongoing process that helps in answering the research questions as well as provide direction for future data collection (Alsulamy, 2015). Data analysis for this study was implemented in two phases: qualitative data analysis (i.e., analysis of open-ended questionnaire data) and quantitative data analysis (i.e., analysis of questionnaire survey data) as discussed in the following sections. Findings from the two phases of data analysis informed the outcome of the research in developing a framework for the integration of the TPM and AgPM methodologies for the management of UK construction projects.

5.8.1 Qualitative Data Analysis

The procedure for the qualitative data analysis in this study included narrative data analysis and document content analysis. Narrative inquiry is majorly concerned with the stories individuals share in everyday lives (Murray, 2018). Narrative data analysis makes use of texts, such as stories, interviews, photo, journals, letter, conversation, field notes, to analyse and substantiate grounds for the research question (Ashirwadam, 2014).

Convenience sampling was adopted because participants were selected based on availability and willingness to take part in the study. The researcher reached out to various construction practitioners via LinkedIn and eight participants agreed to take part in the study. These participants are from different sectors of the construction industry within the north-west of England, such as site management, health and safety, contracting/sub-contracting, building and construction site workers. Open-ended survey was then designed based on literature findings and sent out via MS forms. Open-ended survey was chosen because it provides detailed responses from the participants, thereby minimising the researcher's bias (Farrell, 2016). Although not everyone completed the questions. For instance, one of the participants simply responded "n/a" indicating no knowledge on AgPM. The open-ended survey in this study was aimed at exploring the perceptions of UK construction practitioners on the current state of the industry, the methodologies adopted in managing construction projects, and their perceptions on the use of the AgPM methodology in managing construction projects. Consequently, drawing a conclusion which in turn informed the next phase of data collection.

5.8.1.1 Open-Ended Survey

Open-ended surveys are key tools used for the understanding of participants' views as they enable researchers to slip into the participants' minds and reveal otherwise invisible things, such as attitudes, perceptions, reasonings, and beliefs (Ferrario and Stantcheva, 2022). Also, open-ended surveys shed light on how the research participants reason with respect to the performance issues in the UK construction industry and their perceptions on the use of the AgPM methodology. Open-ended survey in this study constituted the qualitative data which later informed the development of the questionnaire. Several limitations are associated with the use of open-ended survey in research such as low response rate, difficulty to compare responses, hard to analyse, time consuming. However, among these limitations, the researcher experienced low response rate, as well as some irrelevant responses (e.g., n/a). Even though evidence suggests the use of NVivo for the analysis of qualitative research (Myers, 2009; Robson, 2002), considering that the NVivo qualitative analysis software enables the researcher to examine and classify collected data and to draw conclusions, this phase of the study was exploratory with the goal of collecting further (quantitative) data in the next phase of the study. Hence, data analysis involved the use of manual coding method for the analysis of the transcribed data from participants.

The processes of analysing the open-ended survey data collated from the participants was carried out via thematic analysis and manual coding of the data, then followed by transcription of the coded words based on the participants' views. The analysis was conducted following the guidelines suggested by Creswell (2009) as follows:

- precise transcription of the participants' recorded answers to the questions
- preparation and organisation of the data
- re-reading of the transcripts iteratively
- the coding of the transcripts and developing themes from the transcripts.

5.8.1.1.1 Coding Criteria

Coding in qualitative research is a process that enables the collected data to be assembled, categorised, and thematically sorted, providing an organised platform for the interpretation of the findings, that is, construction of meanings from the codes (Williams and Moser, 2019). Coding can be performed manually (i.e., reading through the text or manually writing down concept occurrences) or through the use of various computer programmes (e.g., NVivo). Findings from this phase of the study was presented in key themes drawn from the survey responses and interpreted based on a manual coding technique. Convenience sampling was also adopted since participants were selected based on their availability and willingness to take part in the study. The open-ended questions were designed based on the literature findings and sent out to UK construction practitioners (across the north-west of England) via LinkedIn (see appendix C), and eight of them agreed to take part in the study. Semi structured interview was also considered at this stage of the study considering the low response rate. However, this stage of the study was done at the heart of COVID-19 pandemic and it was rather difficult to get participants for a face-to-face or online interview. Besides, open-ended survey allowed the participants to fill out the responses in their own time, without pressure from the researcher. Although some of the participants did not complete all the questions, some useful findings were made. The data collected from the questions presented were then exported into a CSV/XLS file, and the following were performed:

1). The responses were grouped into themes and sub-themes. Text analyser tool enabled the identification of broad categories of responses.

2). The individual responses that match the categories identified were marked and tallied.

3). The categories that should be grouped together but ended up in different categories because participants used different words to describe the same concept were regrouped.

4). Finally, the data were visually represented.

The key themes (categories) drawn from this phase of the study include the UK construction industry, available tools and methodology, agile project management methodology. Figure 5-12 shows the categories, the codes and sub-codes identified from the data collected.

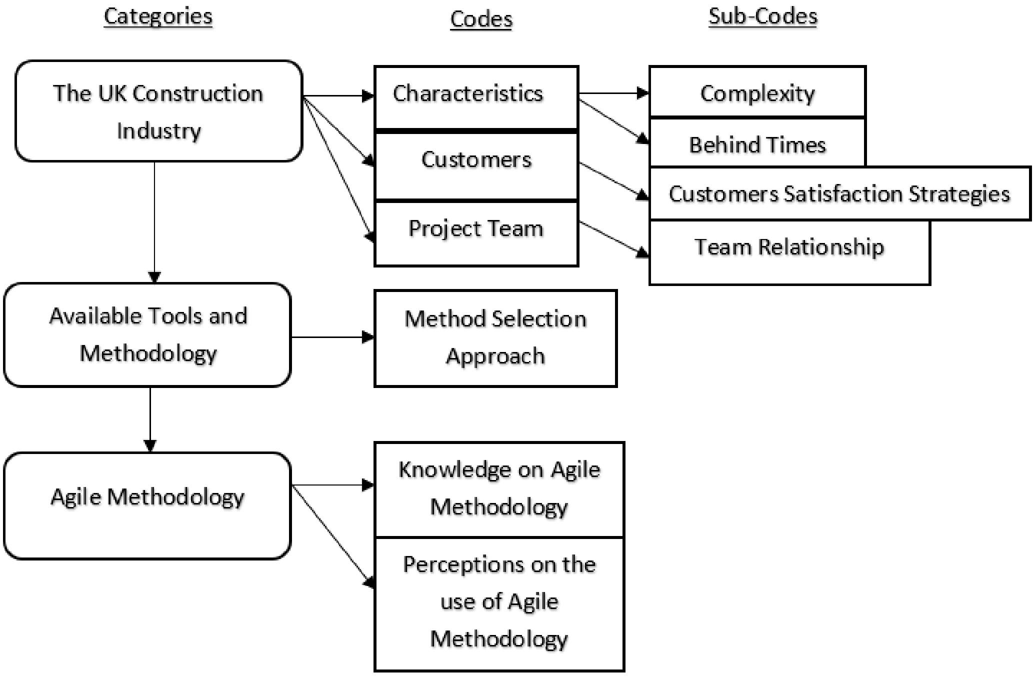

Figure 5-12: Category Coding – The Process

5.8.1.2 Document Content Analysis

Document analysis is a form of qualitative research in which documents are interpreted by the researcher to give voice and meaning around an assessment topic (Bowen, 2009). Document content analysis has been found useful for examining trends and patterns in documents, and it provides an empirical basis for monitoring shifts in the provision of public services (Stemler, 2001). There are three primary types of documents according to O'Leary (2014), these includes:

- Public Records: The official, ongoing records of an organization's activities, e.g., mission statements, annual reports, policy manuals, student handbooks, strategic plans, and syllabi.
- Personal Documents: First-person accounts of an individual's actions, experiences, and beliefs, e.g., calendars, e-mails, scrapbooks, blogs, Facebook posts, duty logs, incident reports, reflections/journals, and newspapers.
- Physical Evidence: Physical objects found within the study setting (often called artifacts), e.g., flyers, posters, agendas, handbooks, and training materials.

Neuman (2006) argues that document content analysis is useful for three types of research problems: (a) problems involving a large volume of text; (b) when a topic must be studied at a distance, like the situation of a topic or problem from existing documents; and (c) when it can reveal important messages in a text that are difficult to see with a casual observation. Document content analysis was incorporated as a qualitative method in this study, which is a viable research method that can either stand alone or be combined with another research method to enhance triangulation (Gross, 2018). The research design for this stage of the study is shown in Figure 5-13

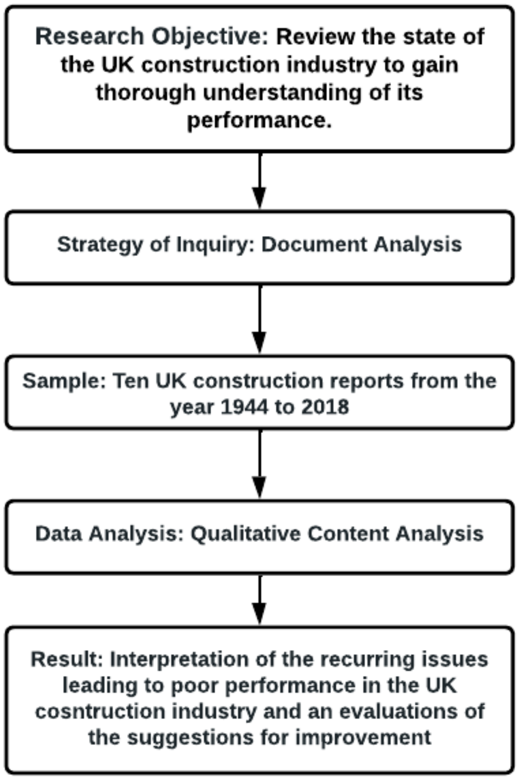

Figure 5-13: The research design for document analysis

5.8.1.2.1 Sampling Strategies

In order to fulfil the objectives of a study, it is doubtful that a researcher can collect data from all cases, hence the need to select a sample (Taherdoost, 2016). While the quantitative research leans towards larger, randomly selected samples, the qualitative research focuses on smaller, purposefully selected samples (Miller and Alvarado, 2005, cited in Gunatilake, 2013). The main focus of random sampling in a quantitative research is to achieve generalisation to a larger population whereas the aim of purposeful sampling in a qualitative sampling is to gain depth of understanding of a fewer number of information-rich cases (Gunatilake, 2013). Patton (1995) proposes sixteen (16) different techniques of carrying out purposeful sampling, as shown in Table 5-5.

Table 5-5: Sampling Techniques

	Type of Purposeful Sampling	**Purpose/Advantages/Disadvantages**
1	Extreme or deviant case sampling	Learning from an extremely unusual manifestations of a phenomenon of interest (e.g., outstanding successes/ notable failures); can gain in-depth understanding; can supplement statistical data about the normal distributions.
2	Intensity sampling	Information-rich cases that manifest the phenomenon intensely but not extremely (e.g., above average/ below average); involves considerable judgement; requires exploratory work to determine nature of variation.
3	Maximum variation sampling	Picking cases with a wide range of variation on dimensions of interest; identifies significant common patterns across cases and derives their significance; can describe variations as well as shared outcomes; cannot attempt to generalise findings.
4	Homogenous sampling	Focuses and reduces variation in sample; purpose is to describe a particular subgroup in depth; simplifies analysis.
5	Typical case sampling	Illustrates what is typical or average; sample is illustrative and not definitive; does not permit rigorous generalisation.
6	Stratified purposeful sampling	Illustrates characteristics of particular sub-groups of interest; facilitates comparison; sample size is generally too small for statistical representativeness or generalisation.
7	Critical case sampling	Identifies cases that can make a dramatic point or are particularly important; useful in situations where resources are limited; does not permit broad generalisations to all possible cases.
8	Snowball or chain sampling	Identifies cases of interest from people; who know people; who know information-rich cases.
9	Criterion sampling	Picking all cases that meet some criterion; provides quality assurance.
10	Theory-based or operational construct sampling	Finding manifestations of a theoretical construct of interest so as to elaborate and examine the construct.
11	Confirming and disconfirming cases	Elaborating and deepening initial analysis; seeking exceptions; testing variations; challenge of finding confirming and disconfirming cases.
12	Opportunistic sampling	Following new leads during field work; taking advantage of the unexpected; flexibility.
13	Random purposeful sampling	Adds credibility to sample when potential purposeful sample is larger than one can handle; reduces judgement; improved credibility.

14	Sampling politically important cases	Selecting (or sometimes avoiding) a politically sensitive site or unit of analysis; attracts attention to the study or avoids attracting undesired attention by purposefully eliminating from the sample politically sensitive cases.
15	Convenience sampling	Doing what is fast and convenient; saves time, money, and effort; lowest credibility; yields information-poor cases.
16	Combination of mixed and purposeful sampling	Triangulation; flexibility; meets multiple interests/needs.

Adapted from Gunatilake (2013)

Based on the above descriptions of purposeful sampling techniques, the criterion sampling technique is the most suitable technique for document selection at this stage of the study and is chosen because it allows the researcher to pick all cases that meet some criteria whilst providing quality assurance. The following section briefly elaborates on the criteria the researcher considered for document selection whilst adopting the criterion sampling technique.

5.8.1.2.2 Criteria Considered for Selecting Documents

Several documents can be used as sources of data in a research, including personal documents (e.g., diaries and letters), official documents deriving from the state, official documents deriving from private sources (e.g., organisations), mass-media outputs, and virtual outputs (e.g., internet resources) (Bryman, 2008, cited in Gunatilake, 2013). However, given the focus of this phase of the research, it is important that the analysis be limited to 'official' documents. Official documents can be originated from either the state or private sources. Hence, general web survey via internet search was used as the primary means of identifying documents for analysis. Besides, consideration was given to the publications, and the researcher ensured the selected documents to be analysed were government sponsored publications relevant to the performance of UK construction industry. The key search was basically for UK construction reports between the year 1944 and 2018, and results gotten covered a broad range of reports. However, only ten of the reports were considered due to time constraints.

According to Bowen (2009, cited in Gunatilake, 2013), the main concern in selecting documents for document analysis should be the 'quality of the documents and the evidence they contain' and not the number of documents selected. Since the quality of results obtained from a document analysis exercise is highly dependent upon the quality of the documents that have been selected for analysis, Scott (1990, cited in Gunatilake, 2013) proposes four criteria that could be used to ascertain the quality of selected documents as follows:

- Authenticity: establishing that the documents are genuine and of unquestionable origin.
- Credibility: establishing that the documents are free from error and distortion.
- Representativeness: establishing that the documents are typical of their kind; and if not, the extent of their untypicality is known.
- Meaning: establishing that the documents are clear and comprehensible.

The documents selected in this study can be considered as authentic since they were published by either the UK government or a recognised professional institution (sponsored by the government). Also, during the selection process for the documents to be analysed, the researcher sourced for the original reports and not just a translated version. Therefore, the selected documents can be considered as of high quality.

5.8.1.2.3 Analysing the Data

Level of analysis: The level of analysis for the document content analysis at this stage of the study is limited to the selected UK construction reports and their recommendations. Based on this information, the following section discusses the steps adopted in conducting the conceptual analysis.

Preparing for the coding process: Whilst it is always good for the researcher to have an overview of the research process and to prepare the different steps in advance, certain things need to be in place before coding can be initiated (Linneberg and Korsgaard, 2019). In the case of this study, the researcher began with the design of the study (section 5.2) and defined the objectives of the study, which helped in streamlining the kind of data needed for this study as well as served as an arbiter in respect of any questions that appeared during the research process. The research design for this study summaries the nature of this research and examines the overall elements to determine how they fit together. More so, it defines the unit of analysis, the context, and the data that needed to be collected. Secondly, in-depth literature review on the UK construction reports was conducted (refer to section 2.3), which helped in the development of tools needed for collecting the data. Accordingly, Eisenhardt (cited in Linneberg and Korsgaard, 2019, p. 4) states thus, “I believe in knowing the literature, and then looking for a problem or questions where there’s truly no known answer. It’s almost impossible to find those problems without knowing the literature.” Finally, following the literature review process, the relevant reports were downloaded in their original format and saved for further analysis.

The concepts to code for: Coding in its most basic form is the simple operation of identifying segments of meaning in data and labelling them with a code (Linneberg and Korsgaard, 2019), which can be defined as “a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language-based or visual data” (Saldaña 2015, p. 3). The concepts coded for in this study are built around a set of words that are most recurrent, excluding generic words like construction, industry, sector, organisation. Also, some level of flexibility was given in the consideration of the set of words in order not to overlook some important words that could add significantly to the final outcome.

Decision on what to code for/Pattern of coding: According to Colorado State University (2008), cited in Oyebanji (2014), a researcher can decide to code for ‘existence’ or ‘frequency’ of a concept for determining the pattern of coding. Nevertheless, “when coding for the existence of a word or phrase,” the word or phrase would only be counted once, no matter how many times it appears, thus giving the researcher a very limited perspective of the text. More so, it could be that the number of times it appears is indicative of its importance (Oyebanji, 2014). As a result, the ‘existence’ of a word was not considered as the coding construct for this study; rather, the researcher used ‘frequency’ to code for the set of words as related to the study.

Distinguishing among concepts: Distinguishing among concepts in the code is essential in determining the level of generalisation, i.e., whether the words in the reports are to be examined, considered, and recorded, as they appear different or similar to one another (Oyebanji, 2014). Likewise, in this study, different words were considered and grouped accordingly.

Rule for coding the texts: This section pertains to the development of a “translation rule that allows for streamlining and organising the coding process so that what is required is coded for, consistently throughout the text, in the same way every time”

(Colorado State University, 2008). In some cases, a set of pre-defined translation rules is used to translate the instruction sequence and contexts into translations (Sun *et al*, 2022). For the purpose of translation in this study, consistency was maintained in order not to lose the exact focus of the research. This enabled the translations drawn from the documents to remain valid and not confusing, thereby allowing a concise level of coherence.

Decision on irrelevant information: Even though the goal of this stage of the study is synonymous with the first objective of this study, the approach adopted by the researcher for this stage was slightly different from that of this research i.e., to evaluate construction reports on performance of the UK construction industry, the recommendations, and how the industry has implemented those recommendations. Therefore, submissions that do not add value to the focus of this stage of the study were ignored.

Coding the texts: The process of coding involves examining a coherent portion of empirical material – a word, a paragraph, a page, and labelling it with a word or short phrase that summarises its content (Linneberg and Korsgaard, 2019). According to Colorado State University (2008), cited in Oyebanji (2014), texts coding can either be done by hand, that is, reading through the text or manually writing down concept occurrences, or through the use of various computer programmes (e.g., NVivo).

Analysing the results:

According to Gunatilake (2013), interpretation brings to light an 'underlying coherence or sense' in a text, which in some ways may seem 'confusing, incomplete, cloudy, or contradictory.' In qualitative content analysis, the coding system constitutes an essential part of its data analysis. Coding refers to how the data is defined, and what the data you are analysing is about (Gibbs, 2007). In essence, it is the process of identifying a passage in the text or other data items (photograph, image), searching and identifying concepts, and finding relations between them (Columbia University, 2022). In the context of this study, coding enabled the researcher to achieve two objectives: a mechanical reduction of the data and an analytical categorisation of the document (David and Sutton, 2004; Neuman, 2006, cited in Gunatilake, 2013). Three categories of coding could be employed in document content analysis, including manual coding of documents, category coding, and content coding with the use of

NVivo software (Oyebanji, 2014). However, content coding were used for this analysis.

5.8.2 Quantitative Data Analysis

To analyse the quantitative data in this study, descriptive and statistical analyses were employed. Descriptive data analysis provides summary of samples available to a researcher in a sensible way (Sharma, 2019). It is usually quantitative in nature. On the other hand, statistical data analysis, which is an important aspect for all research activities, proffers approximate solutions to an unknown in its true form. The survey questionnaire for this study was designed to collect nominal data through the general questions (in section one of the questionnaire) and ordinal scale data for the rest of the questions. Generally, ordinal data allow the use of non-parametric data analysis techniques whereas nominal data allow the use of parametric data analysis. After inputting all the data into the SPSS statistical analysis tool, and the types of variables were determined, the next step was to carry out the statistical analysis tests in the following four major steps:

1. descriptive data analysis for independent variables
2. reliability and validity of data (internal consistency analysis)
3. central tendency test for dependent variables
4. inferential statistics

The following sections explain in detail the processes employed in analysing the data for this study.

5.8.2.1 Descriptive Data Analysis

Descriptive statistics are basically mathematical procedures used to simplify, summarise, and organise numerical data (Mertler, 2017). Basically, descriptive statistics are categorised into measures of central tendency, measures of dispersion, and measures of relationship. For the purpose of this study, the measures of central tendency (mean value) was employed in analysing the independent variables, and the data analysed covered biographic data of the research participants to explain the general characteristics of the participants, their gender, their years of experience, their roles, and the sector they work in. The main research questions (dependent variables) were also analysed using descriptive statistical tools (mean value).

5.8.2.2 Reliability and Validity of Data Analysis

Reliability refers to the degree to which a measurement of a phenomenon provides stable and consistent result (Taherdoost, 2016). It measures consistency, precision, repeatability, and trustworthiness of a research as well as the extent to which the research is without bias (Haradhan, 2017). For a survey questionnaire to be valid, it must be reliable. Hence, Saunders *et al* (2009, p. p. 169) propose three approaches to assess the reliability of collected data from the questionnaire, including:

- test retest
- internal consistency
- alternative form

The test-retest reliability approach allows the administration of questionnaire and re-administration at a later date to measure the stability of the scores obtained from the same person on two or more separate occasions (Vilagut, 2014; Demir, 2013; Bryman, 2012; Neuman, 2011; Gill and Johnson, 2010; Saunders *et al*, 2009), with the aim of comparing the consistency of the results obtained from the questionnaire. For this research, however, the test-retest approach would not be feasible, considering the difficulty in gaining responses from the research participants and the time it would take to re-administer and collect responses from the same set of questionnaires twice (Bryman, 2012; Saunders *et al*, 2009). Alternate-form reliability is the consistency of test results between two different but equivalent forms of test. In this approach of reliability test, two equivalent (but different) tests were administered, scores were correlated, and a reliability coefficient was calculated, and a test would be deemed reliable if differences in one test's observed scores correlate with differences in an equivalent test's scores (Glen, 2020). However, the alternate-form reliability test has not been used in this study, as it would increase the time required for answering and completing the questionnaire.

Internal consistency shows the degree to which items within an instrument measure various aspects of the same characteristic or construct (Gravesande *et al*, 2019; Revicki, 2014). "[…] involves correlating the responses to each question in the questionnaire with those to other questions in the questionnaire" (Saunders *et al*, 2009, p. 374). Subsequently, the internal consistency of the survey questionnaire for this study was achieved using the Cronbach's alpha [α] test. The Cronbach's alpha [α] test is the most popular internal consistency measure, which is usually ascertained as the mean of all possible split-half coefficients (EL Hajjar, 2018). Alpha value varies from 0 to 1, and a high alpha value shows a high degree of consistency among items on a test (Tavakol and Dennick, 2011). Generally, alpha values between 0.70–0.95 are considered as good, but it is also imperative to note that alpha values are affected by the number of items on a test; so, the higher the items on a test, the higher the alpha value (Gravesande *et al*, 2019). Hence, the researcher is expected to be cautious when interpreting alpha values > 0.90 because this may indicate the presence of redundant items (Tavakol and Dennick, 2011).

In SPSS, reliability assessment with the Cronbach's α is used to measure the internal consistency where the question has different variables, which in SPSS are called 'items,' and a group of items is called a 'scale' (Saini, 2015). These scales are mostly to determine an average or total score that represents this underlying construct (Yu, 2001). Whilst the Cronbach's α attempts to ascertain how well a set of question is grouped together in a survey, it cannot ascertain whether the items it is analysing consist of a single dimension or multiple dimensions (Saini, 2015). Also, considering that the questionnaire for this study was designed to have multiple scales, the result for such questionnaires might require multiple re-runs of the Cronbach's α tests (Saini, 2015). Cronbach's α was performed for all dependent variables, including construction performance issues, benefits of TPM, weaknesses of TPM, benefits of AgPM, and factors that hinder the adoption of AgPM. The minimum value is for Cronbach's $\alpha = 0.700$ (Field, 2005), which is considered sufficient for the purposes of this research. However, for the case where the Cronbach's $\alpha < 0.700$, the item total statistics were used to identify if there were potential dependent variables which could be deleted to increase the α-value.

Validity, on the other hand, explains how well data collected in a research covers the actual area of investigation (Taherdoost, 2016). It shows how well the results among the study participants represent true findings among similar individuals outside the study (Patino and Ferreira, 2018). In a research, validity does not necessarily mean the same in an interpretivist study as it does in a positivist study (Bryman, 2012; Creswell, 2009; Bryman and Bell, 2007). The concepts of validity - internal validity, external validity, reliability, and objectivity (Bryman and Bell, 2007; Bryman, 2012) - sprung from the positivism, and is therefore situated in a completely different perspective in research. So, most of the validation concepts seem appropriate only for research within the positivist paradigm (Bryman, 2012; Saunders *et al*, 2009; Creswell, 2009; Bryman and Bell, 2007). However, Bryman (2012) is of the opinion that the evolved concepts of validation for qualitative research studies are different in their nature but are comparable with quantitative ideas since validity is related to trustworthiness of the research. Also, Bryman (2012, p. 390) notes that the concept of trustworthiness consists of four criteria as follows:

- credibility, which parallels internal validity
- transferability, which parallels external validity
- dependability, which parallels reliability
- confirmability, which parallels objectivity.

Credibility deals with how believable the data is (Bryman, 2012); transferability covers issues on the applicability of the findings to other contexts (Bryman, 2012; Remeny *et al*, 1998); dependability is also related to the trustworthiness of the study; and confirmability "[...] that is, has the investigator allowed his or her values to intrude to a high degree?" (Bryman, 2012, p. 49) Saunders *et al* (2009, p. 373) also suggest three approaches to assess the validity of the collected data from the questionnaire:

- content validity
- criterion validity
- construct validity

Content validity deals with the extent to which elements of the derived questions are relevant to a representative of the targeted construct for a particular assessment purpose (Koller *et al*, 2017). Content validity covers several aspects e.g., the validity and representativeness of the definition of the construct, the clarity of the instructions, linguistic aspects of the items (e.g., content, grammar), representativeness of the item pool, and the adequacy of the response format (Koller *et al*, 2017). One way of ascertaining the content validity in a study is by employing others to judge the intended questionnaire (Bryman, 2012; Saunders *et al*, 2009). In the case of this study, content validity was achieved through piloting the initial questions for both phases of the data collection process.

Criterion validity estimates how well the scores, or responses of a test converge with criterion variables with which the test is supposed to converge (Shou *et al*, 2021). It is basically concerned with the ability of the indicators to make appropriate forecasts (Bryman, 2012; Neuman, 2011; Saunders *et al*, 2009). This validity approach is assessed by statistically testing a new measurement technique against an independent criterion or standard (concurrent validity) or against a future standard (predictive validity) (Bellamy, 2015). Construct validity is generally concerned with "[…] the extent to which your measurement questions actually measure the presence of those constructs you intended them to measure" (Saunders *et al*, 2009, p. 373). In this study, the criterion and construct validity measures are not within the scope and have not been applied since this study focuses on validating the transferability criterion of the findings.

5.8.2.3 Central Tendency Test for Dependent Variables

The central tendency tests usually include count, mean, median, mode, and standard deviation calculations. The main aim of these central tendency tests is to demonstrate that the assumptions, which would be made from literature review and open-ended survey findings, are not the opinions of single individuals, but rather can be transferred to a wide range of people. In this study, the central tendency test employed is the mean value. Results of the mean values were compared with the findings from the preliminary phase of this study, and the mode and median values were used to interpret any potential differences. Furthermore, Relative Importance Index (RII) analysis was used to analyse and identify the most important criteria based on participants' responses as well as served as an appropriate tool to prioritise indicators rated on Likert- type scales (Rafidah *et al*, 2018). In the analysis, the dependent variables were ranked based on their relative importance indices, hence showing the variables with the highest importance (Nasim *et al*, 2019). In addition, the higher value of RII reveals a higher level of importance. The formula for RII adopted in this study is $RII = \Sigma W / (A*N)$ (Rajgor *et al*, 2016); where:

W is the weighting given to each factor by the respondents (ranging from 1 to 4); A is the highest weight (i.e., 4 in this case); and N is the total number of respondents.

Rewriting the formula, we have: $\frac{4n_4+3n_3+2n_2+1n_1}{A*N}$

5.8.2.4 Inferential Statistics

Inferential statistics are used to ascertain the likelihood of a given statistical result for an entire population based on a smaller subset or sample of that population (Mertler, 2017). Inferential statistical procedure is usually employed as a means of analysis for research to draw up inferences from data collated from a study (Alsulamy, 2015). Inferential statistics can be parametric or non-parametric inferential tests. Parametric inferential statistics assume data have come from a normal distribution, and make inference about the parameters, whereas non-parametric inferential statistics, also known as a distribution-free, do not necessitate any condition to be fulfilled about the parametric of the research population (Okoroiwu and Akwiwu, 2019). Two non-parametric inferential statistics were employed in this study - the Pearson correlation and the linear regression - to parsimoniously explain the variability among observed, correlated variables (Watkins, 2018).

5.8.2.4.1 Pearson Correlation

Pearson correlation measures the presence (given by a p-value) and strength (given by the coefficient r between -1 and +1) of a linear relationship between two variables (Gilchrist *et al*, 2014). Pearson correlation was used in this study to understand the relationship between two variables in which changes in the value of one variable are associated with changes in the value of the other variable, thus allowing a deeper understanding of the nature and degree of relationship among variables as well as the ability to predict for the future course of actions. In interpreting the results from the Pearson correlation, it is important to understand what the correlation coefficient means and what it tells of the data, as shown in Table 5-6 below.

Table 5-6: Correlation coefficient and Interpretations

Size of Correlation	**Interpretation**
1	Perfect positive/negative correlation
± .90 to ± .99	Very high positive/negative correlation
± .70 to ± .90	High positive/negative correlation
± .50 to ± .70	Moderately positive/negative correlation
± .30 to ± .50	Low positive/negative correlation

± .10 to ± .30	Very low positive/negative correlation
±.0 to ± .10	Markedly low and negligible positive/negative correlation

5.8.2.4.2 Regression Analysis

Regression analysis, on the other hand, was used to describe how the changes in each independent variable are related to changes in the dependent variable. In regression analysis table, there are five symbols: the unstandardised beta (B), the standard error for the unstandardised beta (SE B), the standardised beta (β), the t test statistic (t), and the probability value (p). Typically, the only two values examined were the B and the p. However, all of them are useful to know. The unstandardised beta (B) value represents the slope of the line between the predictor variable and the dependent variable. The unstandardised beta (SE B) value is similar to the standard deviation for a mean. This means the larger the number, the more spread out the points are from the regression line. The more spread out the numbers are, the less likely that significance will be found.

The standardised beta (β) value works very similarly to a correlation coefficient. It ranges from 0 to 1 or 0 to -1 depending on the direction of the relationship. The closer the value is to 1 or -1, the stronger the relationship. With this symbol, you can actually compare the variables to see which had the strongest relationship with the dependent variable since all of them are on the 0 to 1 scale. The t test statistic (t) is calculated for the individual predictor variable, which is used to calculate the p value. The last symbol, that is, the probability level (p) tells whether or not an individual variable significantly predicts the dependent variable. You can have a significant model but a non-significant predictor variable. Typically, if the p value is below 0.05, the value is considered significant.

5.8.2.3 Pilot Study, Procedure, and Result

In this study, pilot studies were conducted with the aim of testing the reliability, authenticity, and the feasibility of the questionnaire (Mani *et al*, 2017). The participants in the pilot study included construction practitioners within the UK and two lecturers in construction management from different universities. The first draft of the questionnaire based on findings from the literature review was sent to the supervisory team for review. Following their reviews and suggestions, the questionnaire was re-drafted and again sent to the supervisory team for a final review. After the final review and amendments, the approved questionnaire was sent to the university's ethics committee and approval was granted (see appendix A). Six construction practitioners were selected through stratified random sampling, wherein the population was divided into groups and a member from each group was recruited for the pilot study. They went through the questions in the questionnaire and made suggestions for improvements. After working on the suggested areas for improvement with the supervisory team, the final draft of the questionnaire was sent out online via a link created using MS forms.

5.8.2.4 Non-Response Bias

Survey research can be considered as a social exchange (Coon *et al*, 2020). Hence, decision to respond to survey are sometime rooted in the beliefs that the potential benefits the participants stand to gain - e.g., economic, social, environmental will ultimately outweigh the costs - e.g., time, effort, privacy intrusion (Dillman *et al*, 2014). Although selflessness may sometimes explain the decision of some participants to participate in a survey (Spitzm€uller *et al*, 2007). Goyder *et al* (2006) also expatiates that sometimes, the benefits accrued in participating in a survey are not explicitly discussed prior to participation but developed through mutual reciprocity and based on trustworthiness (van Riper *et al*, 2016). Furthermore, Hillygus (2015) notes that apart from the factors that lead to decreased response rate in a survey, the increased rate of robocalls, marketing emails as well as spam emails may sometimes discourage participants from responding to surveys.

It is also important to note that studies with high response rate can sometimes experience non-response bias (Groves and Peytcheva, 2008). Hence, Halbesleben and Whitman (2013) developed a guide that outlines options for evaluating nonresponse bias in surveys, describing methods that are applicable to all disciplines that involve survey research. Several techniques have been provided by studies to increase response rates in a study and the best-known strategies so far has been incentives and personal contact (Toepoel and Schonlau, 2017). According to Dillman (2007), personal contact with the participants increases their decision to participate in a survey, depending on the number of contacts, the timing of the first contact, the time interval between successive contacts, the way each contact is done, the personalization of the contact, information words used.

In this study, non-response bias was addressed via personal contact through various strategies prior and during data collection. Prior to the data collection, the researcher joined relevant groups on LinkedIn in which some of the participants were members, engaged with the participants on posts made on the group to create a level of trust between the participants and the researcher. Then, advance letters was sent to the participants explaining the purpose of the study and the need for their invaluable contributions. After the survey link was sent to the participants, follow up in-mails was sent reminding the participants of how much their contribution will benefit the study.

5.9 Summary

This chapter presents a detailed epistemological positioning of this research as well as establishes the philosophical trinity and philosophical alignment of the research. The pragmatic paradigm adopted in this study informed and enabled the choice of appropriate methodology and methods for this research. The mixed methods approach was adopted in this study. Findings from this chapter reveal that, even though the mixed methods approach comprising the qualitative and quantitative methods can be adopted for different purposes, neither of the methods (qualitative or quantitative) is superior. However, the researcher is responsible for deciding the dominance (between the quantitative and qualitative methods) and the implementation sequence (i.e., if the quantitative and qualitative methods were used concurrently or sequentially). For this study, qual → QUAN mixed method approach was employed, wherein the qualitative method was adopted first, followed by the quantitative method in the second stage. The philosophical position of this research has been presented in section 5.3.5 as well as the justification for the chosen method for data collection in 5.4.1. Literature findings have also demonstrated different point scale variables can be used in a Likert scale, hence the 4-point Likert scale results of this research. This chapter adequately represents all stages involved in the research.

CHAPTER 6 : OPEN-ENDED SURVEY ANALYSES AND FINDINGS

6.1 Introduction

This chapter presents open-ended survey findings from the first phase of this study, which was aimed at achieving the first three objectives of this study: reviewing the state of the UK construction industry to gain thorough understanding of its performance (with respect to the customer, project team, and quality focus of industry); examine the available methodology used in managing construction projects; and to assess the perceptions of UK construction practitioners on the AgPM methodology. Discussions begin with the demographics of the participants, followed by discussions on the themes drawn from the open-ended survey, and finally a summary of the findings.

6.2 Demographics of the Participants

In research, demographic information provides data regarding the research participants, and is necessary in determining whether the individuals in the study are a representative sample of the target population for generalisation purposes (Salkind, 2010). Discussion in this section highlights some of the characteristics of the research participants, including their years of experience, the size of organisation they work in, the size of their project team, and the sector in which they work.

6.2.1.1 Years of Experience

During this phase of the study, participants with varying years of experience were recruited to participate, considering that the participants' experience is one of the common grounds for qualitative studies. Six out of the eight participants have experience of five years and above, indicating that majority of the respondents have attained a reasonably practical and professional experience in the UK construction industry. Reasonable work experience has been regarded as a valuable asset that can greatly assist in making an outstanding contribution towards meeting the need of clients and achieving the organisation's objectives (McFarland, 2010). Hence, it is possible to assume that the years of experience of the participants in this study enabled them to have some clear understanding about the UK industry.

6.2.1.2 Sector

In this study, majority of the participants were from the contracting and sub-contracting sector of the UK construction industry. The UK construction industry is vast with sectors and sub-sectors, namely the contracting sector, service sector, and product sector. The contracting sector is the largest sector in the UK construction industry, consisting of about 70% of Total Value Added, which includes the construction of buildings, civil engineering, and specialised construction such as demolition (Department for Business Innovation and Skills, 2013). The service and product sub-sectors are also very crucial to the general performance of the construction sector, yielding considerable return to the UK economy (Department for Business Innovation and Skills, 2013). A summary of the participants for this phase of the study is shown in Table 6-1.

Table 6-1: Research participants

Participants	Years of Experience	Construction Sector
P1	1	Sub-contracting
P2	2	Contracting
P3	6	Health and Safety
P4	10	Site Management
P5	15	Contracting and Sub-contracting
P6	5	Contracting
P7	50	Contracting/Building
P8	20	Contract Labour

6.3 The UK Construction Industry

The following sub-sections cover findings from research objective one which reviews the state of the UK construction industry to gain thorough understanding of its performance. Discussion is presented in four themes based on the questions presented under this section

6.3.1 Characteristic of the UK Construction Industry?

Responses to the question that says: “How would you describe the characteristic of the construction industry?” were coded into three key themes, namely: complexity (fast paced/pressure), male oriented, behind times.

6.3.1.1 Complexity

Although some of the participants described the UK construction industry as a reliable industry and a nice place to work, majority of the participants used the terms "*rollercoaster, under pressure, energetic, fast"* to describe the complexity of the industry. Globally, the construction industry is constantly criticised for issues, such as low productivity, poor performance, delays, unsafe work practices, and for delivering projects that exceed planned costs and time (Oti-Sarpong *et al*, 2021; Laubier *et al*, 2019; Buehler *et al*, 2018). Besides, Winch (1998) attributes these issues to the industry's lack of innovation and fragmentation arising from its complex configuration and the apprehensiveness towards the acceptance of modifications that will impact established ways of organising work within the industry (Hall *et al*, 2020). In addition, the participants identified some key difficulties associated with the management of construction projects, such as "*time keeping* (delays and overruns), *"team management,"* "*lack of skills*," and *communication gaps*."

The issue of delays and overruns in the UK construction industry has been ongoing for several decades, and several studies have identified numerous causes of delays in construction projects. Hence, it can be argued that up till date, there is no consensus on what constitutes a major delay in construction projects due to the varied perspective on the subject matter by researchers (Sanni-Anibire *et al*, 2022). One of the earliest studies on the causes of delays was presented by Baldwin *et al* (1971) who highlighted 17 causes of construction delays in the United States. Subsequently, Sullivan and Harris (1986) presented a study on the causes of delays in the UK construction industry, which formed the contextual basis for research studies that followed in subsequent years (Sanni-Anibire *et al*, 2022). Regardless of the causes of delays, studies have revealed that the complexity of construction projects and the fragmented state of the industry carrying out these projects have resulted in a limited, clumsy, and extremely irregular project management process (Office for National Statistics, 2018; Kagioglou *et al*, 2000; Gidado, 1996), thus creating the impression that the issue of delays is almost inevitable.

Team management is also identified as one of the key difficulties associated with the UK construction industry. Following the Egan Report on "Rethinking Construction," Egan (2002) notes that team management is not just about bringing people under one roof but in collectively helping one another and working together for the same goal.

The concept of team management goes back to the industrial revolution, wherein organisations adapted hierarchical approach in managing a project team (Kashyap, 2017). Although this hierarchical approach in managing a team has changed, and organisations are beginning to optimise new working styles, the construction industry, unlike other industries, is fragmented in nature. This poses a difficulty in adopting and optimising innovative team management approach. Kissi *et al* (2022) suggest that the construction industry can benefit from multicultural team setting in the promotion of personal and professional growth, strong competitive advantage, and an avenue for effective decision-making. However, considering that design and construction are two separate words, and new teams are usually formed or reorganised for a new construction project, the project team management is therefore based on the project objectives and technical abilities of the individual (Anumba *et al,* 2002). Besides, team management has been identified as one of the reasons for poor performance in the UK construction industry (Nurhidayah, 2012). Therefore, Kashyap (2017) recommends an integration of the processes and teams whilst managing construction projects. Furthermore, shortage of skilled workers and communication issues are also identified as some key issues that are characteristic of the UK construction industry.

6.3.1.2 Behind Times, Male Oriented

According to Merriam Webster Dictionary (2022), ‘behind times’ refers to a state of not having or showing knowledge of current ideas or styles: outdated, old-fashioned. In response to the question, “How would you describe the characteristics of the construction industry?” Six out of the eight participants believes the UK construction industry lags behind times in different areas. For example, P2, agreed the industry lags behind and gave reason thus: “*because it lacks management.”* P6 also stated the industry lags behind considering the many recurring accidents: “*too many accidents.”* P11 also mentioned the industry lags behind *“technology wise*.” Furthermore, some of the participants synonymised the characteristics of the UK construction industry with phrases like “*old* school,” “*needs to modernise*.” For example, P10 who described the characteristics of the industry as “*behind times*” also stated that the industry *“needs to modernise and do more off-site fabrication*." P10 was further asked if there was any difference in managing construction projects in comparison with other industries (especially manufacturing/production and IT), and his response was as follows: "*Big difference. Construction jobs are usually unique, so everyone is a prototype. Most of* *the work is done at the mercy of the weather,"* hence his suggestion for modernisation and off-site fabrication.

Furthermore, Participant 9 who initially described the industry as "*friendly but male oriented*" noted thus, "*It (referring to the UK construction) still operates in an old-school–way,"* and further suggested that *"There could be more integration of technology."* In consideration to the male orientation of the UK construction industry, studies have revealed that the construction industry so far has recorded one of the worst gender imbalances (Norberg and Johansson, 2021; Shah *et al*, 2020; Wright and Conley, 2020; Perrenoud *et al*, 2020), with the UK lagging behind other European countries (Moncaster and Dillon, 2018). In addition, statistical reports show that less than 1% of the UK's 800,000 construction and building trade workers represents women, and when other professions, such as architects, planners, and surveyors, are included to the list it only rises to 18% (University of Cambridge, 2018). According to Worrall *et al* (2010), one of the major barriers to gender balance in the UK construction industry, irrespective of job role or profession, is the male-dominated organisational culture with inflexible working practices. It is appalling that in this era of Industry 4.0, the UK construction industry is still lagging behind times, and is still plagued with the issue of gender imbalance. Besides, these issues have been delineated by several scholars as well as publications and addressed in several themes. For example, Farmer (2016) in his report, tagged "*Modernise or Die*," evaluates the UK construction industry's current and future state, and he asserts that the UK construction industry is one of the last industries to embrace modernisation. It seems like, *while other industries are using smartphones, the UK construction is still pretty much the same as it was during the Roman times.* Hence, Farmer (2016) suggests that the UK construction industry would face 'inexorable decline' except its longstanding problems are addressed.

The ageing population of the UK construction practitioners is another significant "lag" identified in this study. Kenny Ingram (2018) in a report addressing the industry's lag notes that it is time to change the construction industry's reputation, considering that the UK construction industry has a reputation that needs to combat old-fashioned and predominated older age group that is resistant to change. In 2015, CIOB report revealed that an increase in the number of retired practitioners in the near future would cause a strain on the economy and on those still working as the ratio of workers to pensioners declines. Subsequently, ONS (2016) identified that there are currently 3.3 people of working age to each retired person and projected that by 2032 the figure will fall to 2.9 people of working age. Apart from these areas of lag identified in this study, the UK construction industry lags behind in other prominent areas, including in the those of productivity, profitability, digitalisation, customer satisfaction, just to mention a few. For example, McKinsey & Company (2020) reports as follows: "Annual productivity growth over the past 20 years was only a third of total economy averages. Risk aversion and fragmentation as well as difficulties in attracting digital talent slow down innovation. Digitalization is lower than in nearly any other industry. Profitability is low, at around 5 percent EBIT margin, despite high risks and many insolvencies. Customer satisfaction is hampered by regular time and budget overruns and lengthy claims procedures."

Even though the UK construction industry seems energetic and fast-paced, and has evolved considerably over the years, the industry is not necessarily at the forefront with respect to embracing changes when compared to other industries like finance, transportation, and education. This is because of the lethargic nature of the industry in adopting substantial changes due to its inherent traditional nature, coupled with the apprehensiveness for change from the staunch believers of the traditional processes. Hence, several ongoing issues persist, leading to the poor performance of the industry.

6.3.2 Construction Clients

Discussions in the following sub-sections cover questions related to the participants' organisational strategy and objectives in meeting the needs of the customers.

6.3.2.1 Strategies for Clients Satisfaction

In response to the question, "Describe the vision, strategy, and objectives of your organisation in meeting the needs of the customers," seven out of eight participants described their organisational strategies for meeting their customers' needs from the traditional management approach. For example, P1 noted as follows:

"*target the customer needs… think towards the future and ask customers what they would expect in the future.*"

This strategy is synonymous with the traditional PRINCE2 approach, wherein the project manager tries to foresee the future and ascertain the exact needs of the customers. Studies have proven that this approach of attempting to *think towards the future* is one of the major challenges traditional project managers encounter (Tuttle, 2018; Marle and Vidal, 2016; Salameh, 2014; Awad, 2005; Klien *et al*, 1997). Besides, it is almost impossible to fully target and envisage the customers' needs to obtain a vivid report of what they want in the future. Furthermore, P1 provided a breakdown of how they manage project deliverables to meet the customers' needs as follows:

"*deciding on project deliverables* (i.e., agreeing on what is expected of the project at the onset), *deciding on process deliverables* (i.e., how to execute the project – the processes involved to meet the customers' needs), and *get them defined* (and documented). In conformity with the response of P1, P4 also noted as follows:

"We aim to deliver the job they want within an agreed time frame with minimum disruption from them."

"…We like a clear objective from the customer and a full site inspection and site plans as far as they are available."

The response of P4 in conformity with the response of P1 shows that the project manager (in this case) tries to ascertain what the clients want in the future and deliver accordingly. Furthermore, the response of P4 demonstrates their strict reliance on the iron triangle (of quality (or cost), scope, and time). This indicates that once the team has agreed on the requirements (quality, scope and time), the project team embarks on delivering the job with minimal disruptions from the customers. Thus, once they agree with the customers on what they want (from the onset), they go ahead and deliver exactly what they want, giving no room for their interferences (or changing requirements). To emphasise further, P4 further stated:

"We have project managers with excellent communication and negotiation skills, who work with the clients to manage their expectations and discuss changes needed/wanted to the original brief."

It is important to also note that construction projects are underpinned by adopted procurement and contracting arrangement. Hence, the procurement and contractual arrangement would have provisions for variations and changes in the lifecycle of the project. Since the rigidity of the traditional project management, as well as the selected procurement strategy does not allow much deviations from the contracted arrangement, project managers adopt good negotiation skills in order to come to an agreement on all the deliverables of the project in advance before the project's commencement. According to Wysocki and Mcgary (2007), if a project manager undiscerningly accepts what the client proposes from the inception of a project (thinking all is under control), and gives no room for possible reconciliations, in the future, what the client wants may be entirely different from what is needed and trying to resolve such issues usually lead to delays and overruns as well as eventually clients' dissatisfaction. Besides, the third agile value (customer collaboration over contract negotiation) emphasises the need for collaboration between customers and the project team all through the project rather than depending on the negotiation skills of the project manager. Granted, negotiation is good (Shonk, 2020), collaboration on the other hand entails that the customers, stakeholders, and the project team work together throughout the entire project's life cycle (Tumbas and Matković, 2006) rather than just agreeing to a compromise from the onset of the project based on negotiations. Furthermore, in corroboration to the idea behind the rigid TPM methodology, P6 stated that their strategy to meeting the customers' needs is to "*focus on getting it right the first time; … a focus on quality, time, and cost."* Likewise, P5: *"all on plans"* and P7: *"time, quality, cost."*

Conversely, P2 responded as follows: "*It can be difficult, but we just get on with it and try our best."* This response seems more relatable, considering limitations of the TPM methodology and the complexity of construction projects. Indeed, it is usually very difficult to foresee the future and pre-plan as well as ascertain all the client's needs from the onset of a project. Hence, so much time is usually wasted on the planning process.

All the responses gathered in this section establish that the TPM methodology relies heavily on pre-defining the project objectives beforehand, followed by a strict planning of all the project processes and a comprehensive documentation approach to define and record all the agreed plans and structure of the project. This is due to the influence of the selected procurement and contractual arrangements for the project in order to avoid risks and deviations from the agreed scope. Hence, pre-defining the project plans and objectives, and comprehensive documentations allows each team member to know their responsibilities and the project's requirements ahead of time.

Also, most project managers within the TPM methodology work in accordance with the iron triangle, also known as the triple constraints of cost, time and quality (or scope), wherein the project schedule (time) is at the top of the model (triangle) whilst cost and quality (or scope) are situated at the base of the triangle (Villanova University, 2021). These constraints are considered crucial, hence adopted as some of the major strategies in managing project deliverables. However, several studies have also highlighted the weaknesses of the traditional performance measurement system (discussed in section 2.4.1). Hence, the emphasis is on adopting a more effective strategy for measuring and managing project deliverables (ISO 9001:2015; Neely and Platts, 2014; Horta and Camanho, 2014; Yang *et al*, 2010; Neely *et al*, 2002).

Furthermore, in response to how they manage their customers' changing requirements throughout the project's life cycle, their responses were as follows: P8 noted that they "*ask questions and carry out customer surveys*." P3 also responded that they adopt "*regular project updates and drumbeats*" as a strategy in managing changing requirements from the clients. P5: "*daily meeting*." P6 also responded in line with P3 and P5, stating as follows: "*keeping everyone informed and up to date, considering time constraints and how they will affect deliverables. Managing the customers' expectations with regard to timing - if a deliverable change, then the timeline will most likely be affected*." Drumbeat meetings enable the project manager or the team to ascertain which tasks have been completed as quickly as possible and to plan, monitor, and deliver the works as well as to identify if there are any blockers (Berryman and Cheung, 2020). These meetings provide a constant drumbeat for the project team to work well. Therefore, the entire project team is marching to the same drumbeat while facilitating communication (Palmer-Trew and Taylor, 2019), as stated by P6.

6.3.3 Project Team

Discussion in this section focuses on questions relating to the project team members' organisation and their relationships (interactions) within the traditional construction management context.

6.3.3.1 Team Relationship

In response to the question, "What kind of relationship exist among the project team, the technical team (the developers), and stakeholders?" some of participants responded as follows:

P1: "*It's a kind of family relationship; everyone gets on and have been on the team for a very long time.*" P4 also commented that, "*Usually the relationships are strong and supportive.*" P7: "*Usually the relationships are strong and supportive.*"

A project team is not efficient simply because everyone forms a close-knitted relationship or has worked together for a long time. Studies have proven that celebrating, learning, collaboration, and commitment makes a team feel the recognition for their accomplishments and milestones in both business and their personal lives (Frost, 2019; Hale, 2016; Meier, 2008). Therefore, a team needs to deliberately have a retrospective learning about each other and improve their relationship as a team, which is much more than working as a family. When asked further how they disseminate information within the team, P4 clearly stated that:

"We tend to have a quick site meeting daily and at the start of any project, team working on it are taken through the plan… They (team) *are all kept in the loop. They tend to have worked for us for a while, so we have good team relationships, and they seem to enjoy what they do."*

P6 also commented that: "*The technical team only reports to the project team; the stakeholders only communicate with the project team; we keep the project team at the centre of all communication so that unnecessary relationships aren't formed between various stakeholders and the technical team. We feel this is the best way to avoid communication.*"

According to Zulch (2014), communication is the foundation of effective project management. The project team and the stakeholders are expected to diligently work together to understand the project scope, establish the requirements, and prioritise functionality (Salameh, 2014). Therefore, occasional participation and communication with the stakeholders is usually discouraged because the stakeholders are also part of the project team. Hence, the stakeholders should be carried along throughout the project's life cycle (Tumbas and Matković, 2006).

6.4 Available Tools and Methodology

This category covers questions that fall within the research objective two: examine the current the project management methodology used within the UK construction industry, identifying its strengths and weaknesses in relation to the management of complex construction projects. Findings reveal that the UK construction industry predominantly adopts the traditional project management methodology in managing construction projects. In this phase of the study, four out of the eight participants that responded to this question agree to the predominant adoption of the TPM methodology.

P4 - "*We tend to develop projects using the PRINCE2* (project in controlled environment 2) methodology."

P6 - "*I use the PRINCE2 method which I am trained in.*"

In the UK and some other European countries, the PRINCE 2 methodology has been recognised as a *de-facto* standard for the management of projects (Siegelaub, 2020; PRINCE2, 2018; AXELOS, 2018; Matos and Lopes, 2013; The National Health Service, 2003). The PRINCE2 methodology has been prescribed by the UK government as the official methodology in organising, planning, and controlling project deliverables (Department for Business Innovation and Skills, 2010). PRINCE2 is a process-based methodology, in which all project steps are defined at the beginning, based on dividing down the project into procedures and steps, and it focuses on organisation and control over the entire project, from start to finish (Zubon and Taher, 2022; Slate, 2019). In fact, studies have revealed several benefits of adopting the PRINCE2 methodology: can be adopted for a range of tasks, establishes a framework for functions and responsibilities, concentrates on the product that is clearly defined at the start of the project, is fully understood by all stakeholders, employs exception management, and so on (Pawar and Mahajan, 2017). However, what happens in the real world is different. In the real world of project management, project managers cannot foresee everything and clearly define the entire project in advance considering that some aspects might be vague due to the project's changing circumstances.

Furthermore, some scholars believe PRINCE2 misses the importance of "soft skills" that should be a focus for a project manager as well as does not provide the level of flexibility offered by modern methodologies. Therefore, there may be difficulties in catering for some of the modern project management needs (Cotrim, 2015). Furthermore, P5 and P10 responded as follows:

P5 - "*lots of planning*" (synonymous with TPM approach).

P10 - "*good planning and CAD software, scheduling, quality manuals...We use them well generally.*"

P5 also noted that they employ *Idea management and portfolio management* in response to the question: "Which project management tools and methods are available in your organisation?" Ideas are vital for organisations because they are the source for innovation which in turn leads to endless source of competitive advantage (Dorow *et al*, 2015). An operational idea management program with a large number of ideas in an organisation can support in reaching the market faster as well as meeting the demands of shifting consumer preferences or political climates (Gerlach and Brem, 2017). However, idea management does not serve as a replacement for an organisation's project management methodology which refers to the strictly defined combination of practices regarding logic, methods, and processes that determine how best to plan, develop, and control a project along the continuous process of its implementation and successful completion (Ungureanu and Ungureanu, 2022).

Portfolio management, on the other hand, is "an integral part of the strategic planning process and supports the 'how' of strategic delivery and implementation through such things as modelling possible portfolio outcomes to provide various forward views for consideration" (APM, 2019, p.8). It includes interrelated organisational processes, by which an organisation evaluates, selects, prioritises, and allocates its resources to accomplish its strategies (PMI, 2013). To effectively manage a project portfolio, it is suggested that an organisation needs to strategize its management methodological approach (Kononenko and Kpodjedo, 2021). The remaining participants did not give a direct response to the question but rather stated "n/a" and "leadership" as the responses to the question, "Which project management tools and methods are available in your organisation?"

6.4.1 Methodology Selection Approach

This section addresses the follow-up question from section 6.1 that relates to how the participants select the methodology they use in managing construction project. In response to the question, "How do you decide which tools and methods you will implement?" two approaches for the selection of a methodology in managing construction projects were identified: dependent on the leadership i.e., leadership decision or the management decision to select an appropriate methodology for use;

and dependent on the project types. Discussions below further elaborate these findings.

Methodology selection can be based on several factors. First, it can be based on the individual (leadership) knowledge of the project manager, the team, the management (Ferrada *et al*, 2013), as stated by P2 and P5:

P2 - Depends on the team that you have (i.e., the collective decision of the team and its leadership). *P5 - This is decided by management* (also referring to the leadership of the organisation).

Before commencing any project, the problem of choosing adequate methodology arises, considering that there are several management methodologies that can be implemented in a construction project (Kononenko and Kharazii, 2014). In fact, one of the key factors identified that affect the productivity and efficiency of construction project is the selection of construction methods to use (Ferrada and Serpell, 2014). Construction methodology has been considered one of the five potential areas of productivity loss in managing construction projects (European Construction Institute 1994). Hence, an appropriate selection of the methodology used in the execution of a construction project is a very key factor for its development and the achievement of the desired results (Zhong *et al*, 2022; Ferrada and Serpell, 2014), which in many cases is undertaken without considerable attention, hence generating negative consequences for the project. Responses from P2 and P5 indicate that the information or documentation required to select appropriate construction methodology lies in the hands of the management or the person in charge of the project, as corroborated by Ferrada and Serpell (2014) in Figure 6-1 below.

Following an organisations' decision on how to procure a construction project, the available methodological approach for the project would have to be approved by the management before the project can proceed to the next stage (Ferrada and Serpell, 2014).

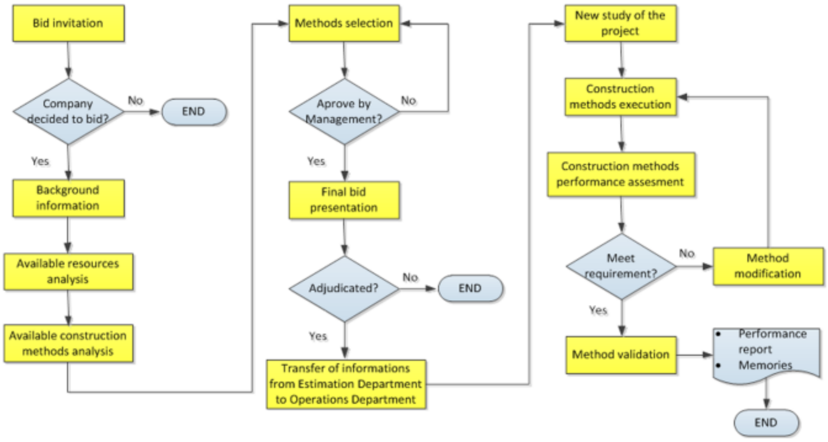

Figure 6-1: General process to select construction methods
Source: Ferrada and Serpell (2014)

The second distinct approach for methodology selection identified from the responses of the participants is that methodology selection approach is dependent on the project itself, as stated by P7, P8, P9, and P10 below:

P7 - These are dictated by the project. If we need lime plaster then we need different tools and methods than those for regular plaster, etc. P8 - Tools and machine available for the project. P9 - I look at each project with a fresh perspective even though I stay informed by past projects. This way I don't miss any foreseeable issues. P10 - Depends on the job but planning is key to all jobs.

Some scholars also believe that the process of selecting an appropriate methodology is based on the project itself, i.e., profit, financial standing, and risks involved (Parvaneh and El-Sayegh, 2016), as stated by four of the participants in this study. In practice, however, the project manager or the leadership of the organisation does not always have a clear understanding of all existing variants of standards and project management methodologies, considering only limited number of options (Kononenko and Kharazii, 2014). Hence, there is the need for a deeper understanding of how to identify and select an appropriate methodology for a construction project, as stated by P9: "*I look at each project with a fresh perspective even though I stay informed by past projects.*"

Even though the response of P9 shows their methodological selection approach depends on the project itself and does not negate the importance of making forecasts based on previous projects executed, rather than focusing on the profit, scope, and risks as yardsticks to decide a methodological approach, this response shows that every project is unique and should be dealt with uniquely.

Over the years, studies have presented criteria for the selection of a method. For example, Cockburn (2000) provides four principles involved in selecting an appropriate methodology. Principle 1- A larger group needs a larger methodology, i.e., small team methodology cannot effectively work for a big team, and vice versa. A methodology is larger when it contains more elements (roles, work products, reviews, standards, and so on), considering that methodology exists primarily to coordinate people. Hence, a larger methodology would be appropriate on a larger project. Principle 2 - A more critical system (one whose undetected defects will produce more damage) needs more publicly visible correctness (greater density) in its construction. That is to say that the project team must consider investing in a worthwhile methodology, regardless of additional costs. Principle 3 - A relatively small increase in methodology size or density adds a relatively large amount to the project cost. This principle does not question whether the coordination activities and deliverables are beneficial or hazardous; it addresses the cost of adding elements and control to the methodology. Principle 4 - The most effective form of communication (for transmitting ideas) is interactive and face-to-face communication, as at a whiteboard. This implies that as the project size increases, interactive and face-to-face communication becomes hard to arrange, communication effectiveness goes down, and the associated cost goes up.

Turner (2003; 2004) also suggests a method of balancing between the rigid planned methodology (TPM) and the agile methodology while managing a specific project in the expected environment based on the following stages:

- Stage 1. An evaluation of the risks connected with project's implementation through use of the planned and agile methodologies according to specific environment conditions.
- Stage 2. If the risks relating to application of agile methodology prevail over the ones inherent to the planned methodology, the latter should be applied.
- Stage 3. If the risks associated with application of the planned methodology prevail over the risks inherent to agile methodology, they should apply agile methodology.

- Stage 4. If some components of the project meet the stage 2, and others meet the stage 3, the most adequate methodology should be applied to the outlined components.
- Stage 5. They map out the project's implementation.
- Stage 6. They monitor the project's progress, evaluate the risks and potentials, readjust the balance if necessary.

Sheffield and Lemétayer (2013), by virtue of a reference analysis, recommend eight important factors that must be considered when choosing a methodology, which are focused on a rigid planned approach (Prince 2, PMBoK) or on the adaptive agile approach. Kononenko *et al* (2013) design a method for the selection of a methodology based on the following situations: 1). Where the project manager and project team do not have a full knowledge of alternative project management methodologies available, i.e., their knowledge of alternative methodology is rather superficial. 2). Where the project team does not have enough time and/or resources to study and master alternative methodologies before executing a project. Hence, the authors suggest the following methods: 1). A survey questionnaire for the project manager which would ascertain the most appropriate methodology to use for a particular project. 2). An assessment of labour intensity of the project management by means of the methodologies in question, cost of management, and risks. 3). A triple-criteria task of optimisation for selecting the best methodology.

In spite of selection criteria for a project management methodology, Kononenko and Kharazii (2014) suggest that the most precise choice of methodology is based on optimising the project scope based on the following criteria: profit, time, cost, quality, risk, and a company's maturity growth, adding also that the project team must consider the advantages and weaknesses as well as the range and efficient use of methodologies. Likewise, Burgan and Burgan (2014) corroborate and agree that choosing the right project methodology in an organisation involves more than just the leadership or the project itself; it entails carefully selecting which project management practices the team should perform based on the specific, high-level project characteristics gathered from the project charter and other related environmental factors to adequately plan and execute the project. Invariably, to identify and select the right methodology for use, an organisation needs to first consider the details of the project, then assess the existing systems and processes to ascertain what is needed and what is already in place.

6.5 Agile Methodology

Agility in construction has been a leading interest of the government and private sectors (Langford and Murray, 2008; Fernie *et al*, 2006). Literature reveals that AgPM was initiated to curb failures in projects (Agile Alliance, 2001). Hence, the questions that still linger are: has AgPM really made impact in UK construction? Has it changed the organisational culture and behaviour of the industry? This section will cover questions relating the participants knowledge on AgPM and their perceptions on the application of the AgPM methodology for construction projects.

6.5.1 AgPM Knowledge

In response to the question, "What do you know about agile project management?" four of the participants had no knowledge of AgPM while the remaining four responded as follows:

P5 – "*A little. A way of doing business adapted to construction job sites and overall project delivery."* P5's response to the questions reveals the gaps in knowledge on the AgPM methodology from the participant as the response was more inclined towards business agility. According to State of Agile Coaching Report (2022), business agility is a set of organisational capabilities, behaviours, and ways of working that affords your business (or organisation) the freedom, flexibility, and resilience to achieve its purpose, no matter what the future brings.

P2: *It's an approach to software development under which requirements and solutions evolve through the collaborative effort of self-organising and cross-functional teams and their customer/end user.* P7: "*….* Not *a great deal other than it provides* (allows) *teams to concentrate on different roles and to bridge the gap between ourselves and the customer."*

The responses of P2 and P7 focus on the roles of agile teams (self-organising teams). Self-organising teams are at the heart of agile software development. Self-organising agile teams are composed of individuals who manage their own workload among themselves based on need and best fit, and participate in team decision making (Highsmith, 2004). Self-organising teams have been recognised and studied in various forms: as autonomous groups in socio-technical systems; enablers of organisational theories; agents of knowledge management; and as examples of complex-adaptive systems (Hoda *et al*, 2013).

P8 – "*It's a software used by project team on contract plans.*"

These responses demonstrate that the AgPM methodology is not grounded in the UK construction industry, considering that most of the participants in this study only know the AgPM methodology in part. Despite the growth and acceptance of the AgPM in the business world, it is also important to recognise that the AgPM methodology is relatively new and still in its infant stage in the world of project management compared to the TPM methodology (Zucker, 2017). Findings by Zucker (2017) reveal that only 17% of agile practitioners identifies as being in the mature phase of agile usage while 33% reports as being in the very early stage of agile adoption. Version One (2021) report also shows that despite the growth of the AgPM methodology in other sectors, its adoption in the construction sector is still less than two percent compared to other sectors. This corroborates the paucity of knowledge on the AgPM methodology by the participants of this study.

6.5.2 Perception on the Use of AgPM

In response to the question, "Do you think that there is need for a new project management methodology to improve the performance of construction projects or do you think the current methods and tools are enough?" majority of the participants agree that the current traditional methodology is sufficient. Their responses are as follows:

- *P2 – "Current methods and tools are enough."*
- *P5 – "I think current methods and tools are enough."*
- *P6 – "They are enough."*
- *P8 – "Yes, more so to make it less hard and more productive."*
- *P9 – "I think they are enough."*
- *P10 – "We use key performance indicators like number of defects at handover, completion on time but we need to use more and use the results even more."*
- Except for participant - *P7 – "Possibly for modern construction projects but for heritage ones, I'm not sure that one size fits all or indeed any."*

These responses reveals the participants reservedness in shifting from the traditional ways of managing construction projects. Furthermore, in response to the question: "In your opinion, can the introduction of Agile Project Management (that adapts to changes) enhance the performance of construction projects?" five of the participants agreed and said yes. The remaining three participants fell within the category who had absolutely no knowledge on AgPM, and their responses were either n/a or a blank space. Thus, also suggesting an appetite for the use of AgPM among the research participants.

6.6 Summary of Preliminary Findings

This chapter provides preliminary findings on the state of the UK construction industry, the tools and methodology used in managing UK construction projects, the perceptions of UK construction practitioners on the use of AgPM. Although this phase of the study is rather exploratory, evidence gathered so far reveal the following:

- The UK construction industry is lagging behind compared to other industries with respect to adoption of innovative changes.
- The complexity of UK construction projects coupled with the fragmented state of the industry carrying out these projects, has undeniably resulted in several issues leading to poor performance.
- The TPM methodology is adopted for the management of construction projects within a rigid organisational structure and strict leadership approach.
- The strategy employed in meeting the customers' needs, as well as measuring the performance of construction projects is based on time, cost and scope (quality) which is synonymous with the iron triangle approach.

Moreover, there seems to be an appetite for a new management methodology (AgPM) based on the preliminary findings. However, due to the rigid organisational structure and the apprehensiveness for change from the believers of the TPM methodology (practitioners), the adoption of AgPM methodology has remained stunted. The next chapter will present data analyses with respect to the performance of the UK construction industry, the strengths and weaknesses of the TPM and AgPM methodologies, the barriers hindering the adoptions of the AgPM methodology and the way forward.

CHAPTER 7 : SURVEY FINDINGS

7.1 Introduction

This chapter deals with the presentation and analyses of data obtained through the questionnaire survey. The aim of this chapter is to present findings in line with the research objectives one, two, three, and five on the following: factors leading to poor performance of the UK construction industry, strengths and weaknesses of the TPM methodology, strengths of the AgPM methodology, and critical factors that hinder the adoption and integration of the AgPM methodology in construction management. Findings relating to the research objective four have been presented in the previous chapter of this research. Discussion of findings begins with the demographics of the survey participants, followed by the internal consistency analysis of the independent variables, and lastly statistical analysis of the dependent variables.

7.2 Demographics

The following sections present the demographic data of the research participants.

7.2.1 Gender

In this study, 82.4% of the participants constituted males while 17.6% consisted of females. According to Construction Sector Deal (2019), despite comprising over 50% of the UK population, only 14% of construction workers constitutes women while 86% represents men. This corroborates the findings of the first stage of this study where one of the research participants described the UK construction industry as *behind times, male oriented, and needs modernisation*. The causes of gender inequalities are actively debated in research. Notwithstanding, Petrongolo and Ronchi (2020) suggest a variety of factors ranging from unconscious gender bias and a lack of sufficient training to general perceptions of women working in construction. Gender inequality in construction has been an ongoing global issue. The issue of gender inequality in the UK construction industry is a very critical issue yet to be fully addressed. In addition, despite the huge progress of women in educational achievements over the last few decades worldwide, their progress has not translated into equal advancement in all areas of work (Navarro-Astor *et al*, 2017; Skarpenes and Nilsen, 2015; Lu and Sexton, 2010; Fielden *et al*, 2000). Many professions are still heavily gender segregated, contributing not only to unequal options for individuals but also discrimination and explicit exclusion (Norberg and Johansson, 2021).

The construction industry is a typical example of an industry dominated by the male gender. In 2021, Statista reports that the percentage of construction work held by women was extremely low with only 14.4% workers. Consequently, the gender percentages of responses are representative of the industry's statistics, and thus the figures are not skewed. Table 7-1 below provides an overview of the gender of the survey participants.

Table 7-1: Overview of the gender of the survey participants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	70	82.4	82.4	82.4
	Female	15	17.6	17.6	100.0
	Total	85			

7.2.2 Years of Experience

The following table gives an overview of the participants' years of experience prior to responding to the survey. 47.1% of the participants had experience of 21 years and above at the time of the survey, 27.1% had between 11 to 20 years of experience, 7.1% had five to ten years of experience, but 18.8% had less than five years of experience. This is indicative of the fact that nearly half of the participants ranked as very experienced construction practitioners who might be very traditional in their approach to construction project management and may not necessarily be open to change. The other half represented the middle-aged/younger generation of construction practitioners. Accordingly, CIOB (2015) notes that the UK construction industry has what is considered an ageing workforce, revealing that the industry is losing a valuable teaching resource as the older workers often use their expertise and experience in developing new entrants. This issue is also closely related to the industry's dilemma of skills shortages and its problems in recruiting younger employees. Table 7-2 gives an overview of the participants' years of experience.

Table 7-2: Participants' years of experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	less than 5 years	16	18.8	18.8	18.8
	5 to 10 years	6	7.1	7.1	25.9
	11 to 20 years	23	27.1	27.1	52.9
	21 years and above	40	47.1	47.1	100.0
	Total	85			

7.2.3 Sector

There are two main sectors within the UK construction - the public and private sectors, and within these sectors, there are four types of construction projects that are carried out including residential building, institutional and commercial building, specialized industrial construction and infrastructure and heavy construction (Construction Industry Sector Guide, 2023). According to the System of National Accounts (SNA) (1993), the public sector is defined as the national, regional, and local governments' institutional units controlled by government units (Alford and Carsten, 2017). Simply put, projects in the public sector are driven by central government and local government, and influenced by compulsory regulations from local, regional, national, and international organisations or bodies. Private sector, on the other hand, consists of organisations that have a core strategy and mission to engage in profit-seeking activities through the production of goods, provisions of services, and/or commercialisation (Vaes and Huyse, 2016).

In this study, 7.1% of the participants works only in the public sector, 41.2% works only in the private sector, and 51.8% works both in the public and private sector of the UK construction industry. Work life within the public versus the private sector of the UK construction industry is very different (Dunne, 2021). Besides, construction works in the public sector have consistently been smaller in value compared with private sector works, with the private sector accounting for approximately three-quarters of all new works in the UK construction industry (ONS, 2018). Also, a larger percentage (51.8%) of the research participants works in both the public and private sectors, thus allowing a balanced perception from both sectors and giving credence to the findings of this study. Table 7-3 gives an overview of the sector the participants have worked in.

Table 7-3: Participants' sector of work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Public	6	7.1	7.1	7.1
	Private	35	41.2	41.2	48.2
	Both	44	51.8	51.8	100.0
	Total	85			

7.2.4 Job roles

There are several job roles in the construction industry. Table 7-4 gives an overview of the job roles of the questionnaire respondents. Project managers, construction managers, site managers, engineers, quantity surveyors, architect, contractors, and consultants constituted 76.5% while the category for others was comprised of other professionals not captured in the questionnaire. Construction management is a challenging and demanding profession that requires many professionals and tradesmen from various walks of life, including and not limited to quantity surveyors, civil engineers, building services engineers, building information modelling (BIM) technicians, architects, health and safety officers, structural engineers, construction managers, project managers. However, the percentage of project managers in a construction projects seem to be higher because of the enormous responsibility of the project managers to oversee every aspect of any construction project from inception to closure (Nottingham Trent University, 2022). Furthermore, Economy News UK (2019) asserts that the project management industry has grown into one of UK's largest areas of business over the past decade, amid the increasing 'projectification' of work, with the Gross Value Added estimated to be £156 billion. This explains the higher percentage of project managers among the questionnaire participants.

Table 7-4: Job roles of the research participants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Project manager	22	25.9	33.8	33.8
	Construction manager	7	8.2	10.8	44.6
	Site manager	3	3.5	4.6	49.2

	Engineer	3	3.5	4.6	53.8
	Quantity surveyor	5	5.9	7.7	61.5
	Architect	4	4.7	6.2	67.7
	Contractor	6	7.1	9.2	76.9
	Consultant	15	17.6	23.1	100.0
	Total	65	76.5	100.0	
	Others	20	23.5		
Total		85	100.0		

7.3 Internal Consistency Analysis

Reliability is concerned with the ability of an instrument to measure consistently (Tavakol *et al*, 2008). In the measure of reliability in the social and organisational sciences, Cronbach's alpha, also referred to as a measure of "internal consistency" reliability, is most commonly used to assess the internal consistency of a questionnaire (or survey), which is made up of multiple Likert-type scales and items (Bonett and Wright, 2014). It shows how closely related items of a set are as a group. An example is the Likert scale (UCLA, 2021). In this study, the Cronbach's α analysis was performed for each group of dependent variables (construction performance issues, benefits of TPM, weaknesses of TPM, benefits of AgPM, and factors in the adoption and integration of AgPM) to ascertain the reliability of the questions.

7.3.1 Cronbach's α for UK Construction Performance Issues

The case processing summary indicates that no response was excluded for the analysis of the Cronbach's α for issues associated with UK construction. When analysing the Cronbach's α value for the dependent –variables—issues associated with UK construction (20 dependent variables)—it appears to have a high internal consistency with α value of 0.873 > 0.700, indicating that the response values for each participant across the set of questions are consistent. This reveals how well the questionnaire actually measured what the researcher wanted it to measure, connoting that the questionnaire was reliable, see Table 7-5.

Table 7-5: Cronbach's α for the dependent variables

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.873	.874	20

Furthermore, considering the mean and standard deviations for each of the question items, the mean scores were fairly similar (i.e., the differences between the mean scores of the items on the list of 20 variables), with highest mean score of 3.16 and lowest mean score of 2.56, Table 7-6. Hence, there was no need for further analysis since the questions were reliable.

Table 7-6: Mean and standard deviation of UK's construction performance issues

	Mean	Std. Deviation	N
Fragmentation	3.13	.632	85
Ageing Demographic	2.89	.724	85
Poor Technology Adoption	2.80	.784	85
Prolonged Planning and Negotiation	2.99	.779	85
Hierarchical Leadership and Management Style	3.08	.759	85
Reliance on Traditional Methods	3.07	.737	85
Shortage of Skilled Labour	3.15	.809	85
Inability To Keep Team Motivated	2.73	.793	85
Slow Innovation Rate	2.88	.730	85
Health and Safety	2.56	.879	85
Documentation Issues	3.06	.730	85
Team Unresponsiveness	2.92	.694	85
Non-Collaboration	2.87	.704	85
Changing Requirements	3.16	.687	85
Client Dissatisfaction	3.04	.778	85
Improperly Assessed Project Needs	3.04	.731	85
Coordination and Supervision	2.89	.787	85
Inaccurate Budget	3.04	.747	85
Poor Knowledge Management	2.95	.688	85
Sustainability and Waste	2.71	.814	85

7.3.2 Cronbach’s α for Benefits of TPM

From the case processing summary, no response was excluded for the analysis of the Cronbach’s α for benefits associated with the TPM methodology. The Cronbach’s α value for the dependent variables—benefits associated with the TPM methodology (Table 7-7), with 12 dependent variables—indicates a high internal consistency with α value of 0.813 > 0.700. This shows that the response values for each participant across the set of questions were highly correlated and consistent. Hence, the questions were reliable.

Table 7-7: Cronbach’s α for Benefits of TPM

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.813	.814	12

Furthermore, there was no significant difference between the variable with the highest mean score (clearly defined objectives) and the variable with the lowest mean score (single point accountability), see Table 7-8. Therefore, it is reflective of the fact that the questions were reliable, and there was no need for further statistical analysis.

Table 7-8: Mean and standard deviation for Benefits of TPM

	Mean	Std. Deviation	N
Clearly defined objectives	3.71	.484	85
Clearly Defined Deliverables	3.61	.599	85
Focused on Quality	3.52	.590	85
Good Control of Project Processes	3.34	.665	85
Comprehensive Documentation	3.36	.721	85
Single Point Accountability	2.99	.982	85
Guidance for Project Managers	3.13	.768	85
Division of Labour	3.04	.851	85
Unified Language	3.12	.762	85
Cost Effective	3.32	.743	85
Sequential Nature	3.24	.781	85
Efficiency	3.26	.710	85

7.3.3 Cronbach's α for Weaknesses of TPM

In analysing the Cronbach's α for the weaknesses associated with the TPM methodology, none of the questions was excluded. The Cronbach's α value of 0.814 > 0.700 reveals that the responses to the questions were closely correlated, thus indicating an acceptable internal consistency for the questions, see Table 7-9.

Table 7-9: Cronbach's α for Weaknesses of TPM

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.814	.818	14

Also, Table 7-10 shows that there was no significant difference between the variable with the highest mean score (high cost of restart) and the variable with the lowest mean score (fixed lifecycle). Hence, further analysis was not necessary.

Table 7-10: Mean and standard deviation for Weaknesses of TPM

	Mean	Std Deviation	N
High Cost of Restart	3.13	.784	85
De facto Methodology	3.09	.781	85
Project Plans are rarely Updated	3.05	.830	85
Rigid Structure	2.94	.730	85
Process Centric	2.92	.759	85
Minimal Client Involvement	2.91	.750	85
One way Communication Flow	2.88	.793	85
Assumption of Task or Goal Certainty	2.87	.686	85
Reliant on Predictability	2.85	.748	85
Linear Organizational Structure	2.82	.658	85
Inflexible Gateways Between Phases	2.79	.742	85
Predefined Requirements	2.76	.840	85
Reliant on Task Breakdown	2.75	.858	85
Fixed Lifecycle	2.66	.733	85

7.3.4 Cronbach's α for Benefits of AgPM

The Cronbach's α value for benefits of AgPM appears to have a good internal consistence with α value of 0.902 > 0.700, see Table 7-11. It also indicates that the questions were highly correlated, and more likely had a shared covariance and probably measured the same underlying concept.

Table 7-11: Cronbach’s α for Benefits of AgPM

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.902	.907	20

Furthermore, there was no significant difference between the variable with the highest mean score (efficient communication) and the variable with the lowest mean score (unlimited flexibility and adaptive changes), see Table 7-12. Hence, no further analysis was conducted to test the reliability of the questions.

Table 7-12: Mean and standard deviation for Benefits of AgPM

	Mean	Std. Dev.	N
Efficient Communication	3.65	.611	84
Team Ownership and Accountability	3.63	.576	84
Team Engagement and Commitment	3.61	.602	84
Adaptive Flexible Planning and Continuous Improvement	3.60	.583	84
Collaboration and Transparency	3.55	.629	84
Frequent Evaluation and Resolution of Issues	3.55	.629	84
Focus on Specific Needs of Customers	3.54	.667	84
Attention to Technical Excellence	3.54	.590	84
Greater Expertise and Resource Effectiveness	3.54	.702	84
Increased Productivity and Morale	3.51	.611	84
Closer Engagement with Stakeholders	3.50	.631	84
Reduced Waste	3.49	.685	84
Fast Delivery Time	3.44	.683	84
Discipline and Self-organisation	3.43	.699	84
Value Driven Development	3.43	.699	84
Retrospective and Reflective Practices	3.42	.764	84
Incremental Release Approach	3.35	.649	84
Reduced Cost	3.33	.717	84
Reduced Documentation	3.20	.861	84
Unlimited Flexibility and Adaptive Changes	3.11	.792	84

7.3.5 Cronbach's α for Barriers to the Adoption and Integration of AgPM

The Cronbach's α for barriers to the adoption and integration of Agile Project Management methodology in the construction industry was analysed. The case processing summary indicates that one response was excluded. However, the Cronbach's α for all the dependent variables together in this question was high, with a Cronbach α value of $0.852 > 0.700$, see Table 7-13 below. This indicates that the response values for each participant across the set of questions were highly correlated and consistent.

Table 7-13: Cronbach's α for Factors in the adoption and integration of AgPM

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.852	.851	19

Also, there was no need for further statistical analysis since there was no significant difference between the variable with the highest mean score (organisational resistance to change) and the variable with the lowest mean score (team working on multiple projects), Table 7-14.

Table 7-14: Mean and standard deviation for factors in the adoption and integration of AgPM

	Mean	Std. Deviation	N
Organizational Resistance to Change	3.55	.568	84
Training	3.48	.685	84
Skills and Experience with Agile Methods	3.38	.710	84
Resistance to Change	3.31	.776	84
Management Support	3.31	.744	84
Inconsistent Processes and Practices	3.30	.724	84
Collaboration and Feedback	3.29	.704	84
Prevalence of Traditional Development Method	3.26	.762	84
Minimal Collaboration Knowledge Sharing Practices	3.25	.774	84

Confidence and Ability to Scale	3.24	.801	84
Organizational Culture	3.20	.724	84
Agile Logistical Arrangements	3.20	.757	84
Agile Progress Tracking Mechanism	3.13	.757	84
Transition Time	3.13	.708	84
Availability of Personnel with Agile Skills	3.08	.895	84
Organizational Structure	3.05	.849	84
Existing Technology Does Not Support Agile	2.95	.877	84
Team Distribution and Communication Practices	2.90	.900	84
Team Working on Multiple Projects	2.88	.884	84

7.4 Analysis for Dependent Variables

Findings in this section are presented in five sub-sections: construction performance issues in line with research objective one; strengths of the TPM methodology as well as weaknesses of the TPM methodology in line with the research objective two; strengths of the AgPM methodology in line with the research objective three; and barriers that hinder the adoption and integration of AgPM in line with research objective five. The first stage of analysis began with descriptive analysis of the dependent variables as well as the ranking (Relative Importance Index). This was followed by the Pearson correlation coefficient to establish if there was a relationship between the variables, which could further lead to a bivariate regression analysis (in the case where a relationship is observed) to predict or explain their variations. Finally, a summary of the findings is presented.

7.4.1 Construction Performance Issues

Prior to the questions on issues leading to the poor performance of UK construction projects, the participants' level of agreement was assessed on the performance level of construction projects. Results from Figure 7-1 reveal that 15% of the survey participants strongly agreed to the poor performance level of the UK construction projects, 52% of the survey participants agreed, 19% of the survey participants disagreed, 1% of the survey participants strongly disagreed to the statement.

Figure 7-1: Participants level of agreement on performance issues

The reason for the 20% level of disagreement might be related to the participants' background (including their gender, the project context they work in, and their years of experience in the construction industry), considering that half of the research participants had experienced of 21 years and above in the construction industry, thus it seems like the more experienced practitioners may be comfortable with the present state of the industry. Accordingly, CIOB (2015) describes the ageing generation in the UK construction industry as the biggest challenge of the 21st century since it impacts the workforce as well as their perception of changes and innovation in the industry.

Furthermore, in analysing the dependent variables (issues associated with poor performance of the UK construction industry), 20 key issues were identified, from literature and open-ended survey, that lead to the poor performance of the UK construction projects, see Table 7-15. The variables have been rearranged based on the Relative Importance Index (RII) score ranking, which was calculated using the formula adopted by Rajgor *et al* (2016): RII = ΣW / (A*N).

Table 7-15: Central Tendency for UK construction performance issues

	Construction Performance Issues	**Valid**	**Missing**	**Mean**	**Std Deviation**	**RII score**	**RII Rank**
1	Changing Requirements	85	0	3.16	0.687	0.791	1
2	Shortage of Skilled Labour	85	0	3.15	0.809	0.788	2
3	Fragmentation	85	0	3.13	0.632	0.782	3
4	Hierarchical Leadership and Management Style	85	0	3.08	0.759	0.770	4
5	Reliance on traditional project management methods	85	0	3.07	0.737	0.767	5
6	Documentation Issues	85	0	3.06	0.730	0.764	6

7	Client Dissatisfaction	85	0	3.04	0.778	0.758	7
8	Improperly Assessed Project Needs	85	0	3.04	0.731	0.758	7
9	Inaccurate Budget	85	0	3.04	0.747	0.758	7
10	Prolonged Planning and Negotiation	85	0	2.99	0.779	0.747	8
11	Poor Knowledge Management	85	0	2.95	0.688	0.738	9
12	Team Unresponsiveness	85	0	2.92	0.694	0.729	10
13	Ageing Demographic	85	0	2.89	0.777	0.723	11
14	Coordination and Supervision	85	0	2.89	0.787	0.723	11
15	Slow Innovation Rate	85	0	2.88	0.730	0.720	12
16	Non-Collaboration	85	0	2.87	0.704	0.717	13
17	Poor Technology Adoption	85	0	2.80	0.784	0.700	14
18	Inability to Keep Team Motivated	85	0	2.73	0.793	0.682	15
19	Sustainability and Waste	85	0	2.71	0.814	0.676	16
20	Health and Safety Issues	85	0	2.56	0.879	0.641	17

Results showed that the relative importance indices (ranking) correlated with the mean scores from the central tendency findings. Hence, for the purpose of this study, the variables with mean score > 3 were considered as the major issues leading to the poor performance of UK construction projects. Also, the variable—prolonged planning and negotiation—came very close to the preceding variables, with a mean score of 2.99, as shown in Table 7-15. The following were the preceding variables which had mean scores > 3, accompanied by the variable which almost had a mean score of 3:

1. changing requirements of construction projects
2. shortage of skilled labour
3. fragmentation
4. hierarchical leadership and management style of the industry
5. reliance on traditional methods

6. documentation Issues
7. client dissatisfaction
8. improperly assessed project needs
9. inaccurate budget
10. prolonged planning and negotiation.

Furthermore, variables number 7, 8, and 9 for client dissatisfaction, improperly assessed project needs, and inaccurate budget had a tie in their mean score of 3.04 each, which implies that the three values were centred about the same value. However, this does not suggest that the data values vary by the same amount about the centre, hence the variations in their standard deviations, Table 7-15. Subsequent discussions present the major issues leading to the poor performance of UK construction projects, as identified in this study.

7.4.1.1 Changing Requirements

In the management of construction project, changes are inevitable, considering that the needs of the client may change in the course of the design or construction phase (Lature and Hinge, 2015). Change in requirement is a form of change that would cause deviation from the initial plan, budget or scheduled of a construction project (Rahman *et al*, 2017), and almost all construction projects undergo various degrees of changes throughout the project life cycle. Hence, it had the highest mean value of 3.16. Furthermore, these changes visibly impacts on the project processes; they affect the project schedule, cost, productivity, overall project performance, as well as cause ripple effects on the project (Moayeri, 2017). Thus, accounting for the high mean value presented in this study. Furthermore, due to the complex and dynamic nature of construction projects, coupled with different degrees of uncertainties and risks, changes in requirements usually would lead to excessive claims and disputes (Howick *et al*, 2009, cited in Rahman *et al*, 2017).

7.4.1.2 Shortage of Skilled Labour

The UK construction industry represents a major contributor to the nation's economy, generating approximately £90 billion annually and employing about 10% of the entire UK employment (Department for Business Innovation and Skills, 2013). Therefore, to maintain this status, the UK industry heavily relies on skilled labour to deliver infrastructure projects (Rolfe and Hudson-Sharp, 2016). However, a report published by the Royal Institution of Chartered Surveyors (RICS) indicates that the economic growth and performance of the UK construction industry is being restricted by significant skilled labour shortages (Royal Institution of Chartered Surveyors, 2015). In this study, shortage of skilled labour came second with mean value of 3.15, which invariably affects the client's requirements in terms of time, cost, and quality since the industry is heavily reliant upon its workforce (Mohamed and Pärn, 2017). Also, seeing that majority of the workforce in the UK Construction industry are nearing retirement age, with 22% over 50 years old and 15% over 60 years (Seidu *et al*, 2019), a substantial proportion of skilled construction workers will be lost in the next decade (Henson and Asenievich, 2014). Hence, Construction News (2022) reports that a quarter of a million extra construction workers will be needed by 2026 to meet growing demands on the UK sector.

7.4.1.3 Fragmentation

Over the years, the UK construction industry has been confronted with issues ranging from the common problems such as delays and cost overruns to more interconnected issues, such as conflicts, poor safety, poor satisfaction and many more (Riazi *et al*, 2020). These poor performance issues have been closely attributed to the industry's fragmented nature (Egan, 1998; Latham 1994) and the poor management methods adopted in the industry (Munns and Bjeirmi, 1996), which hinder the industry from meeting up expectations in terms of improvement, innovation, completion time, costs, quality standards, productivity and satisfaction (Chan *et al*, 2003; Egan, 1998; Latham, 1994). According to Nawi *et al* (2014), the issue of fragmentation within construction projects arises from two areas within the traditional construction process: 1) the construction work process where the most significant division is in the separation of the design and construction phase; 2) the construction structure itself. The issue of fragmentation has further exacerbated the poor performance level of the industry whilst the industry is being synonymised with problems (Riazi *et al*, 2020).

7.4.1.4 Hierarchical leadership and management style of the industry

Leadership is without doubt the most essential part of any organisation and is key for the efficient performance and continued development of an organisation (Saiti and Stefou, 2020). The role of leadership in improving performance and innovation in the UK construction industry has been an ongoing subject among scholars (Opoku *et al*, 2015). Findings from this study revealed that the UK construction industry seems to be firmly rooted in very traditional models of leadership; ones that often take a very hierarchical and supervisory approach to managing the project teams (Price, 2022). Hierarchical leadership and management style within construction and project organisation is an antiquated practice, whereby strictly defined roles and their importance are overemphasized (Fernandopulle, 2021). Effective leadership and management may not be achieved via top-down hierarchies but from new types of organisational leadership (Bruchansky, 2020), considering the complicated chains of command within the hierarchical leadership structures which can slow down decision-making. Hence, organisations are attempting different leadership and management approaches to increase productivity, engage workers, foster innovation, and improve team dynamics through a more collaborative and inclusive leadership and management style (Transforming Design and Construction, 2017).

7.4.1.5 Reliance on Traditional Methodology

Choosing the right project management methodology for the management of a construction project is critical for the success of the project (Lalmi *et al*, 2022). The strength of the traditional methodology, as explained by researchers, is that it is characterised by well-organised and thought-out planning and control methods for stages of the project life cycle (Ekanayake *et al*, 2019). Besides, one distinguishing characteristic of the TPM methodology is that the tasks for the entire project are followed in a predetermined sequential order (Špundak, 2014). Even though some scholars perceive this characteristic as a strength of the TPM methodology, studies have however revealed this as a major flaw of the TPM methodology in the face of a dynamic project environment because, in reality, projects are not sequential in nature (Lalmi *et al*, 2022). Furthermore, project plans and estimates are normally made once, in a front-loaded approach, while the rest of the project is spent adjusting to reality. Therefore, studies have suggested the adoption of adaptable and flexible methodologies, capable of handling projects of different sizes and complexities in a constantly changing environment (Lalmi *et al*, 2022; Zimmermann *et al*, 2020; Majchrzak, 2017; Talebi, 2014).

7.4.1.6 Documentation Issues

The TPM methodology emphasises a formal and detailed documentation of every process involved in a project (Salameh, 2014). However, several studies have observed that the rigid documentation of the TPM methodology is actually one of its major weaknesses, as discussed in section 3.3.1.3, considering that the final outcome of a project is more important than generating comprehensive implementation documentation (Bogdanova *et al*, 2020). Also, according to Serrador and Pinto (2015), a rigid documentation requirement can have the following limitations: 1) specifications that do not describe a deliverable as well as the prototype 2) early specification of requirements results in gold plating (adding more features than required) because there would be no further opportunities to add/change functionality 3) solutions focus on a specific point in time although the requirements or environments are likely to change. Consequently, these drawbacks lead to performance issues in construction management. The AgPM methodology, on the contrary, deemphasises the use of formal/detailed documentation (explicit knowledge) and lays emphasis on the team's reliance on personal interactions (tacit knowledge) for knowledge transfer (Nakayama *et al*, 2021).

7.4.1.7 Client Dissatisfaction

Client satisfaction in construction industry can be described as the ability of a project manager (or contractor) to meet the client expectations, whereas clients dissatisfaction is the inability of the project manager (or contractor) to meet with the expectations of the clients (Rahman and Alzubi, 2015). Client dissatisfaction is often associated with the traditional methodology of managing construction projects, due to its rigidity thus, leading to clients dissatisfaction (Chinyio, 2020). According to Rahman and Alzubi (2015), there are five prominent factors perceived to impact on client satisfaction: effective financial management; use of skilled workers; use of advanced technology; customer relation management and time management. In the UK construction industry, clients' dissatisfaction has been an ongoing issue as discussed in section 2.3. Survey findings from this study also corroborated that client dissatisfaction is one of the major issues that lead to the poor performance of the UK construction industry, with a mean score of 3.04. Several studies have highlighted issues leading to client dissatisfaction, including and not limited to the number of complaints issued to project managers and their ability to resolve them promptly (Sarhan *et al*, 2017); performing the project work successfully (Oppong *et al*, 2017; Saunders *et al*, 2016); supporting the clients throughout the project whilst fulfilling their requirements (Soetanto and Proverbs, 2002); effective relationship and leadership qualities (Wu *et al*, 2016); contractors' zero rework, zero rectification, zero deviation, working within budgets and conforming to standards and specifications (Zhou *et al*, 2015; Arslan and Kivrak, 2008); effective waste management, honesty, trustful relationships; and ensuring that quality raw materials and effective processes are used (Nguyen and Watanabe, 2017).

7.4.1.8 Improperly Assessed Project Needs

"Need" refers to the gap or discrepancy between a present state (what is) and a desired state (what should be). The need is neither the present nor the future state; it is the gap between them (Altschuld and Watkins, 2014). Needs assessment is a very useful part of the construction project management, which allows the identification of the gaps and priorities of the project (Royse and Badger, 2015). Generally, project needs assessment is driven by the question, "What do clients need, and how can those needs be met?" (Donaldson and Franck, 2016, p. 5) for the purpose of making plans to meet those needs. However, findings from the questionnaire survey revealed that improper assessment of project needs is one of the issues that lead to poor construction project performance. The development process in the delivery of a construction project is not linear; it requires commitment to a systematic, iterative process of assessment, design, implementation, and evaluation (U.S. Department of Commerce, 2009). More so, the stages involved in the development and implementation of construction project process are not discrete; some stages (or phases) overlap and interrelate to provide a dynamic and flexible guideline for the execution of the project.

Assessing the needs of clients in a construction project is very often easier said than done. According to Dalcher (2014a) reports, the most difficult part of requirements gathering is not recording what the clients want but the exploratory development activity of helping the clients figure out what they want (Stretton, 2016). This is because clients generally do not know what they need with any degree of precision (as discussed in section 3.3). A major function of needs assessment is to work closely with clients to help them develop a more precise sense of their needs. Therefore, properly assessing and identifying the needs of the clients is the product of collaborative effort between the clients and the project team (Dalcher, 2014b).

7.4.1.9 Inaccurate Budget

Findings from this study indicated that inaccurate budget (with mean value of 3.04) is one of the major factors leading to poor performance of the UK construction industry.

Budget overrun due to inaccurate budget is a common phenomenon in large as well as small projects (Memon and Rahman, 2013), and for projects with long duration, it is normal for budgets to be revised (Musarat *et al*, 2021). Major infrastructure projects and programmes suffer from a tendency to cost more (Institute of Civil Engineers, 2019). One of the reasons for this discrepancy in budgeting of construction projects stems from the complexity of construction projects since construction projects themselves are complicated undertakings, consequently resulting in unanticipated additional costs (Young *et al*, 2021). Also, Musarat *et al* (2021) note that the cost of building materials, labour, and machinery increases annually due to inflation, thus resulting in a deviation from the initial cost of the project. In a survey carried out by Jackson (2002), 15 main reasons for inaccurate budget and cost overruns in the UK were identified, and 'design changes' was the main cause being client driven. Olawale (2010) also presents top five factors: design changes; risk and uncertainty; inaccurate estimate of project duration; non-performance of subcontractors, and complexity of works.

7.4.1.10 Prolonged Planning and Negotiation

Planning, as one of the key processes in the life cycle of a construction project, shapes the empirical foundation of the project success, and it plays a primary role in optimising and managing construction operation (Saad *et al*, 2015). Prolonged planning was identified as one of the major issues leading to poor performance in the UK construction industry. For many decades, methods, such as the Critical Path Method (CPM), the Programme Evaluation and Review Technique (PERT), and Gantt Chart, have been applied in construction and have maintained their role for construction project planning (Seymour and Hussein, 2014). However, these planning techniques do not consider the complex planning environment of construction projects and are uniquely suitable for the determination of time windows for project activities. Consequently, more difficult planning problems are faced in construction projects.

7.4.2 Strengths of the TPM Methodology

Prior to the questions on the strengths of the TPM methodology, the survey participants were asked two preliminary questions to: 1. ascertain the participants' usage of the TPM methodology; (2. determine their level of knowledge on TPM. The purpose of these preliminary questions was to aid the validation of the findings from the central tendency and RII for strengths of the TPM methodology (i.e., if the participants have knowledge on TPM and often use the methodology, their responses on the benefits should be valid). Hence, the participants were asked to indicate their level of usage on a Likert scale ranging from Always (4); Often (3); Seldom (2) and Never (1). The result demonstrated that 42% of the participants (Figure 7-2) always uses the TPM methodology, 41% often uses the TPM methodology, 15% seldom uses it, 2% never uses the TPM methodology.

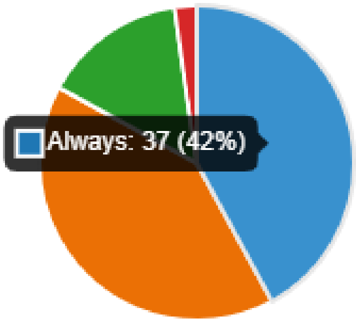

Figure 7-2: Participants usage of the TPM methodology

Putting together the participants that always use the TPM methodology (42%) and the participants that often use the TPM methodology, results showed that a total of 83% of the research participants often/always uses the TPM methodology while 17% seldom/never uses the TPM methodology. This shows that majority of the survey participants are aware of and use the TPM methodology in managing construction projects. Furthermore, to assess the participants' knowledge on the TPM methodology, results showed that 28% of the participants has extensive knowledge on the use of the TPM and 43% has knowledge above the average rating, which cumulatively makes it up to 71% of participants with at least above average knowledge on the use of the TPM methodology. Also, 24% of the participants agrees to have an average knowledge on the TPM methodology, but 5% of the participants attests to having no knowledge at all on the TPM methodology. Based on these preliminary findings on the participants' usage and knowledge on the TPM methodology, it is evident that a large percentage of the survey participants has knowledge on and use the TPM methodology in managing construction projects. Following this, the next question was to identify the strengths and weaknesses of the TPM methodology. To do this, 12 variables gathered from literature were presented, and the survey participants were asked to select the strengths of the TPM methodology on a scale ranging from Very Important (4) to Not Important (1).

Table 7-16 reveals that all of the variables presented for strengths of the TPM methodology had a high mean score of 3 and above, except for "single point accountability" that had a mean score of 2.99 (very close to 3 - important). The high scores may be due to several factors, including the participants' inclination towards the TPM methodology, their age group or their years of experience using the TPM methodology, coupled with their apprehensiveness for change. This was also demonstrated in the first phase of this study where most of the participants agreed that there was no need for the introduction of a new methodology, claiming that the TPM methodology was sufficient. Hence, it is safe to conclude that all 12 items presented in the Likert scale for the dependent variables (strengths of TPM methodology) were considered as strengths by the research participants.

Table 7-16: Central Tendency for Strengths of the TPM methodology

S/N	Strengths of TPM	Valid	Missing	Mean	Std Dev.	RII score	Rank
1	Clearly defined Objectives	85	0	3.71	0.484	0.926	1
2	Clearly defined deliverables	85	0	3.61	0.599	0.902	2
3	Focused on Quality	85	0	3.52	0.590	0.879	3
4	Comprehensive Documentation	85	0	3.36	0.721	0.841	4
5	Good Control of Project Processes	85	0	3.34	0.665	0.835	5
6	Cost Effective	85	0	3.32	0.743	0.829	6
7	Efficiency	85	0	3.26	0.710	0.814	7
8	Sequential Nature	85	0	3.24	0.781	0.808	8
9	Guidance for Project Managers	85	0	3.13	0.768	0.782	9
10	Unified Language	85	0	3.12	0.762	0.779	10
11	Division of Labour	85	0	3.04	0.851	0.758	11
12	Single Point Accountability	85	0	2.99	0.982	0.747	12

Furthermore, based on their relative importance indices (RII), the five variables with the highest mean scores for the strengths of the TPM methodology include:

- clearly defined objectives
- clearly defined deliverables
- focus on quality
- comprehensive documentation
- good control of project processes

These findings also substantiated the findings from literature review. The first is that the strength of the TPM methodology lies in its waterfall approach of clearly pre-defining the project requirements (objectives), followed by planning and controlling the project deliverables within a rigid organisational structure and strict leadership approach. Besides, comprehensive documentation ensures that the pre-planned goals and objectives of the project are well recorded and archived for future reference. In addition, the waterfall approach of the TPM methodology enforces a strict focus on the quality of the project deliverables, ensuring the deliverables align with the pre-defined objective whilst enacting good control of the project process within a rigid organisational structure. Also considering their standard deviation, variables 1 (clearly defined objectives), 2 (clearly defined deliverables), and 3 (focused on quality) seem to have the lowest standard deviation values from the entire list, indicating clearly that data are closely around the mean, hence more reliable. To further evaluate the relationships between the five key strengths of the TPM methodology and the highest mean scores, the Pearson correlation coefficient (correlation matrix) was employed to measure if there was any linear relationship between the variables, Table 7-17.

Table 7-17: Correlation matrix for important strengths of TPM methodology

	Clearly defined objectives	Clearly defined deliverables	Focus on quality	Single-Point accountability	Good control of project processes
Clearly defined objectives	1				
Clearly defined deliverables	.341**	1			
Focus on quality	.123	.339**	1		
Single-Point accountability	.218*	.296**	.298**	1	
Good control of project processes	.242*	.575**	.425**	.298**	1

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Table 7-17 shows that good control of project processes is moderately correlated with clearly defined project deliverables. In other words, clearly defining the deliverables of a project seems to have a moderate impact on the control of the project's processes.

In construction project management, control of the project's processes is key to project success, and is implemented to ensure projects finish on time, within budget, and achieve other project objectives (Olawale and Sun, 2013). The core processes of controlling a construction project encompasses the resources, procedures and tools needed for the planning, as well as monitoring and controlling all phases of the project life cycle (Construction Industry Institute, 2022; Perrier *et al*, 2018). However, the dynamicity and complexity of today's construction projects sometimes makes the control process highly critical (Regmi *et al*, 2019).

Over the last few decades, several project control tools, and techniques have been established and adopted by project managers, such as the Gantt Chart, Critical Path Networks/Method (CPM), Milestone Date Programming Technique, Precedence Network Diagram (PND), the Last Planner® System (LPS) (Ballard and Tommelein, 2021; Olawale and Sun, 2013). Notwithstanding, due to the rigidity of the TPM methods, wherein project control process is stipulated at the inception of the project with detailed planning, project managers are unable to adjust the project schedules or do what is needed to keep the project on track (Regmi *et al*, 2019). Hence, the high dependence on clearly pre-defined project deliverables to effectively monitor and control the project's processes. Besides, if the client is unable to clearly define the project deliverables at the planning/design stage of a project, coupled with several moderating factors, such as environmental factors, the client's involvement may sometimes lead to changing requirements and changes in the scope of the project. Consequently, the project manager then struggles to keep the project on track. This culminates in issues of delays and overruns, clients' dissatisfaction, and in some cases a halt in the project.

Bivariate regression analysis was employed to further determine the degree of association and whether one variable may be predicted from another (Sandilands, 2014). This enabled a deeper understanding, which in turn allowed the generalisation of predictions and decisions for the future. Therefore, the two variables were denoted as X and Y, with clearly defined deliverables as the independent variable (or explanatory variable) and good control of the project's processes as the dependent variable (or outcome variable), *Table 7-18*.

Table *7-18Table 7-18: Bivariate regression analysis*

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.037	.364		2.846	.006
	Clearly Defined Deliverables	.638	.100	.575	6.410	<.001

a. Dependent Variable: Good Control of Project Processes

The result showed a positive beta value, B which represents the slope of the line between the predictor variable and the dependent variable, thus indicating that one unit increase in the percent of 'clearly defined deliverables' would yield a .638 increase in the control of the project's processes. Also, there is need to consider the p values (sig) which test (the null hypothesis) that there is no relationship, and that the coefficient is equal to zero. A low p value ($P \leq 0.05$) means that the test hypothesis (no significant relationship between good control of project's processes and clearly defined deliverables) is false or should be rejected, which is also a meaningful addition since changes in the predictor's value are related to changes in the response variable. In this case, the p value of <.001 indicates that the weights of the coefficients are not zero, which means there was a relationship between the dependent (good control of project processes) and the independent variable (clearly defined deliverables).

Furthermore, considering the R-squared (R^2) value which measures the proportion of variance (or deviation) for a dependent variable that can be explained by an independent variable or variables in a regression model.

Table 7-19 presents an R Square value of .331 (33.1%) which shows the variation in the dependent variable (good control of project processes) that can be explained by the independent variable (clearly defined deliverables). Therefore, the null hypothesis was rejected.

Table 7-19: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.575[a]	.331	.323	.493

a. Predictors: (Constant), Good Control of Project Processes

7.4.3 Weaknesses of the TPM Methodology

In analysing the central tendency and RII for the dependent variables (weaknesses of the TPM methodology), 14 variables identified from literature review were presented in a Likert scale covering Strongly Agree (4), Agree (3), Disagree (2), Strongly Disagree (1). Results presented in Table 7-20 have been rearranged based on the Relative Importance Index (RII) score ranking.

Table 7-20: Mean and standard deviation for the weaknesses of the TPM methodology

S/N	Weaknesses of TPM	Valid	Missing	Mean	Std Dev.	RII score	Ranking
1	High Cost of Restart	85	0	3.13	0.784	0.782	1
2	De facto Methodology	85	0	3.09	0.781	0.773	2
3	Project Plans are rarely Updated at the later stages of a project	85	0	3.05	0.830	0.761	3
4	Rigid Structure	85	0	2.94	0.730	0.735	4
5	Process Centric	85	0	2.92	0.759	0.729	5
6	Minimal Client Involvement	85	0	2.91	0.750	0.726	6
7	One-way Communication Flow	85	0	2.88	0.793	0.720	7
8	Assumption Of Task or Goal Certainty	85	0	2.87	0.686	0.717	8
9	Reliant on Predictability	85	0	2.85	0.748	0.711	9
10	Linear Organisational Structure	85	0	2.82	0.658	0.705	10
11	Inflexible Gateways Between Phases	85	0	2.79	0.742	0.697	11
12	Predefined Requirements	85	0	2.76	0.840	0.691	12
13	Reliant on Task Breakdown	85	0	2.75	0.858	0.679	13
14	Fixed Life cycle	85	0	2.66	0.733	0.664	14

Results, as seen in Table 7-20 above, indicated that three variables (high cost of restart; *de facto* methodology; project plans are rarely updated) had mean scores > 3 and ranked numbers 1 to 3 respectively, thus indicating that a larger percentage of the participants considered these variables as the major weaknesses of the TPM methodology. Also, the –variables—rigid organisational structure, process centric, and minimal client involvement—had mean scores close to 3 and ranked numbers 4, 5, and 6 respectively. Variable number 6 (minimal client involvement) was added to the list because the difference between its mean score and the mean score of the preceding variable was only 0.01, hence considered also as an important weakness of the TPM methodology. These findings also corroborated some of the findings from the first phase of this study, wherein the participants in agreement to the weaknesses of the TPM methodology suggested that the AgPM methodology would enable the project team respond to issues quickly as well as eliminate the issues of cost and time overruns. Below are the variables considered to be the major weaknesses of the TPM methodology in this study:

1. high cost of restart
2. *de facto* methodology
3. project plans are rarely updated at the later stages of a project
4. rigid structure
5. process centric
6. minimal client involvement

Owing to the rigid and linear nature of the TPM methodology (wherein requirements are fixed after the project manager/contractor have finalized the project requirements), the TPM methodology often experiences issues with budgets and deadlines because the static, developmental model of the TPM methodology does not account for unforeseen changes or unpredictable hurdles (Potter, 2020). Hence, in the event where unavoidable changes occur, the cost of restarting a phase is usually very high. This is a major weakness because, while the TPM methodology hinges on upfront planning of the project processes and deliverables, the AgPM methodology prioritises flexibility and collaboration with the customers throughout the project. Thus, the AgPM methodology enables the project team attend to change in the project requirements without necessarily affecting the scope of the project.

Another major weakness with the use of the TPM methodology in the UK construction industry is that this methodology is considered as a *de facto* methodology for the delivery of most construction projects with respect to the procurement strategy with which the project is underpinned. Although several studies have dissuaded this ideology of “one-size-fits-all” associated with the TPM methodology (Naik and Jenkins, 2020; PRINCE2, 2018, p.1; Burgan and Burgan, 2014; Matos and Lopes, 2013, p. 788), within the UK and other European countries, this has continued to be an issue. Every project is unique and –different; some projects are straightforward and predictable, others are very complex and risky, and some involve iterations to a greater or lesser degree than others depending on the complexity of the project (Burgan and

Burgan, 2014). Therefore, adopting the same methodology for every project is counter-productive and wasteful as one size does not necessarily fit all in reality. Hence, it is considered as a major weakness of the methodology.

The evasiveness of the TPM methodology with respect to frequently updating the project plans constitutes another major weakness of the methodology and is due to its emphasises on static project scheduling, thorough planning, extensive documentation with deterministic parameters, which ultimately results in deterministic schedules without necessarily considering uncertainties in complex projects (Marle and Vidal, 2016). Besides, the project clients sometimes are not certain of what is expected of the project, thus necessitating a regular update in the project plans as the project evolves. Notwithstanding, it is worth noting that most of the weaknesses of the TPM methodology can be blamed on its rigid top-down structure and process centric approach. Thus, such methodology discourages clients involvement and the propensity towards project-based configurations in managing construction projects, which would serve as a better fit to the current project environments (Sarkar and Locatelli, 2017).

To further evaluate the major weaknesses of the TPM methodologies identified in this study, the Pearson correlation coefficient (correlation matrix) was employed to assess and understand the relationship (if any exists) between them.

Table 7-21: Correlation matrix for weaknesses of the TPM methodology

High Cost of Restart	1					
De facto Methodology	.233*	1				
Rarely updated plans	.247*	.434**	1			
Rigid Structure	.305**	.407**	.280**	1		
Process Centric	.318**	.354**	.101	.442**	1	
Minimal Client Involvement	.264*	.117	.122	.186	.279**	1
	High Cost of Restart	De facto Methodology	Rarely updated plans	Rigid Structure	Process Centric	Minimal Client Involvement

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Results, as presented in Table 7-21 above, revealed a weak relationship between the variables with Pearson correlation coefficients <.50, indicating that increase or decrease in one variable does not significantly relate to the increase or decrease in another variable. For example, considering the correlation coefficient between the variables “process centric” and “rigid structure” of the TPM methodology of .442, it shows that an increase in the process centric nature of the methodology has no significant relationship with the rigid structure of the methodology because the two variables exist independent of each other. Therefore, this confirms that there was no significant relationship between the variables for the weaknesses of the TPM methodology. Hence further analysis was not conducted at this instance.

7.4.4 Strengths of AgPM Methodology

After considering the strengths and weaknesses of the TPM methodology with respect to the management of UK construction projects, the AgPM methodology was also evaluated even though the AgPM methodology is relatively new compared to the TPM methodology, coupled with the findings from the first phase of this study, which revealed that most of the participants had very little knowledge of AgPM. This section of the questionnaire commenced with some preliminary questions to evaluate the awareness and knowledge of the participants on the AgPM methodology.

In response to the question on their awareness of the AgPM methodology, findings revealed that 63% of the participants was aware of the AgPM methodology while 38% was unaware (i.e., might have heard of it, but had no knowledge of it). Furthermore, the participants were asked to rate their knowledge on the AgPM methodology on a Likert scale covering Extensive, Above Average, Average and Below Average. This question was to further ascertain the participants’ level of knowledge on the AgPM methodology, considering that some participants attested to have knowledge of AgPM in the first phase, but could not describe it.

Results indicated that only 14% of the participants had extensive knowledge on AgPM, 18% had knowledge above average, 31% of the participants had average knowledge on AgPM, 37% had knowledge below average on the AgPM methodology, Figure 7-3. The results corroborated the findings from the first phase of this study, wherein 50% of the participants agreed to have an awareness of the AgPM methodology but had very little knowledge on the use of AgPM.

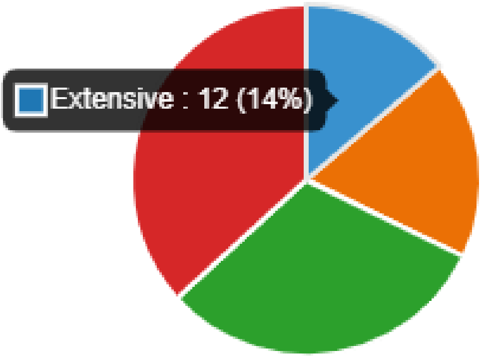

Figure 7-3: Participants knowledge on AgPM methodology

The findings also demonstrated that having an awareness (having knowledge or perception of AgPM methodology) does not necessarily mean to have an understanding (or full knowledge) of it. Studies have proven that awareness has the object of what research participants know as well as what they do not know (Trevethan, 2017; Gafoor, 2012; Caspar *et al*, 1999). Consequently, in the evaluation of the strengths of the AgPM, 20 variables (Table 7-22) were presented for the strengths of the AgPM methodology on a Likert scale ranging Definitely (4), Probably (3), Probably Not (2), Definitely Not (1), and the participants were asked: ”which of these agile strengths would you like to see when managing a construction project?”

Table 7-22: Mean and standard deviation for Strengths of AgPM Methodology

S/N	Agile Strengths	Valid	Missing	Mode	Std Dev.
1	Value Driven Development	84	1	4.00	0.699
2	Collaboration and transparency	84	1	4.00	0.629
3	Closer engagement with stakeholders	84	1	4.00	0.631
4	Adaptive Flexible Planning and Continuous Improvement	84	1	4.00	0.583
5	Focus on Specific Needs of Customers	84	1	4.00	0.667
6	Unlimited Flexibility and Adaptive Changes	84	1	3.00	0.792
7	Attention to Technical Excellence	84	1	4.00	0.590
8	Incremental Release Approach	84	1	3.00	0.649
9	Frequent Evaluation and Resolution of Issues	84	1	4.00	0.629
10	Fast Delivery Time	84	1	4.00	0.683
11	Reduced Waste	84	1	4.00	0.685
12	Reduced Cost	84	1	3a	0.717
13	Greater Expertise and Resource Effectiveness	84	1	4.00	0.702
14	Team Ownership and Accountability	84	1	4.00	0.576
15	Increased Productivity and Morale	84	1	4.00	0.611

16	Team engagement and commitment	84	1	4.00	0.602
17	Discipline and self-organisation	84	1	4.00	0.699
18	Efficient communication	84	1	4.00	0.611
19	Reduced documentation	84	1	3.00	0.861
20	Retrospective and reflective practices	84	1	4.00	0.764

All the variables presented in Table 7-22 had a high mean value > 3, indicating that the participants would like to see most of the agile strengths presented. Also, 11 of the variables presented for the strengths of AgPM had a mean value of 3.5 and above, which is closer to 4 (pointing towards the definiteness of the participants in wanting to enjoy those AgPM benefits when managing a construction project, as shown in Table 7-23 below).

Table 7-23: Strengths of AgPM Methodology

S/N	Strengths of AgPM	Mean
1	Efficient communication	3.65
2	Team Ownership and Accountability	3.63
3	Team engagement and commitment	3.61
4	Adaptive Flexible Planning and Continuous Improvement	3.60
5	Frequent Evaluation and Resolution of Issues	3.55
6	Collaboration and transparency	3.55
7	Focus on Specific Needs of Customers	3.54
8	Attention to Technical Excellence	3.54
9	Greater Expertise and Resource Effectiveness	3.54
10	Increased Productivity and Morale	3.51
11	Closer engagement with stakeholders	3.50

Key: Definitely = 4; Probably = 3; Probably Not = 2; Definitely Not = 1

Efficient communication is one major strengths of the AgPM methodology, and it is also a very crucial foundation for effective project management. Communication is the process of obtaining relevant information, interpreting it, and effectively disseminating the information to persons who might need it. In construction project management, Zulch (2014) agrees that effective communication is the function that integrates the project cost, scope, and time to achieve the quality desired by the client. Hence, it was considered as the greatest strength of AgPM by the research participants. Team ownership and accountability is another major strength of the AgPM methodology. Considering the complex needs of today’s projects where every situation, challenge, and customer is unique, and the project team members are expected to proffer creative solutions to every issue that may arise, team ownership and accountability allows the project team to think outside the box while engaging with the clients to come up with innovative solutions that would suit the customers' need. Also, in a situation where the project outcome does not go as expected, the allowance of ownership within a project team ensures that team members feel responsible to solve and account for every outcome of a project without necessarily following the bureaucracies as with the TPM methodology. This improves the team's morale while promoting retrospective learnings.

Furthermore, the adaptive flexible planning approach of the AgPM methodology recognises that the needs and objectives of clients would evolve as the project unfolds. Hence, the project's needs are frequently evaluated with a mindset of resolving any issues that may arise due to changes in the project requirements while focusing on the specific needs of the customer. The AgPM methodology has grown as a flexible approach with greater requirement volatility, focusing mainly on collaboration between the project team and clients, which also supports frequent and early delivery of the product (Shubh and Gandhi, 2012). Experiment on the weaknesses of the AgPM methodology was not conducted in this study owing to the findings from the preliminary stage of this study that suggested that the UK construction practitioners have very limited knowledge on the AgPM. However, it has extensively been considered in chapter three of this study based on literature review.

In addition, further analysis (Pearson correlation coefficient) was conducted to assess if any relationship exists between the variables highlighted as the strengths of the AgPM methodology as well as ascertain how their relationship might impact one another, should any exist. In consideration of the space for the correlation matrix for strengths of the AgPM methodology, the strengths considered were abbreviated as shown in Table 7-24.

Table 7-24: Abbreviation for Strengths of the AgPM methodology

Strengths of AgPM Methodology	**Abbreviation**
Efficient communication	EC
Team Ownership and Accountability	TO&A
Team engagement and commitment	TE&C
Adaptive Flexible Planning and Continuous Improvement	AFL&CI

Frequent Evaluation and Resolution of Issues	FE&RI
Collaboration and transparency	C&T
Focus on Specific Needs of Customers	FSNC
Attention to Technical Excellence	ATE
Greater Expertise and Resource Effectiveness	GERE
Increased Productivity and Morale	IP&M
Closer engagement with stakeholders	CES

Table 7-25: Correlation matrix for strengths of the AgPM methodology

EC	1										
TO&A	.352**	1									
TE&C	.577**	.446**	1								
AFL&CI	.415**	.303**	.331**	1							
FE&RI	.467**	.232*	.512**	.382**	1						
C&T	.467**	.465**	.385**	.447**	.421**	1					
FSNC	.371**	.427**	.411**	.347**	.269*	.413**	1	. *			
ATE	.419**	.270*	.362**	.323**	.369**	.239*	.334**	1			
GERE	.296**	.673**	.476**	.301**	.174	.419**	.409**	.113	1		
IP&M	.608**	.372**	.783**	.386**	.391**	.453**	.413**	.467**	.448**	1	
CES	.360**	.414**	.334**	.426**	.365**	.547**	.473**	.372**	.367**	.391**	1
	EC	TO&A	TE&C	AFL&CI	FE&RI	C&T	FSNC	ATE	GERE	IP&M	CES

**. Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Table 7-25 above reveals the following correlations (highlighted in green):

1. Team's engagement and commitment was moderately correlated with efficient communication, with a correlation coefficient of .577.
2. Increased productivity and morale of the team was moderately correlated with efficient communication, with correlation coefficient of .608.
3. Team's expertise/resource effectiveness of the team was moderately correlated with the project team's ownership/accountability, with correlation coefficient of .673.
4. Evaluation and resolution of issues was moderately correlated with the team's engagement and commitment, with correlation coefficient of .512.
5. Increased productivity/morale of the team was highly correlated with the team's engagement/commitment, with correlation coefficient of .783.
6. Closer engagement with stakeholders was moderately correlated with collaboration and transparency of the team, with correlation coefficient of .547.

Furthermore, bivariate regression analysis was conducted on each of the six correlated variables to test its association and causality, thus allowing for a deeper understanding and also enabling a deduction of how much easier it becomes to know and predict a value of the dependent variable having known the independent variable. Each of the two variables were denoted as X and Y, for the independent variable (or explanatory variable) and the dependent variable (or outcome variable) respectively. A null hypothesis was proposed, which states that all coefficients in the model are equal to zero, and there is statistically no significant relationship between the predictor variable, X, and the response variable, Y. The results are presented based on the following:

- beta (B) value which represents the slope of the line between the predictor variable and the dependent variable, indicating the unit increase in the dependent variable as a result of the independent variable.
- p value (sig) which test (the null hypothesis) that there is no relationship, and that the coefficient is equal to zero. A low p value (<.005) would reject the null hypothesis, which is a meaningful addition since changes in the predictor's value are related to changes in the response variable.

- R-squared (R^2) value which measures the proportion of variance (or deviation) for a dependent variable that can be explained by an independent variable or variable in a regression model.

1. **Team Engagement and efficient communication:**

Table 7-26 shows a positive beta (B) value of .568 representing the slope of the line between the predictor variable and the dependent variable, thus also indicating that one unit increase in the percent of 'efficient communication' within the project team would yield a .568 increase in the team engagement and commitment. It is crucial to consider the p values (sig) which test (the null hypothesis) that there is no relationship, and that the coefficient is equal to zero. A low p value (<.005) would reject the null hypothesis, which is a meaningful addition since changes in the predictor's value are related to changes in the response variable. In this study, a p value <.001 indicated that the weights of the coefficients were not zero, which means there was a relationship between the dependent (team's engagement and commitment) and the independent variable (efficient communication).

Table 7-26: Linear regression for Team Engagement and efficient communication

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.531	.329		4.653	<.001
	Efficient Communication	.568	.089	.577	6.399	<.001

a. Dependent Variable: Team Engagement and Commitment

Table 7-27 reveals an R-squared (R^2) value of .333 (33.3%) which measures the proportion of variance (or deviation) for a dependent variable that can be explained by an independent variable or variable in a regression model (Table 7-27). The R Square value in this analysis indicated the variation in the dependent variable (team's engagement and commitment) that could be explained by the independent variable (efficient communication). Therefore, the null hypothesis was rejected.

Table 7-27: R-squared value for Team Engagement and efficient communication

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.577[a]	.333	.325	.494

a. Predictors: (Constant), Efficient Communication

2. **Increased productivity and morale and efficient communication**:

Table 7-28 shows a positive beta (B) value of .608 which represents the slope of the line between the predictor variable and the dependent variable, and also indicating that one unit increase in the percent of 'increased productivity and morale' within the project team would yield a .608 increase in efficient communication of the team.

Table 7-28: Linear regression for Increased productivity and morale and efficient communication

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.289	.325		3.970	<.001
	Efficient Communication	.608	.088	.608	6.937	<.001

a. Dependent Variable: Increased Productivity and Morale

Table 7-28 also shows a low p value (sig) (<.001) which tests (the null hypothesis) that there is no relationship, and that the coefficient is equal to zero, thus indicating that the weights of the coefficients were not zero, which means there was a relationship between the dependent and the independent variable. Hence, there was rejection of the null hypothesis, which is a meaningful addition since changes in the predictor's value are related to changes in the response variable.

Furthermore, Table 7-29 reveals an R Square value of .370 (37%) which showed the variation in the dependent variable (team's engagement and commitment) that could be explained by the independent variable (efficient communication).

Table 7-29: R-Square value Increased productivity and morale and efficient communication

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.608[a]	.370	.362	.488

a. Predictors: (Constant), Efficient Communication

3. **Greater Expertise/Resource Effectiveness and Project Team's Ownership/Accountability:**

Table 7-30 below shows a positive beta (B) value of .820 which indicated that one unit increase in the percent of team ownership and accountability within the project team would yield a .820 increase in the team's expertise and resource effectiveness. The p value (sig) which is <.001 indicated that the weights of the coefficients were not zero, which means there was a relationship between the dependent and the independent variable.

Table 7-30: Linear regression for Greater Expertise/Resource Effectiveness and Project Team's Ownership/Accountability

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.557	.366		1.524	.131
	Team Ownership and Accountability	.820	.099	.673	8.249	<.001

a. Dependent Variable: Greater Expertise and Resource Effectiveness

Furthermore, Table 7-31 reveals an R Square value of .453 (45.3%) which showed the variation in the dependent variable that could be explained by the independent variable.

Table 7-31: R-Square value for Greater Expertise/Resource Effectiveness and Project Team's Ownership/Accountability

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.673[a]	.453	.447	.522

a. Predictors: (Constant), Team Ownership and Accountability

4. **Evaluation and Resolution of Issues/The Team's Engagement and Commitment:**

Table 7-32 below shows a positive beta (B) value of .535 which indicated that one unit increase in the percent of frequent evaluation and resolution of issues within the project team would yield a .535 increase in the team's engagement and commitment. The p value (sig) <.001 also illustrated that the weights of the coefficients were not zero, which means there was a relationship between the dependent and the independent variable.

Table 7-32: Linear regression for Evaluation and Resolution of Issues/The Team's Engagement and Commitment

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1.618	.363		4.462	<.001
	Team Engagement and Commitment	.535	.099	.512	5.397	<.001

a. Dependent Variable: Frequent Evaluation and Resolution of Issues

Table 7-33 shows an R Square value of .512 (51.2%), thus indicating the variation in the dependent variable that could be explained by the independent variable.

Table 7-33: R-Square value for Evaluation and Resolution of Issues/The Team's Engagement and Commitment

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.512[a]	.262	.253	.543

a. Predictors: (Constant), Team Engagement and Commitment

5. **Increased Productivity/Morale of the Team with the Team's Engagement/Commitment:**

Table 7-34 below shows a positive beta (B) value of .795 which indicated that one unit increase in the percent of the team's engagement and commitment to a project would yield a .795 increase in the productivity and morale. The p value (sig) <.001 showed that that the weights of the coefficients were not zero, and there was a relationship between the dependent and the independent variable.

Table 7-34: Linear regression for Increased Productivity/Morale of the Team with the Team's Engagement/Commitment

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	.642	.255		2.519	.014
	Team Engagement and Commitment	.795	.070	.783	11.405	<.001

a. Dependent Variable: Increased Productivity and Morale

Furthermore, Table 7-35 reveals an R Square value of .613 (61.3%) which revealed the variation in the dependent variable that could be explained by the independent variable.

Table 7-35: R-Square value for Increased Productivity/Morale of the Team with the Team's Engagement/Commitment

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.783[a]	.613	.609	.382

a. Predictors: (Constant), Team Engagement and Commitment

6. **Closer Engagement with Stakeholders/Collaboration and Transparency of the Team:**

The positive beta (B) value of .549, as seen in Table 7-36 below, indicated that one unit increase in the percent of the team's collaboration and transparency in a project would yield a .549 increase in their engagement with stakeholders. The p value (sig) <.001 also indicated that that the weights of the coefficients were not zero, and there was a relationship between the dependent and the independent variable.

Table 7-36: Linear regression for Closer Engagement with Stakeholders/Collaboration and Transparency of the Team

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.554	.334		4.652	<.001
	Collaboration and Transparency	.549	.093	.547	5.918	<.001

a. Dependent Variable: Closer Engagement with Stakeholders

Furthermore, Table 7-37 reveals an R Square value of .299 (29.9%) which illustrated the variation in the dependent variable that could be explained by the independent variable.

Table 7-37: R-Square value for Closer Engagement with Stakeholders/Collaboration and Transparency of the Team

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.547[a]	.299	.291	.531

a. Predictors: (Constant), Collaboration and Transparency

Results from the bivariate analysis demonstrate that the strengths of the AgPM methodology identified in this study share some significant relationship. This means that some of the outcome of the dependent variable is predictable if the independent variable is known. In other words, the strengths of the AgPM methodology affect each other, and an increase in one strength would yield an increase in another strength, and vice versa.

Furthermore, it can be deduced that the strengths of the AgPM methodology are related to the four agile values as shown in Figure *7-4*. The AgPM methodology is based on a set of values, according to the Agile Manifesto, focusing on client value, iterative and incremental implementation, intense cooperation, integrated teams, self-organisation, and constant improvements (Koi-Akrofi *et al*, 2019). It emphasises on ownership as well as prioritises team efforts based on business benefit, whilst enhancing teamwork and a shared understanding of projects' goals (APM, 2015).

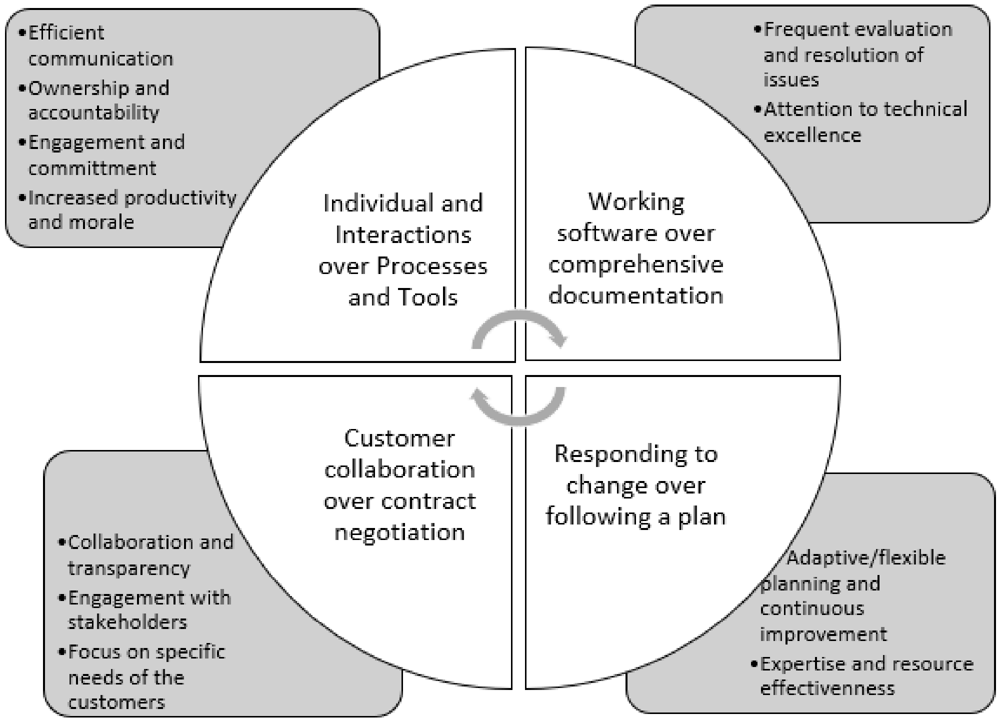

Figure 7-4: AgPM strengths and agile values

It can also be deduced that the strengths of the AgPM methodology can be used in eliminating the weaknesses associated with the TPM methodology, as shown in Table 7-38. For example, considering the TPM's weakness of minimal clients' involvement in a project, the AgPM methodology offers practicable steps to facilitate close collaboration with clients, and undergoes a develop-deliver-feedback cycle that enhances insight on the necessities and requirements from the clients in order to be prepared for any modification at any time (Kataria *et al*, 2017).

Table 7-38: Agile values and the strengths and weaknesses of AgPM

Strengths of AgPM	**Values of AgPM methodology**	**Weaknesses of the TPM methodology**
• Efficient communication • Team ownership and accountability • Team engagement and commitment • Increased productivity and morale	Individual and interactions over processes and tools	• Minimal client involvement
• Collaboration and transparency • Focus on specific needs of customers • Closer engagement with stakeholders	Customer collaboration over contract negotiation	• Rigid structure
• Frequent evaluation and resolution of issues	Working software over comprehensive documentation	• Project plans are rarely updated at the later stages of a project • Process centric • *De facto* methodology
• Attention to technical excellence • Greater expertise and resource effectiveness • Adaptive flexible planning and continuous improvement	Responding to change over following a plan.	• High cost of restart

7.4.5 Barriers to the Adoption and Integration of AgPM in Construction

The barriers hindering the adoption and integration of the AgPM methodology in the UK construction industry were deduced from literature, and 18 variables representing the barriers were presented on a Likert scale ranging Very Important (4), Important (3), Slightly Important (2), Unimportant (1). The participants were asked to select how important (critical) the barriers are in the adoption and integration of agile methodology into the UK construction industry, and the results are shown in Table 7-39 below.

Table 7-39: Barriers to Agile Adoption and Integration

S/N	Barriers to Agile Adoption	Valid	Missing	Mean	Std. Dev
1	Organisational Resistance to Change	84	1	3.55	0.568
2	Organisational Structure	84	1	3.05	0.849
3	Organisational Culture	84	1	3.20	0.724
4	Management Support	84	1	3.31	0.744
5	Agile Logistical Arrangements	84	1	3.20	0.757
6	Skills and Experience with Agile Methods	84	1	3.38	0.710
7	Existing Technology Does Not Support Agile	84	1	2.95	0.877
8	Minimal Collaboration Knowledge Sharing Practices	84	1	3.25	0.774
9	Training	84	1	3.48	0.685
10	Inconsistent Processes and Practices	84	1	3.30	0.724
11	Collaboration And Feedback	84	1	3.29	0.704
12	Agile Progress Tracking Mechanism	84	1	3.13	0.757
13	Transition Time	84	1	3.13	0.708
14	Team Distribution and Communication Practices of agile	84	1	2.90	0.900
15	Availability of Personnel with Agile Skills	84	1	3.08	0.895
16	Prevalence Of Traditional Development Methods	84	1	3.26	0.762
17	Confidence And Ability to Scale	84	1	3.24	0.801
18	Team Working on Multiple Projects	84	1	2.88	0.884

Table 7-39 above reveals that 15 out of the 18 variables presented as barriers to the adoption of the AgPM methodology has mean value of 3 and above, indicating also that 15 out of the 18 variables fell within the scale of "Important" to "Very Important." The remaining three variables had mean values of 2.95 (existing technology does not support agile), 2.90 (team distribution and communication practices), and 2.88 (project team working on multiple projects) respectively, which were somewhere between the scale of "Slightly Important" and "Important." Since this study was focused on identifying the critical barriers that hinder the adoption of the AgPM methodology in the UK construction industry, the five variables with the highest mean values of 3.30 and above were considered top factors as follows:

- Organisational resistance to change (3.55)
- Training (3.48)
- Skills and experience with agile methods (3.38)
- Management support (3.31)
- Inconsistent processes and practices (3.30)

In this era, things are expected to change because change is everywhere, including in organisations (Damawan and Azizah, 2019). Organisational change refers to the process in which an organisation changes its methods, technologies, organisational structure, policies, and strategies as well as what effects these changes have on it (Kaur, 2020). However, findings revealed that organisational resistance to change seems to be the major barrier to the adoption of innovative changes in construction organisations (Karaxha, 2019). Furthermore, this resistance to change ‘trait’ was also observed in the open-ended survey, where the participants were asked if there was need for a new project management methodology to improve the performance of UK construction projects, and 75% of the participants settled that the traditional methodology they adopt in managing construction projects was sufficient. Little wonder the attempts to inspire changes by both the public and private sectors in the UK construction industry have failed to achieve the anticipated result, with failure often attributed to employees’ resistance to change (Construction Excellence, 2020; Buick *et al*, 2018; Hegazy and Hegazy, 2012; Langford and Murray, 2008). This implies that organisational resistance to change in the UK construction industry seems inherent and usually a negative by-product of change, leading top management to believe their employees as obstacles to change implementation (Buick *et al*, 2018).

According to Aninkan (2018), no matter how successfully or administratively perfect a proposed change may be, the culture of the organisation would either inhibit or encourage the change. Kotter and Cohen (2002) describe the cultural traits within organisations that hinder the acceptance of change as the hierarchies, rules, and procedures which tie the hands of employees. Resistance to change is not only synonymous with the UK construction industry but a global phenomenon. Several innovative concepts in organisations fail around the world because the individuals in the organisation misunderstand the interrelated roles of culture and climate in the organisation (Found, 2015). Ik and Azeez (2020) also corroborate and note that employees generally resist change for innovative practices due to their apprehensiveness for change, which is more prevalent with the experienced ones. Vrijhoef and Koskela (2005) explain that the culture in construction organisations is significantly different from the culture in other industries (due to high-level of fragmentation), hence the introduction of new management concepts like AgPM will require substantial reconceptualization.

Organisational resistance to change can be in several forms. For example, Smollan (2011) states that resistance to change can be active (being critical, finding fault, appealing to fear, selective use of facts) or passive (agreeing but not following through, procrastination, withholding information). Singh *et al* (2012) also agree with the concepts of passive resistance and active resistance, and further identify the concept of aggressive resistance to change. Regardless of its form, findings from this study reveal that organisational resistance to change is the most critical factor hindering the adoption and integration of the AgPM methodology within the UK construction industry. Furthermore, it is worth noting that issues associated with organisational resistance to change can have a plethora of effects in the UK construction industry which may not immediately be obvious (Found, 2015). Hence, there is an urgent need in the UK construction industry on how to overcome the apprehensiveness for change as well as effectively implement innovative changes.

The second and third critical barriers that hinder the adoption of AgPM in the UK construction industry relate to training and skills/experience with the AgPM methodology. These two factors are linked together because training is often prerequisite to the acquisition of skills/experience with the AgPM methodology. Training is required to gain the right skills and experience in the use of the AgPM methodology. Besides, PMBOK (2017) suggests a formal adoption approach of the AgPM methodology, whereby the entire team members learn and understand the AgPM methodology before implementing changes in their practices. Also, a publication by Harvard Business Review discloses that training is a serious impediment to the adoption of agile practices, and without prior training to furnish the team with the confidence and ability to scale, the adoption and integration of AgPM within the construction industry might be daunting, especially when the concept is entirely new to the individuals (Rigby *et al*, 2016). Hence, adequate training is recommended to aid the transition process (Kislik, 2018).

Another major barrier to the adoption and integration of the AgPM methodology identified in this study was management support. Top management support usually plays a significant role in facilitating training and learning as well as in the adoption and integration of AgPM into construction. It positively influences structural, process-based, and relational governance in organisations (Zhen *et al*, 2021). Shao *et al* (2017) also agree and note that top management support can motivate and inspire other managers. Besides, once the AgPM methodology is adopted and integrated, the AgPM principle of delivering solutions would inevitably increase support from top management and decrease resistance to change (Amorim *et al*, 2021). Whilst these barriers to the adoption and integration of AgPM methodology in the UK construction industry condense to the prevalence of traditional development method and the rigid organisational structure of the industry, they also seem to be interrelated. Parumasur and Govender (2013) suggest that to facilitate the adoption and integration of AgPM practices and processes within the construction industry, the construction team needs to harness an ethos of team effectiveness as well as continuous training and learning whilst management provides continuous support and create the environment that encourages and nurtures improvement.

Lastly, the inconsistent practices and processes employed in managing UK construction projects posed to be one of the major barriers to the adoption of the AgPM methodology. This was also established in the first phase of this study, wherein responses from the research participants on how they decide the tools and methodology to adopt revealed that their practices and processes were inconsistent and based on either the leadership decision, the project, or the available tools. Studies have also attributed these inconsistencies in the processes and practices to the complexity of construction projects and the highly fragmented state of the UK construction industry (Office for National Statistics, 2018; Kagioglou *et al*, 2000; Gidado, 1996). This indicates that despite the industry's position as an enabler in the promotion of sustainable practices, it is characterised by some deep-rooted and serious structural problems.

Furthermore, the Pearson correlation analysis was conducted to test for any relationships between the critical barriers hindering the adoption and integration of AgPM methodology in the UK construction industry. In this case, the Pearson correlation matrix was used to show the correlation coefficients between variables.

Table 7-40: Pearson correlation analysis for Barriers to Agile Adoption

	Org. resistance to Change	Training	Skills and Experience with AgPM	Management Support	Inconsistent Processes and Practices
Org. resistance to Change	1				
Training	.034	1			
Skills and Experience with AgPM	.104	.366**	1		
Management Support	-.178	.369**	.299**	1	
Inconsistent Processes and Practices	.185	.439**	.292**	.386**	1

**. Correlation is significant at the 0.01 level (2-tailed).

Table 7-40 reveals that there was no significant relationship between the major barriers that hinder the adoption and integration of AgPM methodology in the UK construction industry.

The UK construction industry has been characterised by complexities and issues, such as delays, overruns, and client's dissatisfaction. Findings reveal that the TPM methodology adopted in the management of construction projects are heavily reliant on pre-defining the project deliverables at the onset, followed by comprehensive documentation to record the agreed plans and structure of the project. However, this has also led to some of the major weaknesses of the TPM methodology, thus leading to several criticisms of the methodology. Changes are bound to happen in the life cycle of a construction project, and if changes are not effectively managed, they would inevitably lead to issues in the project delivery. Furthermore, findings have also revealed that the methodology selection approach in the management of UK construction projects centres on the prerogative of the leader (project manager), available tools and resources, and on the project itself. Even though studies have endorsed these selection approaches, every construction project is unique and should be dealt with uniquely. Hence, the project team in collaboration with the project manager should assess the existing systems and processes as well as ascertain which methodology is most suitable for managing a project. That being said, findings from this study also revealed that the weaknesses associated with the TPM methodology can be eliminated with the strengths of the AgPM when integrated into the management of construction projects. However, several barriers have hindered this integration.

7.5 Summary

The construction industry has generally been regarded as one of the least innovative sectors, with issues ranging from the more common problems, changing requirements, shortage of skilled labour to more inter-connected and complex issues, such as client satisfaction, improperly assessed project needs, inaccurate budget, prolonged planning and negotiation. These performance issues have also been closely attributed to several factors, including the industry’s dependence on the traditional methodology, fragmentation, and apprehensiveness for change from the practitioners of the traditional methodology. Findings from this study showed that the major issues leading to the poor performance of UK construction projects include changing requirements of construction projects, shortage of skilled labour, fragmentation, hierarchical leadership and management style of the industry, total reliance on traditional methodology, documentation issues, clients’ dissatisfaction, improperly assessed project needs, inaccurate budget, and prolonged planning and negotiation period. These findings also corroborated the findings from the open-ended surveys, with clients changing requirements identified as one of the major issues leading to the poor performance of the industry since it affects the project schedule and could lead to delay and overruns.

Furthermore, shortage of skilled labour has become a growing challenge for the UK construction industry. Findings disclosed that one of the main causes of the shortage in skilled labour is the declining numbers of younger generation going into construction compared to the ageing workforce. Fragmentation was also identified as one the major issues that lead to the poor performance of the UK construction industry and has been described as a common descriptor of the traditional practice within the UK construction industry. The hierarchical leadership and management style of the industry was also identified as a major issue leading to the poor performance of the industry, considering that leadership is an essential requirement for initiating change, developing cohesive teams, and creating high-performing teams that deliver results. Generally, traditional construction projects are managed in a hierarchical structure, wherein individuals in the construction project are classified according to their ability or economic, social, professional standing or a graded or ranked series. Moreover, the industry's reliance on traditional methodology was identified as another major issue leading to the poor performance of UK construction project.

Considering the dependence of the UK construction practitioners on the traditional methodology, an evaluation of the traditional methodology was conducted. Findings revealed some key strengths of the traditional methodology to include clearly defined objectives of the construction project; clearly defined deliverables; focus on quality; comprehensive documentation; and good control of the project processes. Some of the key weaknesses of the TPM methodology identified in this study include the high cost of restart involved where changing requirements are considered; methodology being used as a de facto methodology regardless of the complexity or scope of the project; project plans are rarely updated considering the enormous time invested in planning the project; rigid structure of the industry; process centric nature of executing construction projects; and minimal client involvement.

Despite the strengths and weaknesses of the TPM methodology, it was also established that the UK construction practitioners are quite eager to participate from the enormous benefits associated with the integration of the strengths of the AgPM methodology. Besides, studies have demonstrated that the strengths of the AgPM methodology can help in eliminating the inherent weaknesses of the traditional methodology. However, several barriers have hindered the adoption/integration of the AgPM methodology in the UK construction industry. A set of these barriers was presented to the research participants, and the five critical barriers include organisational resistance to change, training needs of the industry, shortage of skills and experience with the agile methods, poor management support, and inconsistent processes and practices within the industry. Hence, there is necessity for the UK construction industry to embrace a holistic approach for the introduction of innovative changes as well as for the improved performance of construction projects. Consequently, the following chapter focuses on the integration of the TPM and AgPM methodologies in a framework.

CHAPTER 8 : DISCUSSIONS AND FRAMEWORK DEVELOPMENT

8.1 Introduction

The aim of this research, as stated in section 1.3, is to develop a framework that integrates the strengths of the TPM and AgPM methodologies to improve the performance of UK construction projects delivery as well as the performance of the projects. As discussed in the previous chapter, the reliance on the TPM methodology was identified as one of the issues leading to poor performance. Hence, this chapter therefore proposes a framework that integrates the strengths of both the TPM and AgPM methodologies in order to enable a gradual introduction of AgPM benefits to be realised in construction project delivery whilst retaining the existing benefits of the TPM methodology. This fulfils the sixth and final objective of this research. The findings and key summaries drawn from chapters 4, 6, and 7 are used to justify the need for the proposed framework and to develop its component areas. The developed framework aims to provide the construction practitioners with a comprehensive level of understanding on the concept of integrating the TPM and AgPM methodologies as well as the requirements for its successful implementation at project level. This chapter also presents discussion on the validation of the developed framework.

8.2 The Need for a Framework

According to Moullin *et al* (2015), framework is a graphical or narrative representation of key factors, concepts, and variables to efficiently explain the phenomenon of implementation. It is a tool that allows practitioners integrate skills and competences into a real work situation by synchronising skills, knowledge, experience, data, and responsibility during high-level decision-making procedures (Alsulamy, 2015). A framework can also be considered as a factual or conceptual structure projected to aid the development of a concept that expands into something useful since they guide the paths of a research study and provide basis for establishing its credibility (Adom *et al,* 2018).

A framework also seeks to provide the structure/content for a study, based on review of literature, personal experience which further develops as participants' views through which issues are gathered and analysed (Oyebanji, 2014). Therefore, the development of the framework that integrates the strengths of the TPM and AgPM methodologies is based on findings from literature and data collected from UK construction practitioners. The findings of this study on the strengths of the TPM and AgPM methodologies are therefore used in developing the framework. Furthermore, the framework provides a classification system for identifying and categorising the strengths of the TPM and AgPM methodologies according to the phases of construction project, including initiation, design, execution, monitoring and control, and operation phases. The framework, therefore, presents a flexible approach for achieving the integration of agile methodology into the management of UK construction projects. The conceptual framework for this study is presented in Figure *8-1*.

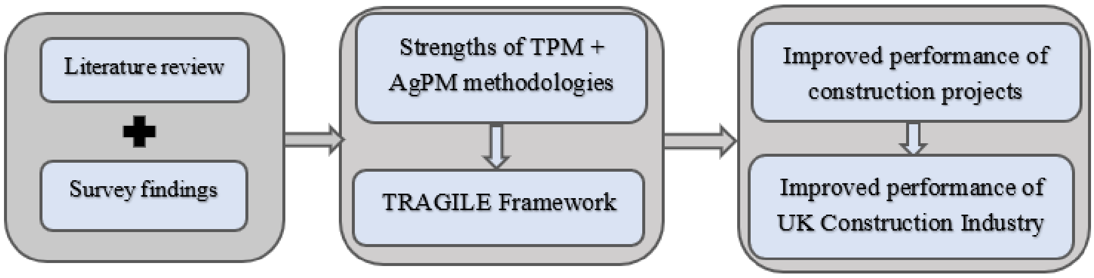

Figure 8-1: Conceptual framework for the TRAGILE framework

Findings have revealed that the performance of UK construction projects is poor, and inconsistent, mainly due to issues ranging from changing requirements to issues such as prolonged planning and negotiation periods of construction projects, as discussed in section 7.4.1, thus leading to issues like delays, client's dissatisfaction, failures, and overruns. Also, literature findings have faulted the issues leading to poor performance to several factors, including the reliance of the UK construction industry on the TPM methodology. Several initiatives have been proposed to improve the performance of construction projects. For example, the Lean Construction by Koskela (1992), the Last Planner System (LPS) by Ballard (2000; 1994), and the Integrated Project Management (IPM) or Integrated Project Delivery (IPD), all of which share many core principles in common with the AgPM methodology (Straçusser, 2015).

The UK government also introduced several reforms and policy initiatives to promote innovation and improve the performance of construction projects. Examples include the Construction 2025, Farmer's (2016) Review, Construction Sector Deal, 2018.

Nevertheless, the industry still faces issues related to poor project performance (Farmer, 2021; Naoum *et al*, 2015), thereby posing a major setback on how best to arouse the industry's interest towards innovative changes in construction project management. Hence, Wolstenholme (2009) argues that since performance has not significantly improved despite several reports and publications, a great deal of work needs to be done to improve its performance.

So far, it is evident that there is need for a holistic approach in addressing the issues relating to the performance of UK construction projects, also considering the apprehensiveness from the practitioners of UK construction industry. Solutions to issues as such are usually proffered in the form of a framework that provides procedural approaches through which the challenges of poor performance associated with construction projects are reduced or eventually exterminated. Such a framework should be explicit and easy to understand by construction practitioners who are involved in the execution of the different phases of construction projects (Gunatilake, 2013).

Considering that no system can depict all the important elements or activities that can enhance the performance of UK construction projects, the TRAGILE framework would therefore serve as a guide, directing the behaviours of the management practices for construction projects. In addition, it is important to note that the TRAGILE framework is not a substitute for judgement and wisdom that are necessary for knowledge acquisition and actions (Alsulamy, 2015); rather, the framework is proposed based on the ideas of Gustavsson (2016) and McBreen (2002), and it suggests dropping parts of the TPM methodology that are not working, replacing some of its parts while introducing the best practices (strengths) of the AgPM methodology. Therefore, the TRAGILE framework, with the aid of key variables deduced from this study, would potentially enhance the management of construction projects as well as improve the performance of construction projects.

The goal is to bridge the performance gap of UK construction projects by developing a framework that integrates the strengths of the traditional and agile methodologies in order to achieve the desired outcome of improved performance and satisfied customers. Therefore, the approach adopted in the development of the TRAGILE framework corresponds to previous studies conducted by (Takim, 2005), wherein data collection provided rationale and enhanced confidence of the research findings. Discussions in the next section provide a comparison of the proposed TRAGILE framework and TPM methodology.

8.2.1 TPM vs TRAGILE

Several studies have evaluated and revealed the distinctions between the agile and traditional methodologies and have settled that there is no universal methodology nor particular approach that would be versatile enough to fit in any project type (as discussed in section 4.2). Neither is the agile methodology a perfect methodology for the management of all the complexities associated with construction projects. Both the traditional and agile methodologies have their individual share of strengths and weaknesses, and the idea of integrating the two methodologies have been suggested by several scholars. The traditional methodology in managing construction projects focuses on rigid planning process and a sequential project delivery approach while the agile methodology, on the other hand, allows maximum flexibility, adaptability, and collaboration with the clients throughout the project life cycle. The TRAGILE framework, which has integrated the strengths of TPM and AgPM, is designed for dynamic construction projects, and the outcome is the management of project uncertainty in an effective and efficient manner. *Table 8-1* present a summary of the key differences between the TPM methodology and the proposed TRAGILE framework identified in this study.

Table 8-1: Key differences between the TPM and TRAGILE

Criteria	**TPM**	**TRAGILE**
Origin	The Hoover Dam project in 1931 (Kwak, 2003)	UK Construction projects
Reason	To manage projects	To enhance flexibility in UK construction project management
Designed for	Managing all the phases of projects	Managing all the phases of construction projects
Component	Traditional-sequential project management approach	Integrated strengths of TPM and AgPM methodologies
Concept	Iron triangle, strategic, holistic, proxy of clients	Customer focus, flexibility, responsiveness, adaptability
Focus	Delivering objectives of the project	Improved delivery of construction projects objectives

Environment	Static	Dynamic. All project environment
Adapts to	Established requirements	Established and customer's changing requirements
Applicability	Simple and straight forward projects	All projects, including complex and adaptive projects.
Processes	Sequential	Iterative
Documentation	Heavy documentation. Well-documented prior to any developmental process.	Although documentation is required, the emphasis is not on heavy documentation.
Workflow	Follows a strict sequence of the pre-planned phases, which cannot be violated.	Mutual interactivity of the team and customer collaboration throughout the phases of the project.
Requirement	Requirements are identified during the planning phase and are rarely revisited.	Iterative planning enables the team to collaborate with the customer at every stage of the project requirements.
Knowledge transfer	Requires documentation which must be carried out once a developmental phase is completed.	Tacit knowledge – sharing between the team members whilst project is ongoing.
Change management	The level of change allowed in this methodology is controlled and minimised.	Change management is very important since changes are necessary for any project's success. Hence, customer collaboration enhances the embrace of change.
Approach to risks	Reactive	Proactive adaptation
Management style	Command and control	Collaborative leadership and management style
Management structure	Close and hierarchical	Flat and team-based
Customer's role	Important	Critical
Attitude to customer involvement	Irritating obstruction	Key to organisational learning
Desired organisational structure	Mechanistic (bureaucratic with high formalisation)	Organic (flexible and participative, encouraging cooperative social action)

8.3 Overview of the TRAGILE Framework

Project management methodologies (whether traditional or agile) share a homogenous principle of delivering good value to the customers (Gardiner, 2014; Hass, 2008). However, the traditional and agile methodologies individually have their strengths and weaknesses, thus making it biased to emphasise that one methodology is superior to the other (Špundak, 2014). For example, consider a typical TPM methodology where the overall goal of the project team is to complete the project on time, within the scope and budget, disregarding some other benefits the entire effort is supposed to yield the organisation. Agile methodology, on the other hand, aims to produce shorter development cycles and frequent deliverables while relying heavily on teamwork, collaboration, and flexibility, which enables the project team to react to the customers' changing needs more efficiently as well as enhance their learning process.

Even though the growth and acceptance of AgPM in the business world has been overwhelming, it is important to recognise that AgPM is still in its infant stage in the world of project management compared to the TPM methodology (Zucker, 2017). Besides, findings from this study showed that only 17% of practitioners were identified as being in the mature phase of agile usage while 33% was observed to being in the very early stage of agile adoption (Zucker, 2017). Consequently, Špundak (2014) discourages the idea of adopting a pure AgPM or TPM in managing construction projects due to their individual weaknesses. In addition, findings from a survey from large, medium, and small organisations suggested that for large-scale project context with high levels of uncertainties, as with construction projects, might require a combination of the AgPM and TPM methodology since it would be more beneficial than adopting a pure AgPM or TPM methodology (Imani, 2017). Furthermore, in a study that compared the management processes presented in the PMBoK (traditional) with components of AgPM, Usman *et al* (2014) revealed that AgPM methodologies are not perfect in themselves; some AgPM's processes, such as cost and procurement management processes are either absent or not defined clearly (risk management processes). Therefore, it is advantageous to integrate both the agile and traditional methodologies in managing construction projects since there is no one-size-fits-all methodology that suits all imaginable purposes (Ziółkowski and Dręgowski, 2014; Cho, 2009; McCauley, 2001).

Project management professionals and practitioners are gradually recognising the potential of the benefits of the principles and practices of AgPM in the construction industry (Ciric *et al,* 2018; Straçusser, 2015). However, whilst its implementation has remained an apprehension for many, there are several ongoing debates on the topic, wherein some scholars are still of the opinion that the TPM and AgPM methodologies are polar opposites. Notwithstanding, this study believes that integrating the strengths of the TPM and AgPM methodologies in a framework can provide a broad spectrum of tools and ideas for effectively managing the complexities associated with construction projects (Ciric *et al,* 2018; Špundak, 2014). Likewise, one major goal of the TRAGILE (TRaditional-AGILE) framework is to create a unique methodology for the management of UK construction projects as well as enhance and appropriate agile benefits while executing a construction project. Therefore, the TRAGILE framework will function in three dimensions. First, it will present a route for the enhancement of agility in UK construction project management. Second, it will serve as an alternative approach to construction project management, thus enabling agility. Third, it will provide a basis for validating the proposed agile ideas within the UK construction industry.

The development of the TRAGILE framework in this study was based on the ideas from nuclear physics, as described in section 5.8.4. The model atoms for traditional and agile methodologies respectively were deduced from literature and findings from data analysis. Then, a separation process or fission was employed to separate the model atoms (traditional and agile methodologies) into their strengths and weaknesses, which was followed by a fission process (merger), wherein the individual strengths of the agile methodologies were used to eliminate the weaknesses of the traditional methodology, and vice versa. Following this, a re-merger process was employed, in which the strengths of the traditional and agile methodologies were integrated and consequently developed into the TRAGILE framework. Before delving into its development, the following section expatiates on what a framework is and the rationale behind the TRAGILE framework.

8.4 Components of the TRAGILE Framework

This study took on a general approach, wherein the TPM and AgPM methodology were considered holistically (and not the methods within them) for the integration of the strengths of the TPM and AgPM methodologies. Also, whilst each methodology has its own vocabulary, a combination of the TPM and AgPM terminologies was used for the TRAGILE framework. The components utilised in the development of the TRAGILE framework include the concepts and principles of TPM and AgPM methodologies, their strengths, together with the phases of construction project management. There are several phases identified in literature, in which a construction project can follow as discussed in section 3.3. For example, the RIBA plan of work organises the process of briefing, designing, delivering, maintaining, operating, and using a building into eight stages (RIBA Plan of work, 2020). APM (2018) presents five stages: concept **s**tage; planning **s**tage; execution, monitoring and control **s**tage; and closure **s**tage. PMI (2013) include project conception and initiation, project definition/planning, project launch/execution, project monitoring/control, project close. Whilst CIOB code of practise for project management includes - Identify: needs and benefits; Assess: options and feasibility, Define: delivery approach and procurement strategy, Design: specifications and functionality, Implement: manufacture and construction, Validate: integrate and handover, Operation: use and maintain, Retire: repurpose or demolish, covering the full life cycle of construction projects. The five stages proposed by PMI (2013) which is also similar to the five stages proposed by APM (2018) have been adopted in this study considering the scope of this research is focussed on construction project delivery and not the whole life cycle of a construction project. The following sub-sections briefly present the components of the TRAGILE framework. Data from literature reviews and findings from data analysis were extracted in developing the TRAGILE framework.

8.4.1 Concepts and Principles of the TPM Methodology

Findings from literature and data analysis allowed the derivation of the following concepts for traditional project management methodology (Figure 8-2).

Figure 8-2: Concepts of the TPM Methodology

These concepts above are based on the findings that the TPM methodology exhibit an integrative characteristic, wherein clients are represented in proxy and allowed minimal involvements in the running of the projects (Špundak, 2014; Demir, 2013). To facilitate this ideology behind the TPM methodology and to yield result, the TPM methodology approaches a project in a holistic way, focusing on strategic planning (Hass, 2007) which is enabled by first identifying the aim and objectives of the project. Hence, the TPM methodology is more focused on strategic issues rather than operative (Demir, 2013). The TPM methodology also focuses heavily on the project cost, time, and scope (iron triangle), thus instigating a profound reliance on predictability of the project outcomes in order to meet the project's objectives (Gledson, 2017; de Melo *et al*, 2016; Crotty, 2012; Love *et al,* 2011).

There are several principles of the TPM methodology, as suggested by Zasa *et al*, 2021; Matovic, 2020; Engelhardt, 2019; Spundak, 2014, PMI (2008); APM (2006), which are more universal and may be applicable to any type of project. The more specific literature about construction project management (e.g., Sommer, 2009; Walker, 2007; Kochendoerfer *et al,* 2007) and the findings from this study indicated five core characteristic principles of the TPM methodology, which are commonly practiced in managing construction projects in the UK, and can be linked with the above concepts, including organisation and structure, pre-defined requirements, rigid planning, leadership, monitoring and control, as shown in Figure 8-3.

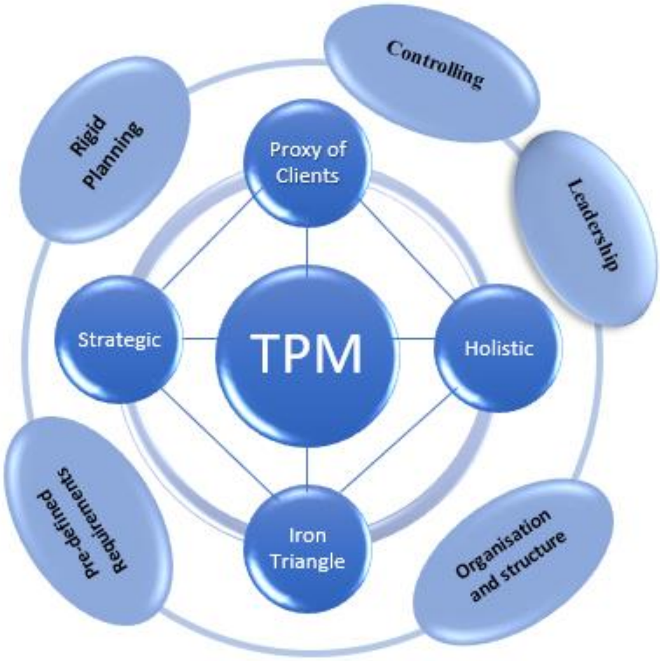

Figure 8-3: Concepts and principles of the TPM methodology

The idea behind the TPM methodology is that projects are predictable and straightforward with clear scopes (Maja, 2017; Spundak, 2014; Cicmil *et al*, 2009; Andersen, 2006; Boehm and Turner, 2003; Boehm, 2002). Therefore, the focus is to meet up with the projects' requirements (Demir, 2013). In order to achieve this ideology, project requirements are usually pre-defined before the commencement of the project based on the assumption that project outcomes are foreseeable and straightforward with clearly defined boundaries (Bergmann and Karwowski, 2019; Wysocki, 2007; Boehm and Turner, 2003; Kliem, *et al*, 1997). Findings from the first phase of this study revealed that pre-defining project objectives followed by a rigid planning are some of the strategies construction organisations in the UK employ to enhance customer satisfaction, as stated thus: "…*We target the customer needs… think towards the future and ask customers what they would expect in the future." "We aim to deliver the job they want within an agreed time frame with minimum disruption from them."*

Furthermore, the idea of pre-defining the project requirements works hand-in-hand with the concept of the iron triangle (cost, scope, and time) which represents the relationship between key performance criteria of the TPM methodology (Pollack *et al*, 2018; Kliem *et al*, 1997). Moreover, the rigid organisational structure of the TPM methodology enables strict adherence to the project plan and a very stringent implementation process (Kibler, 2019). Therefore, once the aforementioned principles (characteristics) are adhered to, the TPM methodology exercises monitoring and control to ensure quality control of the project deliverables (Albrecht, 2017). Koskela and Howell (2002b) note that the monitoring and control process within the TPM methodology is reactive, as opposed to the proactive approach within the AgPM methodology. The TPM methodology employs strict leadership as a strategy in managing the expectation of the clients, which was also confirmed from the findings of the first phase of this study: *"We have project managers with excellent communication and negotiation skills, who work with the client to manage their expectations and discuss changes needed/wanted to the original brief."* Hence, the focus within the TPM methodology is on good leadership and management styles rather than team development and learning. Despite the plethora of studies on leadership, only diminutive consideration has been given to the leadership styles adopted in construction management (Liphadzi *et al*, 2015; Ahmed *et al*, 2010; Bresnen *et al*, 1986) partly because of the lack of understanding of the industry on the part of social scientists and lack of understanding of the social sciences by those in the construction industry (Langford *et al*, 1995).

8.4.1.1 Strengths and Weaknesses of the TPM Methodology

The TPM methodology has strengths and weaknesses that can be related to its concepts and principles. For example, the five key strengths of the TPM methodology identified in this study with the highest mean value (clearly defined objectives, clearly defined deliverables, focus on quality, comprehensive documentation, and good control of project processes) are related to two TPM principles, wherein project objectives and deliverables are thoroughly planned (rigid planning), following a strict monitoring and control process while focusing on delivering quality outputs. On the other hand, the key weaknesses of the TPM methodology identified in this study (high cost of restart, *de facto* methodology, rarely updated project plans, rigid structure, process centric, and minimal clients involvement) are also linked to its principles of pre-defined requirements (due to high cost of restarting), organisation and structure (wherein projects follow a rigid structure and are process centric), and strong leadership team that negotiates with the clients to ascertain the clients requirements and to inhibit clients' interferences during the course of the project), as shown in Table 8-2.

Table 8-2: Strengths and Weaknesses of the TPM Methodology

PRINCIPLES OF THE TPM METHODOLOGY			
	Rigid Planning	Clearly defined objectives Clearly defined deliverables Comprehensive documentation	STRENGTHS
	Monitoring and Control	Focus on quality Good control of project processes	STRENGTHS
	Pre-defined Requirements	Project plans are rarely updated High cost of restart	WEAKNESSES
	Leadership	Minimal client involvement De facto methodology	WEAKNESSES
	Organisation and structure	Rigid structure Process centric	WEAKNESSES

The strengths (highlighted in green colour) and weaknesses (highlighted in red colour) have been discussed in sections 7.4.2 and 7.4.3 respectively. Hence, Figure 8-4 is deduced.

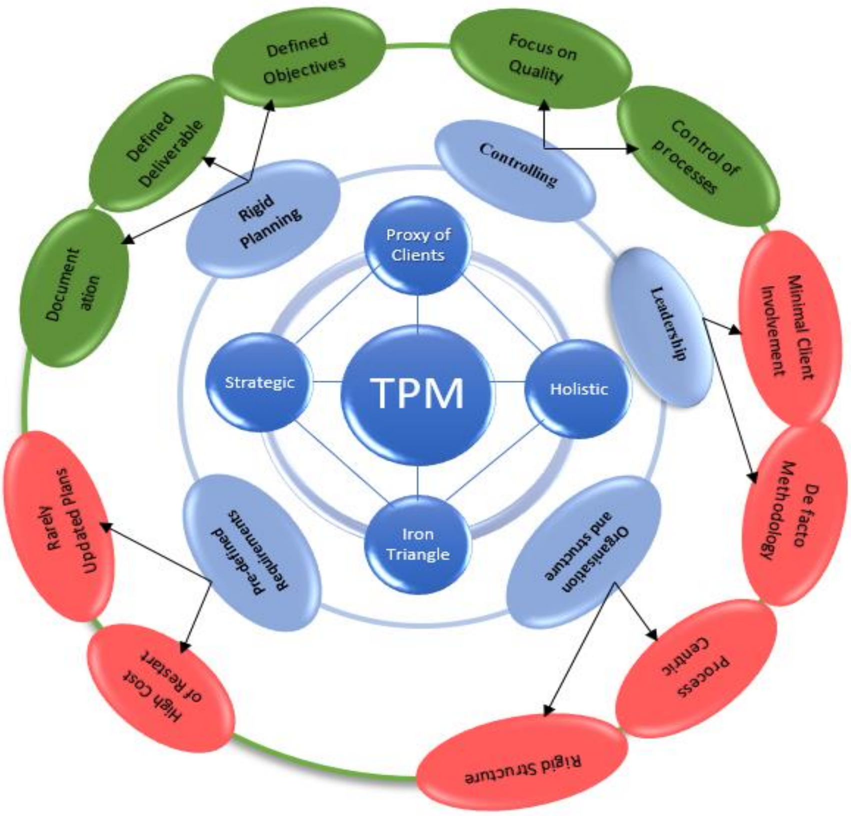

Figure 8-4: Strengths and Weaknesses of the TPM Methodology

8.4.2 Concepts and Principles of the AgPM Methodology

The Agile Manifesto (Beck *et al* 2001), which is the pioneering reference for agile implementation, has highlighted the agile values and principles which are applicable to any project. Studies also have attested to several concepts of the AgPM methodology, such as describing effectiveness, ability to steer, rule-base, people, communication, speed, flexibility, responsiveness, empowerment, change, feedback, value, delivery, innovations, adaptability, collaborative, iterative development, self-organisation, light-weight process, cost-conscious, customer-driven, strategic, conceptual framework (Laanti *et al*, 2013). Besides, the agile principles span customer satisfaction, continuous delivery, value, early delivery, adaptability, competitiveness, customer benefit, collaboration, motivated individuals, good environment, support, trust, efficiency, communication, progress measurement, sustainability, people, technical excellence, simplicity, optimisation of work, self-organisation, built in improvement of efficiency, and behaviour (Gren and Lenberg, 2019). Even though the Agile Manifesto (Beck *et al* 2001) and studies have expressed the concepts and principles of the AgPM methodology, findings from this study allowed the derivation of the following concepts and principles which seemed relevant for the purpose of this research since they were influenced by the data collected from UK construction practitioners. Therefore, the concepts of the AgPM methodology adopted in this study include flexibility, responsiveness, customer focus, and change (see Figure 8-5), which also cover the key agile characterisation discussed in section 3.4.2.5.1, as described by Gobin (2016).

Figure 8-5: Concepts of the AgPM Methodology

In this study, the AgPM methodology is perceived as a competitive advantage that would enable construction practitioners to adapt better with the complexities associated with the management of construction projects as well as serve as a guideline for innovative construction practices. Flexibility is undeniably one major concept of the AgPM methodology since it relates to the project team's ability to respond to changes quickly (speed) and easily in a construction project. In today's turbulent market environments, the flexibility of responding to changing requirements is at the heart of a successful development project (Zasa, 2021). Flexibility is very important to effectively address and tailor a project to suit the client's needs (Tendedez *et al*, 2018). Accordingly, Latham (1994) asserts that the clients are the core of construction process, and their needs must be met. Hence, flexibility lies in the embrace of changes from the customers, which most times are expected changes that enhance the team's retrospective learning (Han and Bogus, 2013).

Furthermore, change (changes to project requirements) within the AgPM methodology is another key concept unlike the traditional response to changes that seem passive. In this case, the goal of the agile project team is to take advantage of every change opportunity and become better, necessitating the involvement and collaboration of the clients to enhance greater level of satisfaction (Demir, 2013). AgPM also allows a self-motivated and collaborative working environment whilst retrospectively learning new ways of managing projects. Hence, it is built on the concept of responsiveness (and adaptation) (Han and Bogus, 2013). Drawing from experience and several agile transformations projects, Gren and Lenberg (2019) argues that adopting an agile methodology simply boils down to being responsive to change, which is the core of agile transformation. Following the above discussion on the concepts of the AgPM methodology, the key principles of the AgPM methodology (Figure 8-6) derived from findings of this study includes self-organised team, short iteration, retrospective learning, collaboration and transparency, which covers the core aspects of agile practices.

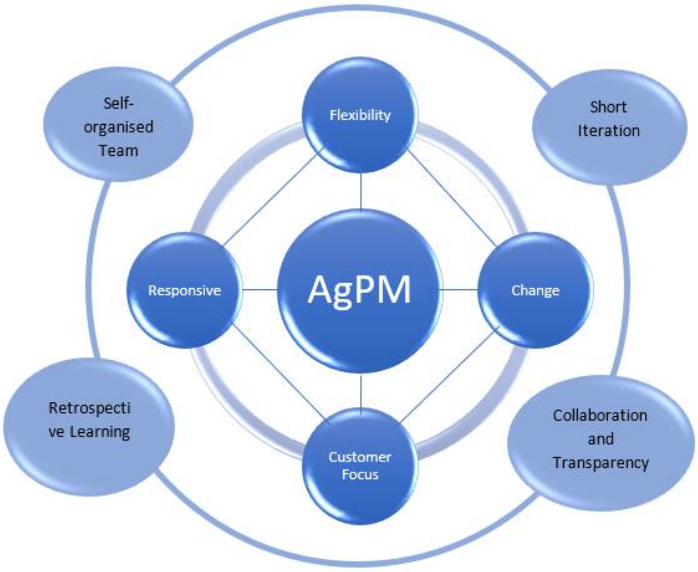

Figure 8-6: Concepts and Principles of the AgPM Methodology

Short iteration is one of the core principles of AgPM. The AgPM methodology employs short iterative process that leads to the progressive release of the project output (Zasa, 2021). Besides, short iteration enhances flexibility and adaptive planning on the specific needs of the customers, and as a result the team is able to react swiftly, thus creating more values for the customers. Likewise, the AgPM methodology dissuades occasional participation of the clients as this would lead to failure and low-quality output. Therefore, 'collaboration and transparency' necessitates that the clients, the stakeholders, and the project team work together throughout the entire project life cycle (Betta and Boronina, 2018). Ku (2018) also notes that the clients' needs are usually met when they collaborate with the project team since there are more opportunities to make inputs as required, thereby enhancing retrospective learning of the team. Retrospective learning is an avenue for the team to brainstorm based on the changes and inputs from the clients and to create plans for future improvements (Schwaber and Sutherland, 2017). Furthermore, since the motivation of each team member with shared goals and objectives is critical to the success of the project, self-organised team within the AgPM methodology encourages the implementation of individual contributions and improvements based on the ideas and expertise of the project team.

8.4.2.1 Strengths and Weaknesses of the AgPM Methodology

Despite the acceptance of the AgPM methodology as a solution to the weaknesses associated with the TPM methodology, some weaknesses of the AgPM were also identified from literature review and discussed in section 3.3.3.5. These weaknesses were not presented in the quantitative study, since the AgPM methodology is still in its infant stage within the UK construction industry, and most of the participants in the first phase of the study do not fully know the AgPM methodology. Furthermore, studies have also revealed that some of the strengths of the AgPM methodology also constitute its major weaknesses. For example, co-location of the project team members suggests that the team members need to be at the same location throughout their work. However, this can become difficult as it is not possible for teams that work on the different projects and are far away from each other to come together and work at the same physical location. Hence, it makes coordination difficult. Also, considering that the AgPM principle enhances collaboration and transparency, active participation of clients or users throughout the development lifecycle of a project can sometimes lead to major weaknesses since the clients sometimes do not have the time to interact. The strengths and weaknesses of the AgPM methodology identified in this study are presented in Table 8-3.

Table 8-3: Strengths and Weaknesses of the AgPM Methodology

Principles	**Strengths**	**Weaknesses**
Self-organised team	• Team ownership and accountability ▪ Team engagement and commitment ▪ Increased productivity and morale	▪ Small teams ▪ Co-located team
Short iteration	▪ Focus on specific needs of customers ▪ Adaptive flexible planning and continuous improvement	▪ Frequent delivery/Testing
Retrospective learning	▪ Frequent evaluation and resolution of issues ▪ Attention to technical excellence	
Collaboration and transparency	▪ Greater expertise and resource effectiveness ▪ Closer engagement with stakeholders ▪ Efficient communication	▪ Face-to-face communication

Based on the strengths (highlighted in green) and the weaknesses (highlighted in red) of the AgPM methodology presented in Table 8-23, the following structure (Figure 8-7) is deduced.

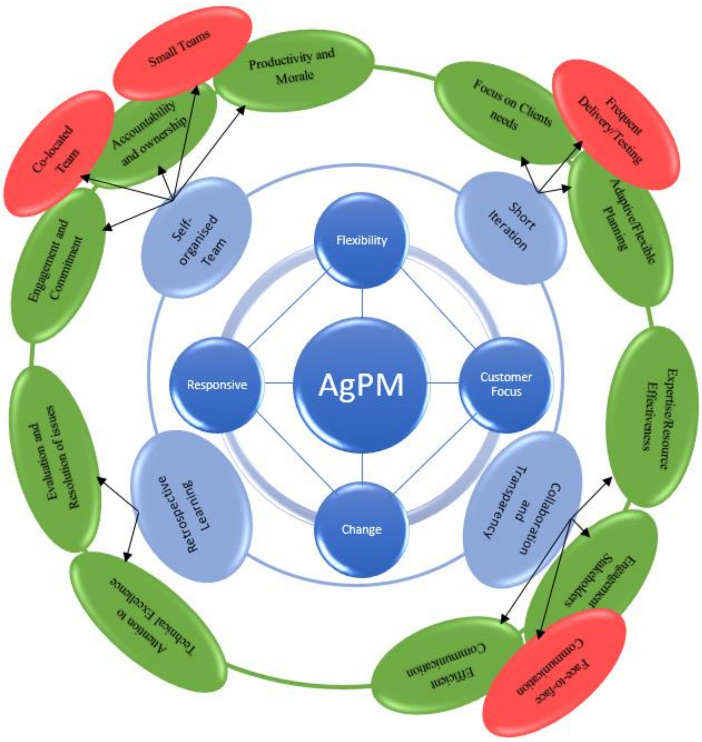

Figure 8-7: Strengths and Weaknesses of the AgPM Methodology

8.4.3 Application of Fission (Separation)

During the fission process of the model atoms (TPM and AgPM) discussed in section 5.8.4, each model atom (TPM and AgPM) was split into fragments, containing the strengths and weaknesses of the individual atoms with respect to their principles, as shown in Figure 8-8.

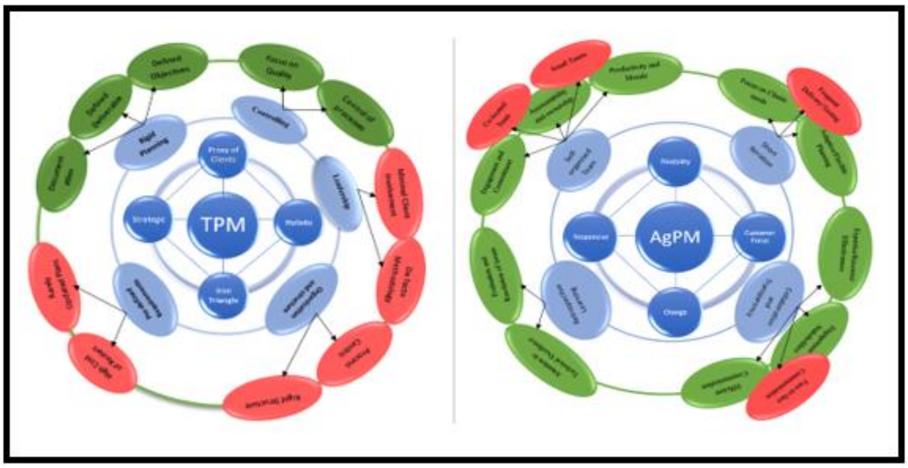

Figure 8-8: Model Atom

Considering that the strengths and weaknesses of the model atoms are related to the principles, fission (separation) process was therefore applied only to the principles of the model atoms, as shown in Figure 8-9.

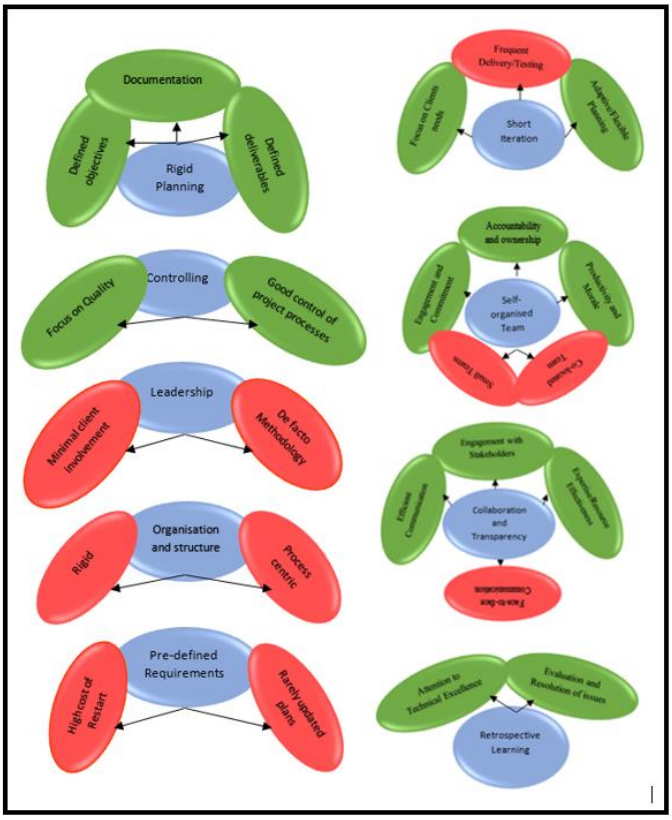

Figure 8-9: Application of Fission (Separation)

Also, as discussed in section 5.8, the strengths of a model atom cannot be used in eliminating the weaknesses of the same model atom because, if the strengths could eliminate its inherent weaknesses, then this reaction would have happened already and there would not be any recognisable weakness of the model atom (Demir, 2013). So, it is under these circumstances that the strengths of agile model atom were used in eliminating the weaknesses of the traditional model atom, and vice versa. This was then followed by an integration (fusion) of their individual strengths.

The model atoms (TPM and AgPM respectively) seem to have quite an unbalanced number of strengths and weaknesses because more strengths were identified with the AgPM methodology compared to the TPM methodology. Furthermore, a fusion process was employed to integrate the strengths and eliminate the weaknesses from each model atom.

8.4.4 Application of Fusion

Application of fusion reaction to the pool of principles shown in Figure 8-9 above results in different reactions between the atom nucleus fragments of the model atoms. The fusion process integrated the strengths of both the TPM and the AgPM methodologies based on Gustavsson (2016) and McBreen (2002)'s suggestion on integration, wherein some aspects (strengths) of the TPM methodology are retained, and some parts changed while introducing a new methodology (the strengths of the AgPM methodology). In the fusion process, the strengths of AgPM were used to eradicate the weaknesses of the TPM methodology. This was attainable in the process whereby the strengths search for weaknesses of another paradigm to eliminate it. Also, the concepts and principles of the model atom were retained whilst replacing the weaknesses with the strengths of another model atom. Figuratively, it can be said that the strengths and weaknesses created explosive reactions. The following sections discuss how the weaknesses were eliminated by the strengths of another model atom. Subsequently, the individual strengths of the TPM and AgPM methodologies were integrated (fused) into the model atom (known as the TRAGILE).

8.4.4.1 Rigid Planning, Predefined Requirements (TPM) vs Short Iteration (AgPM)

Planning is one of the most important aspects of managing a construction project. Findings from this study revealed that the UK construction practitioners invest heavily in the planning process before executing any construction project. Since the TPM methodology is driven by early planning, it only seem to work well when most of the project information is known up front and is unlikely to change significantly during execution phase of the project. Also, studies have revealed that the traditional planning processes are simply too linear and rigid, thus inhibiting proactive response to change during the development process of a construction project (Thesing *et al*, 2021; Gorod *et al*, 2018; Robert and Anita, 2018). Moreover, findings from this study reveals that one of the major factors that heightens the rigid planning process of the TPM methodology is the high cost of restart, which was identified as one of the weaknesses of the TPM methodology. This is because the TPM methodology focuses on planning up front, wherein the entire project is planned beforehand without any scope for changing requirements, hence a high cost of restarting a phase where any alteration to the original plan is implemented.

For projects where knowledge discovery (coupled with changing requirements) continues to take place throughout execution (as with construction projects), Jackson (2012) suggests an iterative waterfall planning approach, i.e., integrating flexibility in the planning process of the TPM methodology. The principle of short iteration of the AgPM methodology, on the other hand, allows a flexible planning approach, corroborating with the suggestions of Jackson (2012). In addition, it is focused on the customers' needs and continuous improvement, thus eliminating the weakness of high cost of restarting a phase of the project since the clients are involved in every stage of the project execution. Therefore, when this strength of the AgPM methodology (short iterations) is integrated into the planning phase of construction projects, it would enhance frequent feedback from customers and also afford the project team more opportunities to reflect and improve their work practices (Nicolette, 2022). At its core, the AgPM methodology eliminates the rigid bureaucratic cultures of the TPM methodology (top-down, zero failure), wherein the entire project requirements are laid out before the actual design and development of the project (Mergel *et al,* 2021). Besides, the Agile Manifesto acknowledges that the highest priority in any project is the satisfaction of the customers. Therefore, suggests that working results are delivered frequently in short iterations to the customers.

Even though frequent delivery/testing of the AgPM methodology was identified as one of the weaknesses associated with the principle of short iteration, Ahmed and Mohammed (2018) however argues that its strength is that continuous feedback (deliverables) and recognition of customers' changing requirements are regarded as fundamental for delivery of quality in a project. Therefore, to facilitate repeated and incremental delivery within a construction project, Straçusser (2015) suggests that rather than following the normal sequential construction process, construction projects can be performed based on *short, flexible planning approach* in components, subsystem, or system, and integrated testing/delivery is introduced when a functional system is achieved.

Studies have also justified the importance of implementing agile in the planning phase of construction projects (Ingle, 2019; Mohamed and Moselhi, 2019; Kibler, 2019; Mnqonywa *et al*, 2018; Burmistrov *et al*, 2018; Streule *et al*, 2016; Owen *et al*, 2006; Owen and Koskela, 2006). Hussien *et al* (2016) also contend that agile process improves on-time delivery and client satisfaction by 23%, increases construction predictability by 40%, and most importantly increases organisational skills of both management and development personnel by 97%. It has also been demonstrated that the adoption of the AgPM in the delivery of construction projects has a positive impact on the on-time delivery; improves client satisfaction and collaboration; and enhances project development. Figure 8-10 below illustrates how the strength (short iteration) of the AgPM model atom has eliminated this weakness (predefined requirements) of the TPM model atom.

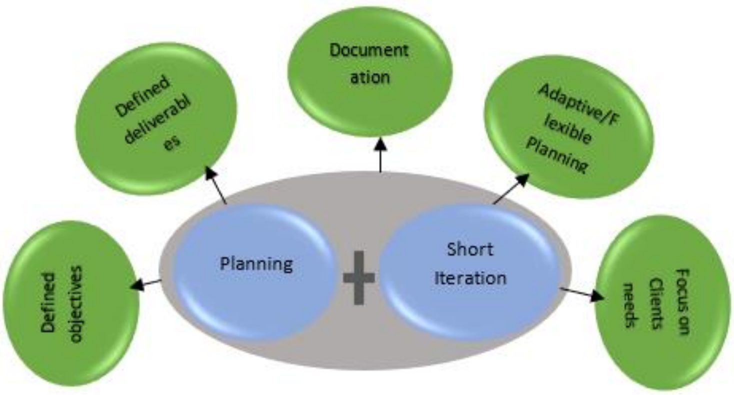

Figure 8-10: Figure: Fusion of Planning and Short Iteration

To enhance flexibility in the face of increasing uncertainty and complexity of construction projects, Burmistrov *et al* (2018) suggest the need to decompose the whole large-scale project and to split it into the project chain, consequently resulting in an iterative (flexible) approach to planning and guiding the project's processes. Also, one major advantage of integrating AgPM in the planning phase of a construction project is its use of small deliverables. Rather than planning up front, the entire project life cycle, the iterative principle of AgPM recommends that project objectives and deliverables should be defined but in short iteration since requirements are likely to change over time. Hence, short iterative planning (i.e., planning + short iteration) would give room for regular adjustments and reconciliation (changes) in the project processes, allowing the client's input at every stage of the project. Figure 8-11 illustrates the fusion of the principles of TPM and AgPM, which shows a short iterative planning process of defining the project's objectives and deliverables, while focusing on the customers and continuous improvement of the team, thereby eliminating the weaknesses of high cost of restart, changing requirements, and issues of frequent delivery.

Figure 8-11: Short Iterative Planning

8.4.4.2 Controlling vs Self-organised Team

Monitoring and control of a construction project usually runs parallel with the execution phase to ensure quality control of the project deliverables (Albrecht, 2017). Based on the principle of monitoring and control within the TPM methodology, two strengths were identified in this study: focus on quality and good control of the project's processes (which is moderately correlated with clearly defining the project's deliverables). Despite careful planning of all the project deliverables within the TPM methodology, construction projects still experience glitches during the execution phase. According to Al-Agele and Ali (2017), these issues can be linked to several limiting factors, including the inability of the organisation to meet up with the client's requirements, multiple sources of decision and overlaps in power, inadequate/prolonged planning process, just to mention a few. Therefore, during the execution phase of a construction project, the project manager reconciles the projected performance detailed in the project plan documentation with the actual project's performance (Peterman, 2016). Hence, the main goal of the monitoring and control phase is to meet up with the project requirements and ensure the satisfaction of the clients.

Several activities are covered within the monitoring and control phase of a construction project including time management, cost management, quality management, change management, risk management, issues management, procurement management, acceptance management, and communication management, which are carried out side-by-side (Active Collab, 2020). However, amongst all these activities, change management is the most critical since the execution phase requires significantly elevated work processes. Evolving circumstances would mean a deviation from the original blueprint, hence causing a major drift in the project outcome (Zwikael, 2019; Albrecht, 2017). So, rather than sticking to the rigours associated with the traditional monitoring and control, studies suggest a collaborative and adaptive approach which focuses on adding value to the customers, improving the time-to-market, integration of good feedback system, and promoting continuous improvement (Pareliya *et al*, 2018; Smeekes *et al*, 2018; Boerman *et al*, 2015; Conforto *et al*, 2014).

In addition, one of the primary measures of progress in a project is an incremental deliverable that is functional and provides value to the customers (Mas *et al*, 2020). Therefore, rather than monitoring, controlling, and adjusting the outcomes of a project, Conforto *et al* (2014) propose that project managers should focus on adding value to the customers, and improving the time-to-market, integration of good feedback system, and promoting continuous improvement (Smeekes *et al*, 2018; Boerman *et al*, 2015). Due to the iterative and incremental nature of the AgPM methodology, the project team gains early feedback which enables them to provide customer visibility, confidence, and control of the project (PMI, 2017). Consequently, also improving the team members' productivity/morale, their engagement, accountability, and ownership of the project.

Figure 8-12 below illustrates the fusion of the monitoring and control of the TPM methodology with self-organised team of the AgPM methodology. With self-organised project team, monitoring and control within the AgPM methodology is somewhat different from that of TPM methodology because the project team members are self-organised/managed. Also, the project team members within the AgPM methodology are held accountable for the progress of the project, thereby enabling them to implement individual contributions and improvements based on their ideas and expertise without a project controller (Wanner, 2021).

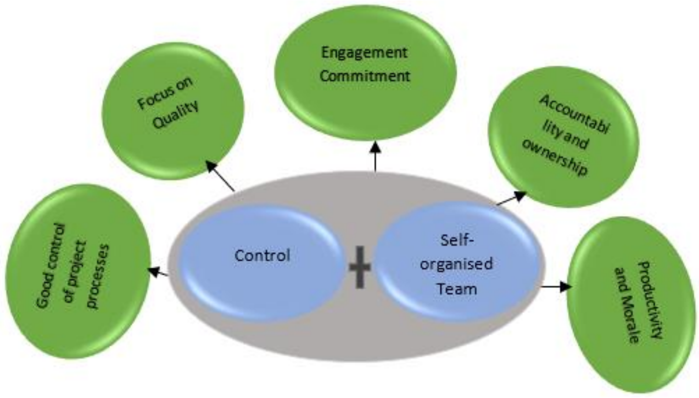

Figure 8-12: Monitoring and Control (Execution Phase) vs Self-organised Team

This study also identified ‘co-located teams’ and ‘small teams’ of the AgPM as some of its weaknesses. Reichert (2022) also agrees that the concept of co-location is overrated and typifies a reflexive reaction to communication and comprehension issues that may occur when working with agile team in different parts of the world. Even though the AgPM methodology strongly demands co-location of the project teams, co-location of the project team members is not an inevitable requirement, and in some cases it may even be counterproductive (Stadler *et al*, 2019; Lehmann, 2003; Katzenbach and Smith, 2003). In fact, a closer look into the Agile Manifesto shows that the term ‘co-location’ is not specifically mentioned but has often been derived from one of its 12 principles: “the most efficient and effective method of conveying information to and within a development team is face-to-face conversation” (Beck *et al*, 2001). Therefore, in considerations of the complexities in a construction project, having all the team members in the same location seems nearly impossible. Likewise, even though some studies suggest that co-location holds the promise of significantly reducing time, effort, and financial resources, while enhancing the quality of documentations in a construction project (Aliber, 2018), the various entities that have a stake in construction project’s success are not usually co-located (Williams, 2022). Therefore, rather than emphasising on co-located small team, an integrated working team is suggested in this study.

Accordingly, Construction Excellence (2022) refers to an integrated working team to mean bringing together everyone involved in the delivery of a project so that they work in unison towards a common goal. So, when issues arise, everyone comes together to find a solution rather than splitting up. An integrated working team, consisting of the client team and the supply team jointly managed by a sponsor or project manager, is recommended. Figure 8-13 illustrates the result (integrated self-organised team) of the fusion reaction between the principles of 'monitoring and control' and 'self-organised team.'

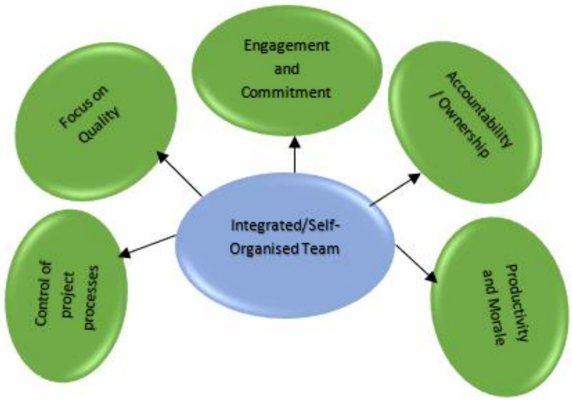

Figure 8-13: Integrated/Self-organised team

8.4.4.3 Organisational Structure vs Collaboration and Transparency

Good organisational structure serves as moderator for improving the influence that construction project managers have on the behaviour, performance, and work of the project team in search of the satisfaction of the client (Neubert *et al*, 2016). However, findings from this study revealed that the organisational structure within the TPM methodology is bureaucratic with high formalisation (rigid, process-centric) (Gregor, 2021; Spalek, 2016), which has undoubtedly posed as barrier to the adoption of new innovative changes. Also, the traditional ways of managing construction projects seem to be less attractive for younger project managers because of its autocratic, hierarchical organisational structure that is perceived as 'old school', 'command and control' ways of working (Hatum, 2013). This was also identified as a major weakness of the TPM methodology in this study.

Two strengths ('good control of project processes' and 'documentation') and three weaknesses ('project plans are rarely updated,' '*de facto* methodology,' and 'rigid management structure') were identified to be related to the rigid organisational structure of the TPM methodology. The strength, good control of project processes, was identified to be very crucial as it provides a meticulous avenue to risk identification and management. According to Olawale and Sun (2015), the key project control tasks in construction project management include planning, monitoring, reporting, and analysing. Thus, construction project management is accomplished by pre-emptively identifying risks, continuous monitoring and control process as well as developing a contingency plan to mitigate subsequent issues, thereby reducing negative impact on the budget and project schedule. Furthermore, since the TPM methodology emphasises linear processes, documentation, planning up front, and prioritisation, the rigid organisational structure within the TPM methodology facilitates its coordination and implementation.

On the other hand, the simple and flexible organisational structure within the AgPM methodology, with its minimal interconnected department promotes interaction, collaboration, and effective communications among the project team, enables the team members to freely discuss new ideas, gain expertise and effectiveness while boosting their knowledge sharing best practices (Ribeiro *et al*, 2010). Also, AgPM's principle of continuous improvement through short, frequent meetings enables the team to evaluate the job done and what needs improvement (Yllen Johansson, 2012; Gustavsson 2011), thus enhancing the team's efficiency (Ribeiro *et al,* 2010). Figure 8-14 illustrates the fusion process of the principles of organisational structure of the TPM methodology and collaboration/transparency of the AgPM methodology.

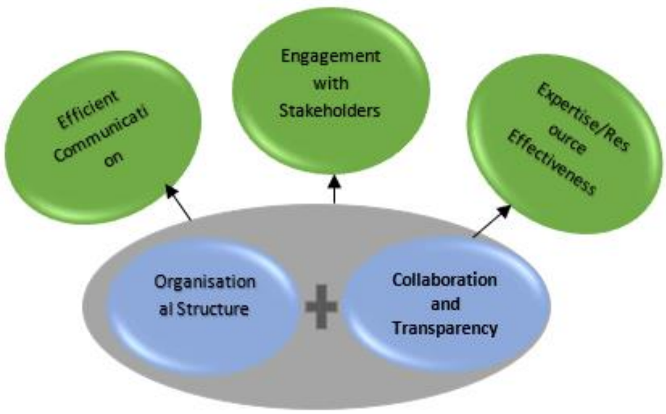

Figure 8-14: Organisational Structure vs Collaboration and Transparency

Figure 8-15 shows the result of the fusion process resulting in a collaborative organisational structure, wherein there is collaborative control of the project processes with the stakeholders while enhancing effective communication, expertise of the team, and iterative documentation.

Figure 8-15: Collaborative organisational structure

In the collaborative organisational structure, the project teams and the project manager have a great deal of independence to collaborate with stakeholders (Hendrickson, Hendrickson, and Au 1989). Consequently, enhancing the formation of interdisciplinary self-organized teams which have all the needed expertise to carry out the project (Mohamed and Moselhi, 2019).

8.5.4.4 Leadership vs Retrospective Learning

Leadership plays a vital role in the motivation and performance of the project team (Saad *et al*, 2020). Accordingly, Imam and Zaheer (2021) agrees that leadership as well as the style employed in the management of construction projects can directly amplify or repress project performance via knowledge sharing and cohesion. In addition, improving the motivation of project team is vital, and it has direct influence over their performance as well as the projects' success (Saad *et al*, 2020). However, findings from this study revealed two major weaknesses (process centric and proxy of the clients) that are linked to the leadership style employed in managing UK construction projects. Since the goal of the project manager (project leader) within the TPM methodology is to achieve quality deliverables, the project team concentrates majorly on following the processes in the predefined requirements, giving no room for the client's inputs or collaborations. One of the participants in the first phase of this study stated as follows: *The technical team only reports to the project – team - the stakeholders only communicate with the project team. We keep the project team at the centre of all communication so that unnecessary relationships aren't formed between* *various stakeholders and the technical team. We feel this is the best way to avoid communication.*

According to Richardson (2010, p.4), the role of a project manager is to “make it happen” since “taking it” for granted has resulted in the strict reliance on the TPM methodology, which focuses on the mechanics of project planning, implementing, and controlling while paying lip service to front-end assessments of project goals (Picciotto, 2019). Furthermore, the fragmented state of the UK construction industry has resulted in a functional and firm separation between the organisation, leadership, and execution of construction projects. Thus, causing a huge amount of diversity within a construction project, where the parties involved are mainly focused on their own interests (Demir, 2013). On the other hand, with the AgPM methodology, every member of the project team is expected to stand up to the tasks of ensuring quality deliverables (Abbasi and Ruf, 2022).

Besides, the first agile value gives priority to the individuals (the project team) and their interactions over the processes and tools employed in the management of construction projects. Therefore, adopting a leadership style that strengthens the competencies of the team, as well as self-organisation to become independent of regulations and instructions, is very crucial (Abbasi and Ruf, 2020) since team building has been observed as a complex task for construction projects (Demir, 2013). Likewise, if the developmental process of a project is driven by processes and tools (as with the traditional methodology), the team becomes less responsive to changes and are less likely to meet the projects requirements with minimal retrospective learning (Ku, 2018). Hence, it is suggested that project management practitioners adopt a stance of justifying the means rather than just focusing on the ends as with the TPM methodology (Picciotto, 2019; Morris, 2013).

According to Marshburn (2018), retrospective learning is the principal means through which a team focuses on continuous process improvement since it avails them an avenue to independently identify and resolve issues that impact team performance. Hence, integrating the principle of retrospective learning of the AgPM methodology with the leadership style of the TPM methodology would enhance the elimination of the weaknesses associated with the TPM leadership and enhance the team’s technical excellence whilst evaluating and resolving issues in a project. Figure 8-16 illustrates the integration process of the principle of retrospective learning and leadership of construction projects.

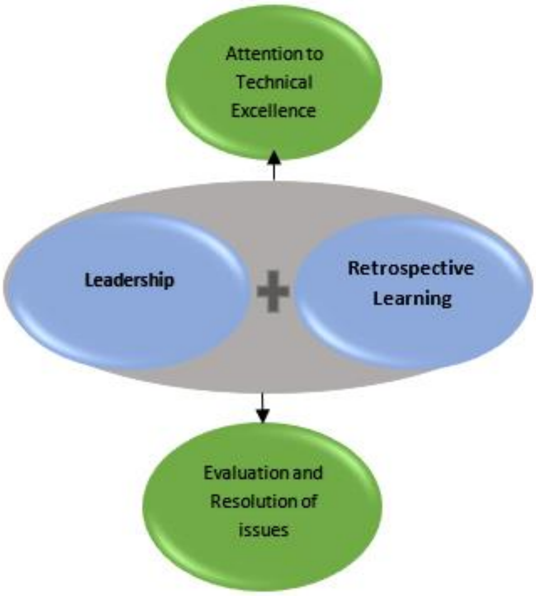

Figure 8-16: Leadership and Retrospective Learning

Consequently, rather than focusing only on the processes of arriving at quality deliverables, with clients at a proxy, the principle of retrospective learning would enhance collaboration and transparency as well as enable the identification, evaluation, and resolution of issues, alongside technical excellence of the project team, Figure *8-17*.

Figure 8-17: Leadership and Retrospective Learning

8.6 The TRAGILE Framework

The TRAGILE framework was developed based on the findings from this study and in line with the five phases of construction project management, namely the initiation phase, planning/design phase, execution phase, monitoring and control phase, and closure phase, as discussed in section 8.4. Organisational structure and leadership was also considered in the TRAGILE framework development since it defines how activities, including task allocation, coordination, and supervision of the project, are directed toward the achievement of organisational aims and objectives. Traditionally, construction projects are perceived as poor candidates for the implementation of AgPM since they are typically very sequential in nature, and changes in the project's requirements are very expensive (Straçusser, 2015). Conversely, the agile methodology is considered as an innovative methodology that can be applied to almost any large-scale project in any industry, including construction.

The main belief of this study is that the TRAGILE framework can be used as a guideline for the design and architecture of the horizontal, vertical, and end-to-end integration of the agile methodology within the UK construction industry. Furthermore, the developed TRAGILE framework (Figure 8-18) is intended to function as a wheel of change (hence, the rotating arrows), whereby at every phase the desired organisational structure should be organic (flexible and participative, encouraging flexibility and adaptation to new ideas). Hence, whenever the wheel rotates (i.e., a new phase in the construction process), the flexible organisational structure should promote interaction, collaboration, and effective communications among the project team, whilst also enabling them to freely discuss new ideas, gain expertise and effectiveness, and boost their knowledge sharing practices.

So far, very few studies have examined the integration of the TPM and AgPM methodologies for the management of construction projects. Therefore, this study provides an addition to the advancement of the much-needed studies on construction agility in the UK construction industry. Although the concept of Construction 4.0 is still evolving, this study draws from the definitions provided by Construction 4.0, which generally refer to the use of innovation (changes in the processes and work methods) within the construction industry (García de Soto *et al*, 2022). In the context of this study also, vertical integration refers to the integration of all the phases of a construction project, horizontal integration refers to the integration of all members of the project team, whereas longitudinal integration is the integration of inter-project learning and knowledge management (Sawhney *et al*, 2020). This study is however limited to the scope of vertical and horizontal integrations, considering that longitudinal integration occurs by virtue of the principles proposed by the agile concepts and principles in the AgPM methodology. Also, the underlying rationale behind this integration idea is that integration should align with the concepts and principles of the traditional and agile methodologies. Consequently, the integration mechanism adopted in this study can be tailored to individual organisation based on the value it adds to construction clients (customers) or based on the product or service offered (Sony, 2018).

The integration of the strengths of the TPM and AgPM methodologies is considered with regards to the initiation phase, planning phase, execution phase, monitoring and control phase, and closure phase of a construction project. However, this kind of integration can only be effective where the organisation allows flexibility, and the project team focuses on the following (as shown on the left-hand side of the framework), Figure 8-18:

- quality project deliverables for the clients
- evaluation and resolution of issues arising (on the go) rather than depending on predictive plans for the project
- monitoring and controlling the project with the help of effective communication, engagement of all stakeholders, and iterative documentation
- retrospective learning for the project team

The following sections will briefly discuss the integration as well as the implementation strategy for the framework. Discussions in the following sections will elaborate on the phases of the TRAGILE framework (Figure 8-18), its implementation strategy, as well as assumptions made in the development of the framework.

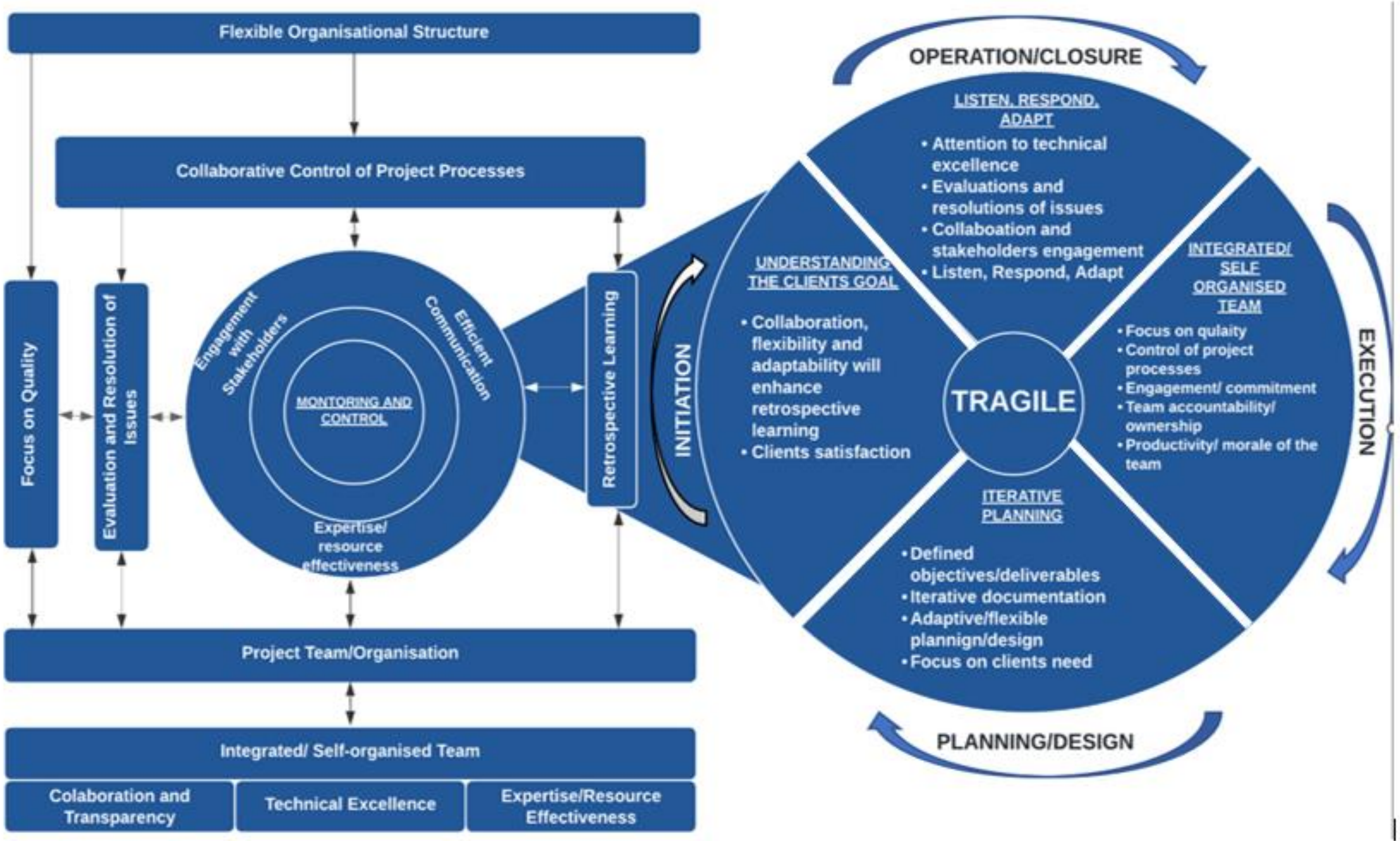

Figure 8-18: The TRAGILE framework

8.6.1 Initiation Phase: Understanding the Client's Goals and Priorities

Every construction project begins with the client; this is the party who has instigated the project, who has thought about the need for the project, and who would eventually have organised the funding and be convinced that it is a worthwhile investment (Greenhalgh and Squires, 2011). Hence, understanding the client's goals and priorities is very paramount at the initiation phase for the successful execution of the project. Project initiation is a very essential phase in managing a construction project since the success of the project delivery is determined by what happens during the initiation phase. During the initiation phase within the traditional methodology, the project manager evaluates the project to determine its feasibility and whether the project should be undertaken. Consequently, all the key components of the project are established and documented. Likewise, all parties (including the clients) must be clear on what the project is intended to achieve, so the client at this point is expected to clearly define the project's objectives and project deliverables. [… "*we like a clear objective from the customer and a full site inspection and site plans as far as they are available*"].

The purpose of clearly defining the project objectives at the initiation phase of a construction project is to specify and constrict the scope of the project to the agreed requirements, leaving little or no room for requirement changes [… "*we aim to deliver the job they want within an agreed time frame with the minimum of disruption to them"*]. However, this approach does not enhance flexibility and adaptability; it rather leads to issues relating to changes in design, scope, and overruns, considering that the client may not be able to clearly define what he/she wants at the onset of the project. Integration of the strengths of the AgPM methodology (i.e., flexible, and iterative planning, continuous improvement) into this phase of a construction project would promote the client's satisfaction due to their early and continuous involvement in the project. As a result, the project team's focus should be on the client as well as the understanding and adoption of the client's goals and priorities, which would be achieved via enhanced flexibility, adaptability, and customer collaboration. Therefore, the strengths of the AgPM methodology in the initiation phase of a construction project would enable continuous improvement in the project, and the implications of the TRAGILE framework in the initiation phase include:

- Communication with the clients/stakeholders would be clear and optimised to deliver a robust and well-defined project scope with clarity around the deliverables needed to execute the project.
- Stakeholders involvement would be enhanced throughout the project life cycle, and this would enhance the creation of a continuous feedback loop that drives transparency and an improvement in productivity.
- The framework would promote a culture that favours team building and improved collaboration, thus eliminating any unnecessary stress and burden that might prevent cross-functional teams from reaching shared goals together.
- It would drive a faster developmental schedule that does not require as many revisions to create the perfect conditions for clients' satisfaction due to collaboration with the clients.

8.6.2 Planning/Design Phase

Design is the intermediate phase of a project, where the idea generated during the pre-design phase is developed and transformed into the desired specifications and prescriptions to guide construction, operation, and maintenance of the building (Kagioglou *et al*, 1998). As such, two major issues usually would emerge: the integration between design and production; and the dynamic process of requirements capture (Koskela, 2006). Traditionally, the design phase is planned and executed iteratively considering the client will have to review and accept the design. So, changes and alterations to designs (due to its iterative nature) can lead to delays and challenges in maintaining a stable and reliable schedule without leading to tremendously unexpected costs during the later stages of the project.

A dynamic project environment like construction requires an iterative management system based on short cycles and rapid feedback loops in order to continuously arrive at the desired goal of the project. Also, considering that design evolves over time, only at the later stage of a project does it become clearer, i.e., what is to be executed or implemented. Therefore, the rigidity of the TPM methodology employed in the planning/design phase of a construction project may not be fully appropriate for managing the project work and tasks, especially in the early stage such as preliminary design. For example, considering a typical design phase of a construction project, a draft of the design is produced and presented to the client who provides feedback, which is then incorporated into the design and implemented. In an ideal situation, this iterative feedback cycle continues until the client is satisfied with the design. Even though the traditional model may seem to improve coordination, it contributes to greatly reducing the flexibility of the project and consequently the client's satisfaction.

The AgPM methodology, on the other hand, has gradually replaced the goal of optimisation from the TPM methodology with the goals of flexibility and responsiveness (Moe *et al*, 2010). Given that the time for a change in the planning/design phase of a construction project is long overdue; the current 'best practice' adopted in the design phase must be set aside for the next practice. More so, considering that the similarities between the design phase in construction and software development lies in their iterative characteristics, the TRAGILE framework proposes that the team in a construction project should collaboratively optimise flexibility through feedback loops (Wysocki, 2006) while reflecting on the project's risk mitigation strategies. Furthermore, considering that the AgPM methodology promotes variability, the feedback loop wrought by the collaborative strengths of the AgPM methodology within the TRAGILE framework would enhance flexibility and responsiveness, consequently resulting in the team's ability to respond to change in a systematic and structured way (Hunt, 2006).

8.6.3 Execution Phase

Prior to the execution phase, the project team should have a thorough understanding the project plans, specifications and contractual documents to be able to prepare the project baseline (Mohamed and Moselhi, 2019). The project baseline should also include the known constraints as well as contingencies for unforeseen risks. Furthermore, in order to benefit from the TRAGILE framework at this phase, the project team should anticipate the schedule for the milestone, whose durations depends largely on the scale of the project.

The execution phase of a construction project has always been seen as a sequential set of activities which can only be linked to the traditional waterfall approach. It is also true that essential decisions may be delayed in other industries' project delivery; in construction, however, it has always proven to be more complex. Besides, with the situations of continuous scope changes (the changes in project requirements, coupled with the fragmentation of the industry) these can only lead to a constant improvisation that makes it even more challenging to stick to a traditional execution process of any construction project.

The AgPM methodology, in contrast, allows for detailed and manageable short-term schedules (iterations), due to its incremental approach. Although, applying a pure AgPM methodology in this phase of a construction project might be difficult in practice, considering the procurement arrangements, apprehensiveness for change, the rigid organisational structure, the shortage of skills in the use of agile methodologies, just to mention a few. Hence, the TRAGILE framework, wherein the strengths of the TPM and AgPM methodologies have been integrated, would enable the ease of the team to work faster and efficiently, minimising costly mistakes (Demski, 2022). In addition, the goal of the TRAGILE framework at this stage is to enhance the delivery of project in stages, following the adaptive/flexible planning of the previous phase while collaboratively monitoring and controlling the project processes. Hence, it is suggested that regular review sessions should be held by all the stakeholders to refine and iteratively improve the performance of the project, based on the pre-determined evaluation metrics (Mohamed and Moselhi, 2019). The TRAGILE framework would also enable the enhancement of the execution phase by creating an environment that promotes a self-organised team, engagement/commitment of the team, continuous improvement, and the drive to improve processes and maintain quality deliverables. Furthermore, the TRAGILE framework would allow delivery to be carried out in stages while collaborating with the customers, which would help reduce the need for revisions and dissatisfaction at the end of the project.

8.6.4 Monitoring and Control Phase

Project monitoring and control is one of the five project management process groups in the Project Management Body of Knowledge (PMBOK) prescribed by PMI (2004). In a typical construction project, once the project execution phase gets underway, the monitoring and control phase commences in parallel. The goal of the monitoring and control phase is majorly to track and align the project deliverables with the desired goal of the project (i.e., reviewing the status of the project) and to change course where necessary. Also, during this phase, the construction project manager is expected to juggle with several responsibilities of the project, such as keeping the schedule up to date, staying within the budget, avoiding scope creeps, and constantly managing the project risks. The AgPM methodology, on the other hand, offers better prospect to monitor the project as well as provides more opportunities to intervene (i.e., control) due to the incremental delivery nature of projects within the AgPM methodology. This makes it also easier for the client to participate and monitor the project's progress.

The iterative nature of the process within the AgPM methodology means that a project moves forward in stages that include such steps as periodic reviews and retrospective learning. Furthermore, in comparison with the TPM methodology, one of the principles of the AgPM methodology emphasises collaboration; lessened reliance on procedures, tools, and contracts; and a higher value on adapting to change than adhering to a predictive project plan (Rigby *et al*, 2016; Beck *et al*, 2001). Thus, the major priority of the AgPM methodology is to meet the needs of the clients rather than meeting the organisational needs (Kelly *et al*, 2022). As such, the principles of the AgPM methodology align particularly well with construction project monitoring and control process. Therefore, the TRAGILE framework proposes a flexible organisational structure within the UK construction industry that would enable a collaborative monitoring and control process of construction projects, thereby engaging in efficient communication, collaboration with the stakeholders, and iterative documentation of the project activities. Thus, improving and enhancing the team's technical abilities, expertise, and resource effectiveness.

8.6.5 Closure Phase

This is the last phase of a construction project, wherein all the work is completed, and the project is ended. This phase also involves more than just completing the punch list, and extends to the demobilisation of the project team, returns of equipment rentals, clearing of the worksite, and sub-contractors that have finished their jobs would then move on to other projects (Jonas, 2021). From the project management perspective, the close out/operation phase of a construction project is a good time to carry out post project reviews in identifying and detecting any pending tasks, analysing any challenges encountered during the project execution, and collating the lessons learnt from the project. However, the delivery in stages proposed by the TRAGILE framework by virtue of its strength from the AgPM methodology helps in eliminating major issues at the close out/operation phase of a construction project (Rana *et al*, 2021). Hence, at this phase, the focus is attainment of technical excellence, evaluation and resolution of pending issues with the clients, and collaboration with the stakeholders on the deliverables of the project. The goal here is to listen, respond, learn, and adapt.

8.7 Implementation of the TRAGILE Framework

The TRAGILE framework provides UK construction practitioners with the necessary model to manage and execute construction project based on the integration of the strengths of the TPM and AgPM methodologies. In its implementation however, consideration has to be given carefully to its strategy of implementation. To implement the TRAGILE framework, UK construction practitioners need to first consider apparent gaps between the current TPM methodology employed in managing UK construction projects and the proposed TRAGILE framework, close those gaps, and act accordingly to introduce the new practices proposed by the TRAGILE framework to the industry through formal training plans (Manuti *et al,* 2015).

The implementation strategy will also enable UK construction organisations to evaluate their current practices and formally implement a more synergetic approach in the management of construction projects based on the integration of the strengths of the TPM and AgPM methodologies. Furthermore, the implementation strategy will enable a smooth transition from the TPM methodology of managing construction projects whilst retaining the strengths of the TPM methodology. Successful implementation of the TRAGILE framework will contribute significantly to achieving the goal of reducing the likelihood of project failure through the adaptation of agile practices into a TPM environment, thus improving the performance of UK construction projects.

8.7.1 Overview of the Implementation Strategy

The implementation strategy for the TRAGILE framework will guide UK construction organisations through the process of implementing the framework. It will also provide a high-level guideline of the implementation process for the framework beginning with an evaluation of procedures and practices needed by construction organisations. This will be followed by a high-level model of a training plan and customer process evaluation to ensure readiness to utilise this framework. Finally, the strategy will establish a flowchart of processes for the implementation of the framework by providing the relevant adoption tools and allowing an avenue for continuous improvement within the industry. This implementation plan remains very high level so that construction organisations can apply their own individual practices and procedures to tailor the model to fit their needs best.

The implementation strategy proposed for the TRAGILE framework will include five steps, as shown in Figure 8-19. The first three steps should be completed before implementation of the TRAGILE framework: evaluating current practices in use, developing a training plan on the adoption of the framework, and evaluating the process in place for customer interaction and introducing new practices for customer interaction during project execution. The fourth step covers the actual implementation of the TRAGILE framework and adjusting to fit the needs of the organisation and project. The final step involves continuous improvement and application of lessons learnt so that the TRAGILE framework can be tailored to conform to the specific needs of the project team and the organisational needs.

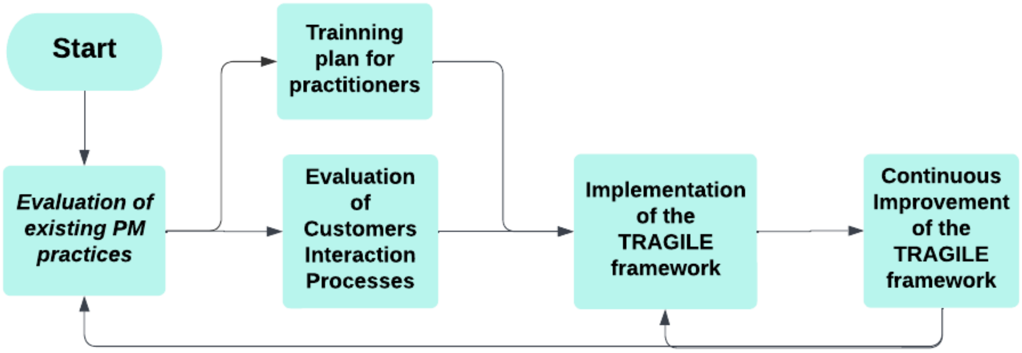

Figure 8-19: Implementation strategy for the TRAGILE framework

8.7.1.1 Evaluation of Current Practices

The first step in the implementation of the TRAGILE framework for the management of UK construction projects is to evaluate the current practices employed in the management of UK construction projects, identifying the gaps, and defining how the improved processes will work (Figure 8-20). Even though organisations perceive project success differently, the goal however should be to enhance the support of the main features of the TRAGILE framework in order to improve collaboration and interaction with construction clients. According to Moira (2017), the establishment of a clear and adequate methodology for the management of construction projects is the first step towards achieving project success. Therefore, data from previously executed construction projects would allow the determination of the aspects of the current practices that are working, and which may require specific training in order to be fully successful in the TRAGILE framework. Following the steps in Figure 8-20, it is necessary to officially document the improved process which would subsequently be reviewed and improved based on the lessons learnt and best practices employed in the project execution.

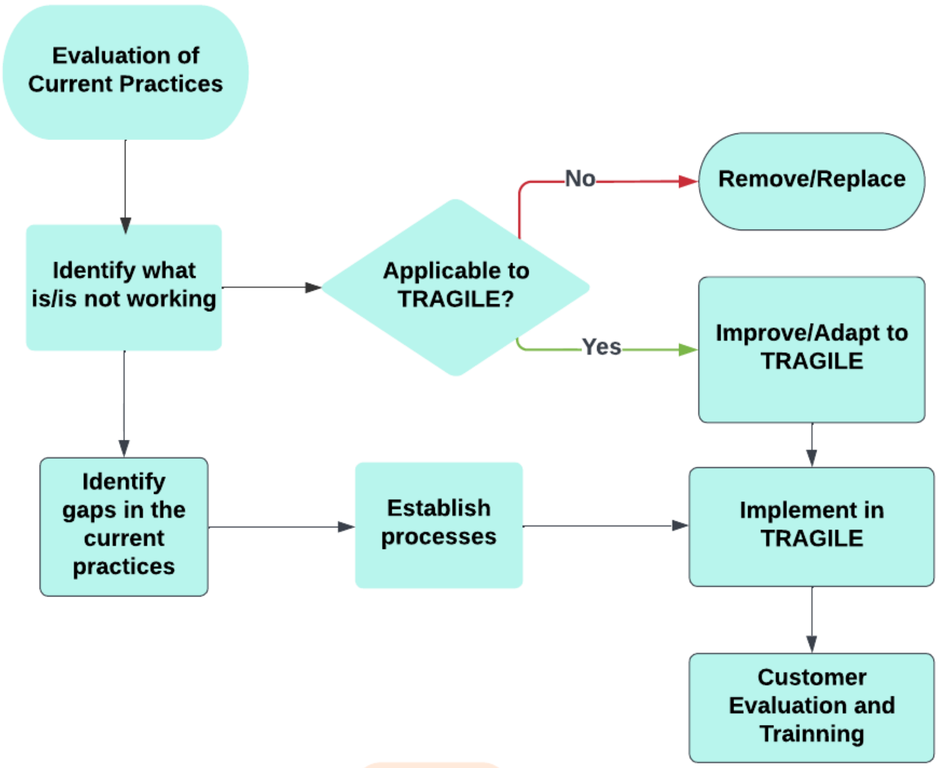

Figure 8-20: Evaluation of Current Practices

It is important to note that if an aspect of an organisational practice is performing well, the project team would be hesitant to implement any changes. Therefore, in the implementation of the TRAGILE framework, it would be beneficial to retain the process that is working well and integrate it into the TRAGILE framework rather than completely reinventing an entire process to potentially create a dysfunctional system for the sake of change (Kibler, 2019). Evaluation of the current practices in the UK construction industry should commence with the identification of what is working well and what aspects needs to be replaced (National Institute for Children's Health Quality, 2022; Qureshi, 2022) for the following reasons:

- It presents the industry in a positive light by demonstrating that the industry adopts good practices and is constantly looking for improvement.
- It provides a list of processes that exist, which require no modification beyond what is required to adapt to the TRAGILE framework. The identification of processes that require modification enables the project team to envision the scope of any gaps that exist between the current practices and the proposed framework.
- It allows the industry to learn how to optimise success and discover the story behind the results
- Evaluation of this nature will pave the way for project improvements.
- It allows the evaluation of existing practices as well as the determination of areas that are not working and needs replacement, thus also allowing the generation of a comprehensive list of areas that are not working well in their current practices.
- It also provides a starting point for the project team to appreciate the TRAGILE framework, enabling the team to decide on what processes should be abandoned.

Alongside the evaluation of what is/is not working well, the project team should perform a gap analysis of the existing tools and processes as well as what needs to be in place following the transition (Markovic, 2019; Mullin *et al*, 2019; Javed and González, 2017). Examples of necessary tools and processes could include the procedures needed to track the project performance with the TRAGILE framework in order to efficiently handle clients' interactions. Since the needs of organisations differ from project to project, based on the evaluations, construction organisations would be able to ascertain the processes needed for a successful implementation of the TRAGILE framework. Furthermore, risk register and communication plan should be included in the implementation strategy of the TRAGILE framework; the risk register will enable a comprehensive documentation of the control processes (George, 2020) whilst the communication plan will formally document how communication between the project team and the clients will be implemented (Zulch, 2014).

8.7.1.2 Training Plan for Practitioners

When implementing a new program or framework in an organisation, it is expected that some gaps in knowledge exist between the known and what is expected to be known (Ejiwale, 2019). However, organisations (especially those that significantly adopt traditional practices and methods) may seem to lack the cultural infrastructure to fully realise the benefits of the agile strengths within the TRAGILE framework (Higham and Thomson, 2015; Opoku and Fortune, 2013). Hence, there is the need to implement a robust plan to capture what knowledge is missing as well as train the project team on the adoption of the TRAGILE framework, as shown in Figure 8-21. It is important to also note that the training plan for the implementation of the TRAGILE framework will function in a circular process for continuous improvement and the adoption of best practices. Therefore, for continuous training and improvement, an informal coaching and feedback session seems more appropriate than a formal classroom setting if a minor issue needs to be addressed or an individual gap exists in knowledge (De Grip, 2015).

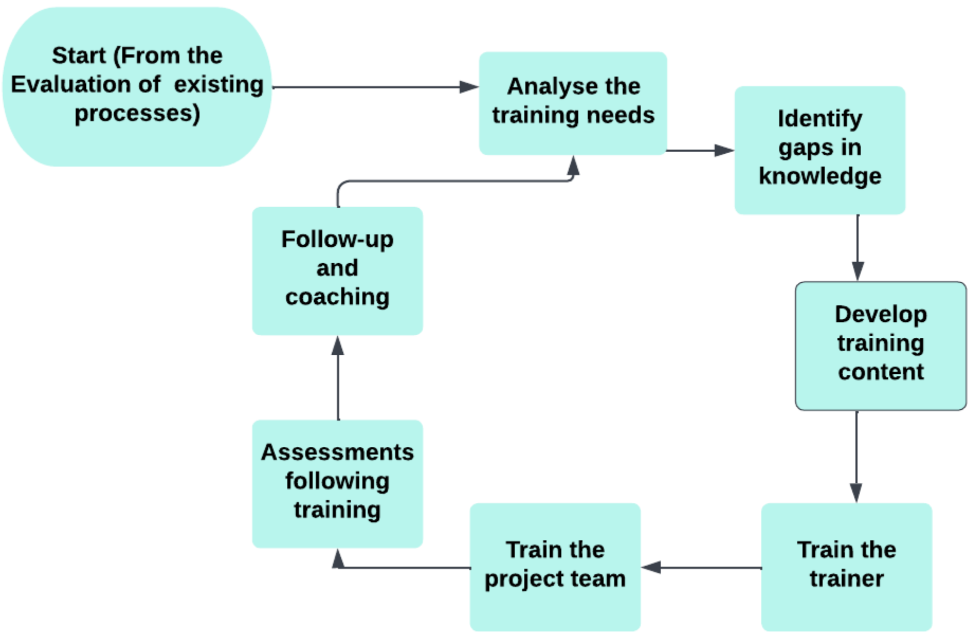

Figure 8-21: Training for practitioners

The training plan begins with an analysis of the training needs required for the adoption of the TRAGILE framework, following the evaluations of the gaps in the current practices. This may involve the utilisation of consulting services, audits, or published literature to analyse the training needs and determine the best practices to adopt. Thereafter, the content for use in the training should be established. The content may include already existing contents or may be obtained via professional services or vendor contract. Alternatively, the organisation may choose to develop training models specific to the needs for adoption of the TRAGILE framework. Irrespective of the source of the training content, a thorough review should be conducted to ensure the training aligns with the policy and procedures of the organisation as well as with the TRAGILE framework to be implemented (Ilyas *et al*, 2016). Furthermore, while implementing the training plan for the adoption of the TRAGILE framework, it is important to consider the differences in the individual roles and responsibilities under the previous practices, the different levels of authority held by each individual, and the change in the focus of project managers from managing to guiding the project through collaborative leading and coaching (Zucker, 2017).

Training the trainer is also necessary for effectively implementing a training plan for the adoption of the TRAGILE framework (Blitz *et al*, 2016). If the resources needed to maintain a training program in an organisation exist, this step would involve the development of a group of individuals to become TRAGILE experts who would act as trainers for the rest of the team members. The trainer(s) in this case would be responsible for effective knowledge transfer from published training documents, industry best practices, or training modules to the rest of the team members. Once the trainer(s) are established, the next step is to adequately train the project team. Hence, a formal training session is recommended for the following reasons (Johnson and Majewska, 2022): to reinforce the commitment of the organisation in new management process, the formal nature enables the organisation to demonstrate that the training and continuous improvement is one of the major aspects for organisational innovation and the adoption of new practices; also, a formal training plan allows for a feedback loop between the project team and the trainer. Moreover, it is recommended that training should be conducted in two stages: the initial training which allows a formal transition from the previous practices to the new practice; and continuous training (improvement), which is ongoing, to demonstrate the organisation's commitment to training and learning.

Furthermore, a formal training programme should precede assessment which evaluates the project team of the knowledge they have acquired and to demonstrate the effectiveness of the training programme. Subsequently, follow-up and coaching sessions should be conducted to allow informal corrections and guidance from the trainer to the project team due to the collaborative and team focused nature of the TRAGILE framework.

8.7.1.3 Evaluation of Customer Interaction Processes

This step of the implementation process is aimed at evaluating the existing customer interaction processes and the implementation of an appropriate process that will enhance the collaboration of customers throughout the project life cycle. The flow chart shown in Figure 8-22 shows the customer evaluation procedure prior to the project (highlighted in green) and after a project selection process (highlighted in blue). The TRAGILE framework requires a robust customer/project team relationship. Therefore, it is necessary for an organisation to develop tools and infrastructure that support ongoing customer interactions.

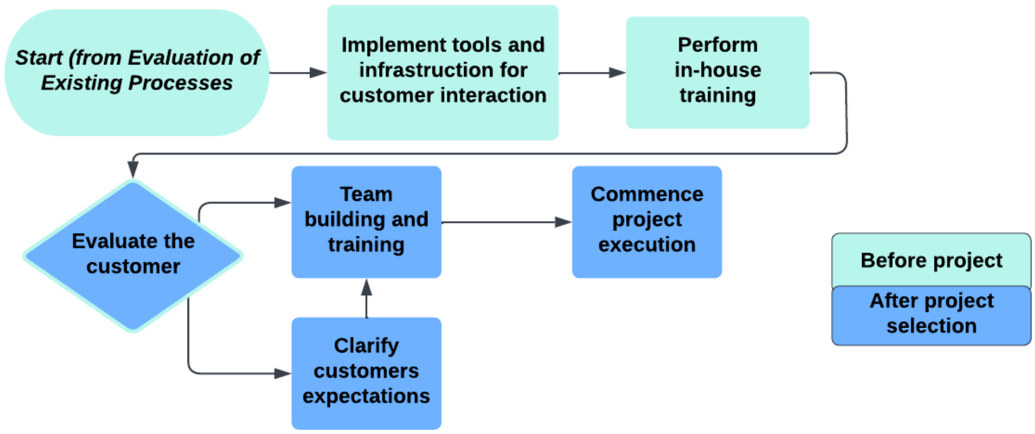

Figure 8-22: Evaluation of customers interaction

Prior to the project selection process, it is important to evaluate the current practices of the organisation and the allowances they have provided for customer interaction, considering that the TRAGILE framework adopts the strengths of the AgPM methodology that enhance customer collaboration and interaction throughout the project. Considering that the organisation may risk the visibility of some proprietary information, cyber information, or financially secure information (Kibler, 2019). Hence, the first step is to ensure the organisation's asset are safe and secure before considering the collaborative approach suggested by the TRAGILE framework. Following this, it is also essential for the organisation to evaluate the existing processes, procedures, and infrastructure to enable implementation. These may include the development of new programs to facilitate tracking, new information technology assets for information sharing, collaborative workspaces with access by the project team and customers, or even some simple office supplies not currently stocked within the organisation. Once the processes and procedures are in place for customer interaction, it is essential to train the project team on the tools and procedures in place since they are the primary users.

After the project has been selected, it is also necessary to define which stage and at what point the interactions would take place. Therefore, this stage of the evaluation begins at the initiation phase of the project to enable the project team to evaluate the customers prior to making any formal commitments. Also, after the evaluation, any customer unable to follow through with the requirements of the TRAGILE framework may require an extensive customer training/coaching or relinquishing the project before it begins. According to Nikraven and Melanson (2008), customer compliance and awareness of the tools and procedure in project management is critical to the successful execution of the project. Therefore, failing to get the approval for the use of the TRAGILE framework ahead of the project execution introduces issues before the commencement of the project. Following this, the customer should be coached on the use of the framework for the following reasons: to enable them to become adept at monitoring the status of their project collaboratively with the project team; to enable them to become autonomous with updated information and be competent to contribute to the collaborative environment (Nikraven and Melanson, 2008; McMahon, 2004).

The customers should also be coached on their expectations of the project team with respect to prioritisation, feedback, and urgency of response. In the case where there already exists a trusted customer/team relationship, it is assumed that the expectations of the customers are already in sync and alignment. Thus, coaching may become unnecessary. Furthermore, it is important for both the project team and the customers to understand that the customers do not completely know what they want. Hence, some customers' expectations may be difficult to comprehend and deliver (Rodov and Tiexido, 2016; Wysocki and Mcgary, 2007). Finally, the customers need to be informed on the procedures for change orders and the prioritisation strategy for removal of scope or scope creeps where there is need for addition to the scope or overruns in the project. The last step in customer interaction evaluation process involves a period of team building since the TRAGILE framework relies heavily on a strong customer/team relationship to function effectively. This step starts before the commencement of the project, and it would enhance trust between the project team and the customers, encouraging continuous collaboration throughout the project life cycle.

8.7.1.4 Implementation of the TRAGILE Framework

In Figure 8-23, the TRAGILE framework is finally ready for implementation. The framework is meant to be used after a project has officially been approved and relationships between the project team and the customers has been established.

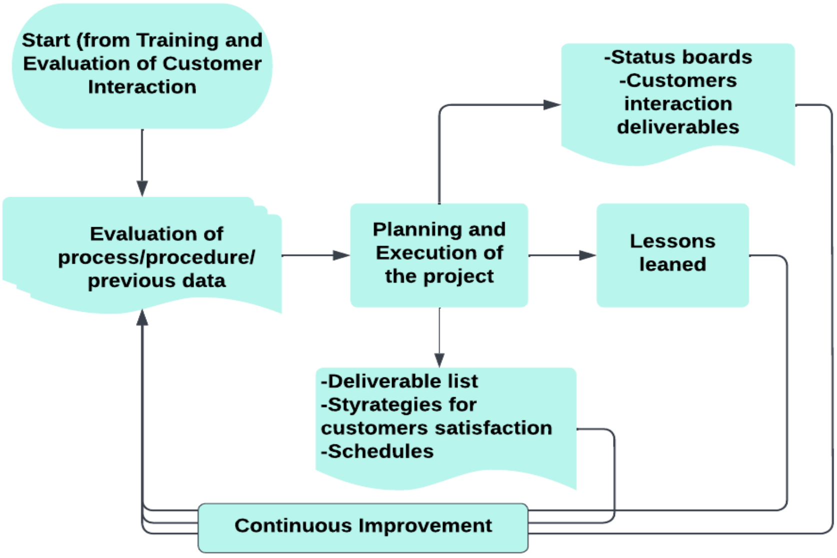

Figure 8-23: Implementation of the framework

The first stage of the implementation is to apply all the practices from the previous phases of the implementation plan (plans, procedures, evaluations, training, documentation), which would support the implementation of the framework. The next stage involves planning formally and execution of the project based on the TRAGILE framework. The TRAGILE framework suggests short iterative plan, as discussed in section 8.5.4.1. Following this, the development of a list of deliverables, strategies and schedules for the project (which can act as historic data for future project) would aid the improvement of future iterations of the project or future projects altogether. Likewise, any documentation developed during the project execution, such as communications plans, risk registers, project schedules, deliverable data, would become the organisation's asset for future use. Furthermore, although documenting communication plan is necessary, the level of documentation that is adopted should be reflected upon, considering that a great amount of informal communication leads to greater efficiency (Zucker, 2017), as discussed in section 4.4.4.

The final stage of implementing the TRAGILE framework is the project close out and lessons learnt, which allows the project team to formally capture the retrospective lessons learnt through the implementation process of the framework. It gives room for the evaluation of the framework and adjustments for future projects. This stage of the framework implementation should also follow a collaborative approach as with the phases of the project life cycle.

8.7.1.5 Continuous Improvement of the TRAGILE Framework

This is probably the most important step in the implementation plan for the TRAGILE framework. The TRAGILE framework is intended to function as a wheel of change within a construction organisation, which allows for improvements and adjustments based on lessons learnt and developed proprietary templates within the organisation. As shown in the Figure 8-23 above, all the documents and assets during the implementation of the framework serve as historic data for subsequent projects. Furthermore, as shown in Figure 8-21, training and personal improvement of the project team is ongoing process based on lessons learnt through projects execution. Therefore, the TRAGILE framework should adapt to the needs of construction organisations in order to be effectively implemented.

8.7.2 Assumptions

Since the implementation plan for the TRAGILE framework was not verified in practice and was only based on the best observed practices noted in the available literature and the findings from data collection and analysis, several assumptions were necessary for development of the framework. These assumptions are related to the project team's competence, clients' relationship, and the accepted project management methodologies (Kibler, 2019).

8.7.2.1 Project Team Competence

It was assumed that the project team has the necessary expertise, ability, and infrastructure to be able to follow a defined project management methodology or framework. Smaller construction organisations may not have the necessary staff, procedures, and other supplementary support functions necessary to follow a formal project management process (Kibler, 2019). In the absence of a formal process, many of the recommendations in this study are still valid but may need breaking down into simpler practices for adoption in a small organisation, and a robust training phase would be necessary in order to educate the project team on the accepted good practices of project management. Also, it is possible that a project team may already have similar practice/procedure to this but unutilised due to lack of training and apprehensiveness for change. Thus, such team may need some level of training.

8.7.2.2 Clients Relationship

This was perhaps the largest assumption made in this study regarding the implementation of the TRAGILE framework. The assumption was that a well-informed, cooperative, and available clients exist. One of the reason construction clients contract a project to an organisation is their lack of knowledge (or limited expertise) and experience in construction project management. Therefore, in the development of the TRAGILE framework, it was assumed that the clients have at least a basic operational understanding of processes. It was also assumed that a cordial relationship between the project team and the client exists, without which the framework is ineffective and impossible to implement. Furthermore, the framework requires a high level of trust from both the project team and the clients: the clients need to understand that the project team may not be able to deliver all of their demands, and the project team needs to understand that the clients may have changing requirements (Rodov and Tiexido, 2016).

With large scale construction projects, where the developer(s) are not local, non-collaboration with the clients would invalidate many ideals of the framework. Although the framework does not require a physically present client all through the project execution, but does assume a large amount of customer interaction, whether via face-to-face contact or remote contact. Finally, it was assumed that the project manager would be willing to work collaboratively with the clients to fully appropriate the benefits of the framework, considering that some project managers may perceive the involvement of the clients as meddling or limiting their ability and autonomy to perform: "*…we keep the project team at the centre of all communication so that unnecessary relationships aren't formed between various stakeholders and the technical team… We feel this is the best way to avoid communication.*"

8.7.2.3 Project Management Methodologies

The third assumption in the development of the TRAGILE framework was that the project team adopts a form of traditional methodology in the management of construction projects. Hence, the TRAGILE framework is based on a shift from the current traditional methodology employed in the management of UK construction projects in order to improve performance even though some organisations do not adopt a formal project management methodology (approach) (Kibler, 2019). If the project team in this case does not adopt an acceptable management approach, and does not subscribe to a formal learning process, then the TRAGILE framework will be difficult to implement. Hence, core practices and standards for project management is required by the project team in order to effectively adopt the TRAGILE framework.

8.8 Summary

This chapter has presented the framework that integrates the traditional and agile methodologies for the management of UK construction projects (TRAGILE). The framework consists of five phases, namely the initiation phase, the planning/design phase, the execution (construction) phase, the monitoring and control phase, and finally the closure phase. This chapter has also explained the processes involved in these phases of the framework. Furthermore, discussions on the implementation strategies for the framework has been provided, as well as the assumptions made. Notwithstanding, it is important to note that a framework of this nature cannot be complete unless it is validated. Therefore, the next chapter will provide discussions on the validation of the framework.

CHAPTER 9 : VALIDATION OF THE PROPOSED FRAMEWORK

9.1 Introduction

This chapter presents the validation of the framework that integrates the strengths of the TPM and AgPM methodologies for the management of UK construction projects (this would be referred to subsequently as ‘the TRAGILE framework’) presented in chapter 8. This chapter begins with the aim and objectives of validating the framework. Then, a background discussion on the validation processes in construction management research is presented. This is followed by a discussion on the methodology adopted for the validation process. Next is the presentation of the analyses of the data collected during the framework validation process. Following this, the suggested areas of improvements.

9.2 Aim and Objectives of the Framework Validation

Validation of the developed framework was carried out with the aim of determining the appropriateness and applicability of the TRAGILE framework. The validation objectives include:

- To assess the relevance and usefulness of the developed framework for the management of UK construction projects.
- To assess the implementation of the developed framework and the extent to which the component of the framework is logical
- To assess the design and ease of understanding the developed framework for the management of UK construction projects
- To assess the extent to which the framework can impact on the performance of UK construction projects
- To obtain suggestions from the potential end users (construction industry practitioners) of the framework on the benefits of the framework, barriers to its use and how to further improve it.

9.3 Participants Selection Processes for the Validation

The validation process involved the use of structured sand semi-structured survey questions during the fourth stage of the research (refer to section 5.6 for detailed discussions on refining and validating the framework). In line with the previous studies, e.g., Brinberg and McGrath (1985), Andersen *et al* (2018) and Ho *et al* (2020), the developed framework was presented to the experts with a wealth of experience within the field of construction management to comment on the relevant sections of the developed framework. The validation process involved the purposive selection of experts in the field of construction management (within the industry and academia), and structured and semi structured questions were asked based on the aim and objectives of the validation process. Also, there seems to be no consensus on the number of participants needed in a validation study. Hence, Cabrera-Nguyen (2010) noted that an appropriate sample size is dependent on the features of the gathered data. Further recommended obtaining the largest possible sample because the adequacy of the sample size cannot be determined until after the data have been analysed (Henson and Roberts, 2006).

After developing the validation questionnaire (comprising of structured and semi-structured questions), the supervisory team provided constructive feedback and then refinement of the questions. Then, a pilot study was conducted to gain feedback on the questions asked within the survey, and consequently the final questions were developed. Following this, invitation (comprising of a summary of the framework, participants information sheet and consent form) was sent to participants within the industry (comprising of practitioners who took part in the survey) and academia to notify them of the validation exercise. After four weeks, with two reminders, considering the short time frame available, a total of 12 participants accepted to participate. An MS form link containing the structured and semi structured survey questions was then sent to the participants who completed it and returned the survey.

Table 9-2 presents details of 12 professionals (5, construction industry practitioners, 6, experienced in both construction industry and academia, 1, academia) who participated in the validation process. A combination of these professionals ensured appropriate balance of experts.

9.4 Methodology Adopted for Framework Validation

Construction management research in general tends to examine real-world issues and methods in a bid to improve the effectiveness and efficiency of the construction industry (Lucko and Rojas, 2010). In construction management research, validation is carried out not to discover new knowledge but to ensure that a developed framework or model is able to serve its intended purpose(s) (Moluwus, 2014). In other words, the main aim of carrying out framework validation is to substantiate the framework to ensure that it possesses a satisfactory range of accuracy and acceptability consistent with its intended purpose (Schlesinger *et al,* 1979). Therefore, it is essential for construction management researchers to ensure quality in every step of validation process including data collection, analysis, interpretations through appropriate validation techniques. However, no formal guide has been proposed for choosing the appropriate validation methodology to use in validating a framework, since each framework tool has its peculiar challenges (Moluwus, 2014).

In the year 2010, the Journal of Construction Engineering and Management published by ASCE, produced a special issue devoted to construction engineering and management (CEM) research covering articles on the types and methodologies of research validation. It was further highlighted that the commonly applied validation methods adopted by researchers in CEM studies includes experimental studies, observational studies, empirical studies, case studies, surveys, functional demonstration, and archival data analysis (Shahi *et al,* 2014). Lucko and Rojas (2010) also opines that the results and the process by which research findings are derived needs to be acceptable by academic and industry practitioners so that the knowledge generated becomes a springboard in further advancement of knowledge. Thus, the need for a well-structured validation approach. However, absolute truth about a phenomenon is unattainable via human means since scientific endeavour is never-ending and iterative. Therefore, the purpose of validation in CEM research is to ensure that each phase of the chosen research methodology rigorously adheres to the highest standards of quality, and this standard of quality in planning, executing, and evaluating the research is measured as validity (Lucko and Rojas, 2010).

This idea of validation has also been corroborated by scholars. For example, Law (2007) emphasised that validation in a research is dependent on the specific purpose of the research. El-Diraby and O'Connor (2004) also argues that "no single definition of the ingredients or subsets of the concept of validity" exists. Besides, studies have been ongoing on the most appropriate method of validation for CEM research. Howbeit, these studies have presented no specific definition of the concept of validity for CEM research. For example, Roschke (1994); Kamat and Martínez (2003); Sargent

(1991) opined that there were currently no specific procedures available for the validation of studies in these fields. Liu *et al* (2014) and Lucko and Rojas (2010) also agrees and notes that CEM research is an area for which no information is available for its validation. Thus, leading to constraints for researchers in CEM.

Furthermore, Leedy and Ormrod (2001) opined that validation process can be broadly categorised into two main areas: establishing internal and external validity. Of which internal validity refers to the concept of causality and focuses on the consistency within a measuring instrument used in a research, whereas external validity refers to the concept of induction and focuses on the generalizability of results for prediction purposes (Leedy and Ormrod, 2001, cited in Lucko and Rojas (2010)). Discussions on the internal validity for this study has been covered in section 5.7.2.2 and presented in section 7.3 using Cronbach's alpha. What is left is the external (or face) validity for this study (i.e., the developed framework). Therefore, the external validation process for the developed TRAGILE framework will be based on two perspectives as discussed in section 5.6.4.1.

- First, the ontology (the philosophical position) of the TRAGILE framework is discussed to ascertain if it is in line with the worldview of construction practice as well as to reinforce the assumption that there is reality in this subject.
- Second, the external/face validity covering the practicality of the derived TRAGILE framework. In this case, the focus of who ascertains the validity of the framework moves from the researcher to the potential end users of the framework. Hence, findings from structured and semi structured survey will be analysed and presented. Using this validation perspective, the framework also gains credibility.

9.4.1 Ontology of the TRAGILE Framework

Ontology addresses whether social entities need to be perceived as objective or subjective: how things really are, and how things really work (Bilau *et al*, 2018). Several industries have come up with ontologies for efficient knowledge management, including medicine, computer science, and biology. In the construction industry, also, ontology has been introduced and studied widely since building projects involve collaborative work from different professionals (e.g., designers, pipeline, heating, ventilating and air conditioning), stakeholders (e.g., designers, contractors, owners), and phases (e.g., design, construction, operating), which may lead to knowledge acquisition (Zhong *et al*, 2019; Zhou *et al*, 2016; Corry *et al*, 2015).

Ontologically, every researcher is either a realist or an anti-realist. Thus, a researcher either accepts that facts are real and independent of human mind (realists), i.e., objective, or that reality is only subjective (anti-realist) (Igansi, 2014). Constructivism is an ontological position that emphasises that reality and its meanings is constantly being actualised by social actors (Bryman and Bell, 2011). Thus, implying that reality is not only produced through social interaction but are also in a constant state of modification. Crotty (2003) however argues that ontological positions do not really matter in research as long as the researcher has a clear epistemological position he/she is working on, thus invalidating the realist perspective of a researcher. The epistemological orientation of this research has been discussed in section 5.4, and the concepts, principles, and strengths (characteristics) of the TPM and AgPM methodologies have also been discussed broadly in the previous sections. However, what is unaccounted for so far is the view on reality, i.e., the ontology of TRAGILE framework, since its view on reality has to be in conformity to the reality of construction project management.

The TPM methodology has been around for several years (since the early BC) and was used in managing some of the world's renown projects like the Great Pyramid of Giza in the 2570 BC; the Great Wall of China in the 208 BC, which was the world's largest military defence structure; the Pyramids of Egypt; and several transcontinental railroads (Wazir *et al*, 2019; PMBOK, 2017; Jing, 2015; Watt, 2014; Haughey, 2014). As an established methodology in managing all forms of projects, the TPM methodology usually adopts a sequential approach of executing projects, following the initiation, planning, execution, monitoring, and closure stages. Furthermore, the TPM methodology emphasises linearity of process, documentation, planning up front, and prioritisation, with the goal of meeting the cost, time, and scope (iron triangle). Hence, cost and time are variables in a project while the project requirements are fixed. Also, findings have revealed that the most suitable environment for the TPM methodology is a static stable environment that allows for sequential prediction of processes and activities within a project. Therefore, an objectivist view of reality is required, which believes in an external reality whose existence is independent of knowledge of it, i.e., reality exists as an independent object waiting to be discovered (Trivedi, 2020).

Likewise, drawing from a construction project management perspective, the objectivist view of reality believes there is an existing construction project waiting to be explored and executed, with little or low influences from its environment, and if these requirements (i.e., little/low external influences) are facilitated, the TPM methodology yields maximum benefits for construction projects. However, due to the high level of uncertainties in construction projects, leading to constant need for changing requirements (dynamicity and flexibility) in the project life cycle, the TPM methodology has been heavily criticised as inefficient to resolve all the issues relating to changes in construction project management. Hence, the agile methodology was introduced.

For the AgPM methodology, contrary to the general opinions, the agile practices did not just emerge in 2001 with the Agile Manifesto. Agility in project management can be traced back to scrum (Belling, 2020) which takes its root from the pre-industrialisation era, wherein the management science by Deming was dominant (Boehm and Turner, 2009). However, very little progress is made integrating those principles into the business world of today. For example, apart from agile in manufacturing and agile in software developmental processes, only a few studies in the last decade have considered its applicability in other sectors. Besides, up till the year 2009, most organisations that adopted AgPM were from the IT and software industries (Bergmann and Karwowski, 2019), seeing that the agile methodology was developed in the IT sector by software practitioners (Agile Alliance, 2001).

A methodology is considered agile when it satisfies the twelve principles of agile and the four agile values (Demir, 2013). Furthermore, the AgPM methodology functions best in a dynamic or flexible environment since the aim of the agility in project management is to respond to changes (see *Table 9-1*). Taking a deeper look at the IT environment where the AgPM methodology was originated, the IT environment is also considered project-based just like construction, and both have some similarities (Thariani and Kloppenborg, 2001). Therefore, integrating the AgPM methodology into a construction project context would infuse into the project team the capability to act proactively and reactively to project changing requirements. Consequently, the ontological view within the AgPM methodology falls within the subjectivity perspective which believes that a researcher cannot know an external or objective reality apart from your subjective awareness of it. That is to say, what we agree exists, exists for us, of and in our intersubjective awareness, based on the idea that social facts are as real as objective facts (Trivedi, 2020).

Table 9-1: Characteristic of TPM and AgPM Socio-Cultural Environment

	Industry	**Sequence of event**	**Environment**
TPM	Construction	One time	Static
AgPM	Software development	One time	Dynamic

Ontologically, subjectivity within construction project management believes a construction project is socially constructed with different levels of influences by its environment. However, the AgPM methodology does not believe in predefining all the project requirements prior to commencing the project due to its awareness that the influences by its environment might necessitate changes in the project requirements. It therefore follows a flexible plan-as-you-go philosophy, which thrives in a dynamic project environment. Consequently, based on discussion and literature findings of this study, the TPM and AgPM methodologies seem dissimilar in their views on reality. Hence, some scholars believe that the AgPM methodology is not a suitable candidate for integration in a construction project due to their different views on reality (which are built from their different socio-cultural environments).

For example, Demir and Theis (2016) reports that AgPM can only be implemented in the planning and design phases that involve more risks and uncertainties, but it is not suitable in the execution phase of a construction project due to the high level of interdependencies among various activities which should be carried out sequentially. Owen *et al* (2006) also suggest that the AgPM methodology is provisionally appropriate for the design phase of construction projects, which deals more with customer involvement, conflicting requirements, and constant trade-offs since AgPM allows changes for continuous improvement. Every project life cycle exhibits similar characteristics at the onset, i.e., initiation and design stages which are characterised more by mental rather than a physical work (Demir, 2013). Hence, the process of changing or adjusting things is very feasible. Also, because the level of flexibility at these stages in a construction project is higher, scholars then believe they are the most suitable phases for the integration of the AgPM methodology.

At the execution phase of a project, the characteristics begin to differ. For example, an IT project, if it is well organised may entertain some changes at the later stage of the project execution since the entire project can be decomposed into smaller segments which are independent of each other. This may not be feasible for a construction project since construction projects generally contain more elaborate elements and stage gates that make the planning more difficult. More so, construction projects exhibit a higher degree of separation between the phases, which makes the ability to react to change even more difficult. Besides, this separation is required since a construction project is designed top-down but built bottom-up (Demir, 2013). So, changes are not necessarily welcome at the execution phase of a construction project.

Linking the above examples to the management paradigms, we can conclude that the TPM methodology follows a more objectivist ontological orientation, and is rigid, whilst the AgPM methodology is devoted to subjectivity of reality, which is flexible and dynamic. In addition, it is important to note that the rigidity or flexibility of the TPM and AgPM methodologies is based on the environment in which they originate (Demir, 2013). Therefore, the question to ask is: are these views on reality in line with the reality of a construction project? Several studies claim that construction projects are linked with both the objectivist and subjectivist views of reality, and that a distinction is rather inappropriate (Boyd and Bentley, 2012; Shepherd and Atkinson, 2011; Morris, 2010; Lehmann, 2010; Dainty, 2008; Smyth and Morris, 2007; Love *et al,* 2002b). Hence, the disparities of the TPM and AgPM methodologies in the management of construction project can only be related to the wrong perception about the reality of construction projects (i.e., what is truly going on in practice).

Several ongoing studies and publications have also debunked this claim and opinion that the AgPM methodology may not be suitable for every phase of a construction project, and have provided further evidence to prove that the principles promoted by the Agile Manifesto have possible links with management practices of all phases of construction projects (Ingle, 2019; Mohamed and Moselhi, 2019; Kibler, 2019; Mnqonywa *et al*, 2018; Burmistrov *et al*, 2018; Azanha *et al*, 2017; Salameh, 2014; Daneshgari, 2010). Therefore, any paradigm suitable for construction projects needs to be objective and subjective in their views of reality because both worlds are true (Osipova and Eriksson, 2013; Koppenjan *et al*, 2011; Geraldi, 2008; Winch, 2006). Accordingly, the TRAGILE framework has considered both worldviews on reality since those views have been integrated to a holistic and unifying framework.

9.4.2 External Validity (Practicality) of the Proposed Framework

The profile of the participants is presented in Table 9-2. Five out of the twelve participants are from the UK construction industry with experience ranging from four to forty years within the UK construction industry. Six participants that participated in the validation exercise have experience in both industry and academia, with experience ranging from three to thirty-three years combined. Whereas one participant is purely from academia with fifteen years of experience in construction related subjects. A mixture of participants from industry and academia have been chosen for the validation exercise to enhance the richness of the data collected considering the varied experience of these participants, as well as their differing perspectives. Furthermore, this will also enable practitioners from both industry and academia to identify with the findings of the study.

Table 9-2: Profile of participants

Participants ID	Background	Experience	Educational qualification
P1	Industry	35	Architectural Degree
P2	Industry	47	HNC (Studying for MSc)
P3	Industry	40	Master’s Degree
P4	Both (experience in both industry and academia)	15	Master’s Degree
P5	Industry	6	Bachelor of science
P6	Both (experience in both industry and academia)	20	Doctor of Philosophy (PhD)
P7	Both (experience in both industry and academia)	3	Master’s Degree
P8	Academia	15	Doctor of Philosophy (PhD)

P9	Both (experience in both industry and academia)	7	Master's Degree
P10	Industry	4	Master's Degree
P11	Both (experience in both industry and academia)	33	Honours degree
P12	Both (experience in both industry and academia)	6	Master's Degree

9.4.2.1 Analysis of Validation Results

The analysis of the findings from the validation exercise will be conducted in the following sequence:

- Relevance and usefulness of the proposed framework
- Implementation of the proposed framework
- Design and ease of understanding the proposed framework
- Impact of the proposed framework on the performance of UK construction projects
- Further suggestions for improvement

The feedback from the framework validation exercise with the participants was positive. Although, suggestions were made during the validation exercise on some areas in the framework that needed amendments, which was resolved and reflected in the final version of the proposed framework presented in the previous chapter.

9.4.2.1.1 Relevance and Usefulness of the Proposed Framework

This section reveals the participants' view on the relevance and usefulness of the proposed framework. It was presented on a scale of 1 to 4, ranging from strongly disagree to strongly agree. Under this section, five questions were asked. An investigation of the results from the closed questions reveals an overall positive response by the validators on the framework. Table 9-3 shows that none of the five questions under relevance and usefulness of the framework was scored 1 (strongly disagree) by the validators and all of them had a score of 4 (strongly agree). The mean scores for the five questions ranged from 3.25 to 3.75, all of them above the acceptable score of 3 for a four-point Likert scale.

The highest mean score of 3.75 out of 4 was recorded by the question on collaborative organisational structure, necessary for the implementation of the framework. Conversely, the lowest mean score of 3.25 out of 4 was recorded by the question on the understanding and effectiveness of the proposed framework within the context of construction project management. Although this is above the acceptable score, it is comparatively the lowest score recorded under the questions for the relevance and usefulness of the framework, as one of the participants disagreed with the question on understanding and effectiveness of the framework. however, further suggestions was made by the participants on the ease of understanding of the framework in the subsequent section.

Table 9-3: Closed Questions

No	Validation questions	Strongly agree =4	Agree =3	Disagree =2	Strongly disagree =1	Sum	Mean score
Relevance and usefulness of the proposed framework							
1	To what extent do you agree the components and phases of the proposed framework is logical and relevant to the UK construction industry?	4	8	-	-	12	3.33
2	To what extent do you agree that collaborative organisational structure is necessary for the implementation of the framework?	9	3	-	-	12	3.75
3	To what extent do you agree with the usefulness of the proposed framework in its main format?	8	4	-	-	12	3.67
4	To what extent do you agree with the structure of the proposed framework and its application?	6	6	-	-	12	3.50
5	To what extent do you agree with the understanding and effectiveness of the proposed framework within the context of construction project management?	4	7	1	-	12	3.25
Implementation of the proposed framework							
1	To implement the developed framework, it is essential to evaluate their current practices, identify the gaps, and define how the improved processes will work.	9	3	-	-	12	3.75
2	To implement the framework, there needs to be an evaluation of the existing customer interaction processes and the implementation of an appropriate process that will enhance the collaboration of customers throughout the project life cycle.	8	4	-	-	12	3.66
3	A robust implementation plan is needed to capture what knowledge is missing and what knowledge is needed for the adoption of the developed framework	6	5	1	-	12	3.42
4	Formal training is needed for the adoption and implementation of the developed framework	8	4	-	-	12	3.66

9.4.2.1.2 Implementation of the Proposed Framework

This section reveals the participants' view on the implementation of the proposed framework. It was presented on a scale of 1 to 4, ranging from strongly disagree to strongly agree. Under this section, four the questions was presented as shown in Table 9-3. Table 9-3 shows that none of the four questions under implementation of the proposed framework was scored 1 (strongly disagree) by the validators and all of them had a score of 4 (strongly agree). The mean scores for the four questions ranged from 3.42 to 3.75, all of them above the acceptable score of 3 for a four-point Likert scale.

The highest mean score of 3.75 out of 4 was recorded by the question "to implement the developed framework, it is essential to evaluate their current practices, identify the gaps, and define how the improved processes will work". On the other hand, the lowest mean score of 3.42 out of 4 was recorded by the question "a robust implementation plan is needed to capture what knowledge is missing and what knowledge is needed for the adoption of the developed framework". Although this is above the acceptable score, it is comparatively the lowest score recorded under the questions for the implementation of the proposed framework, as one of the participants disagreed with the statement.

9.4.2.1.3 Design and Ease of Understanding the Proposed Framework

In this section, the participants were asked: "do you think the phases in the developed framework is easy to understand and follow? Please give reasons for your comment". Most of the participants agreed that the framework is easy to understand and follow. Moreover, they agreed that the proposed framework is clear and concise and logically structured. Other things the participants liked about the proposed framework include consistent terminology: P1 - "*if the framework maintains consistency in its terminology and concepts across all phases, it reduces confusion and aids in comprehending the flow of the process*". Visual representation: P8 – "*the phases/stages in the developed framework are well understood based on the presentation of a well constructive research framework*". P1 – "*visual representations like flowcharts, diagrams, or illustrations can make complex concepts more accessible and facilitate a better understanding of the framework. This works well*". The phases of the proposed framework: P3 - "*As presented and structured I* *feel that the phases in the developed framework are relatively easy to understand and very easy to follow*". P8 – "*In a well-designed research framework for a successful research project, there must be a starting point and an end point, that is a completion stage (like a tunnel)*". P1 – "*The framework is well-defined, logically organised, and clearly explained, it will enable the users to grasp the overall structure and purpose of each phase*".

From the findings in this question, it can be seen that most of the participants agreed to the design and understanding of the framework. However, three participants identified barriers to the ease of understanding of the proposed framework, namely experience, familiarity with both methodologies and training. For example, P5: "*Not as easy as you might think. You need someone with an **experience** who have the knowledge to understand the different phases in the developed framework experience is needed to easily*". P5 suggested that it would require some level of experience to understand the different phases in the proposed framework. P7: "…. *However, The target audience's **familiarity** with both traditional and agile project management methodologies will determine whether the framework is easy to understand and follow. People who are familiar with both approaches may find it easier to understand and apply the framework's concepts to their projects. Individuals who are unfamiliar with these methodologies, on the other hand, may require additional explanations or training to fully understand and implement the framework".* Although P7 agreed that the proposed framework *appears to be well thought out and logically structured*. However, suggests that construction practitioners who are familiar with both the TPM and AgPM methodologies might find it easier to understand compared to practitioners who are unfamiliar with both methodologies. P11: …. "*but people will need to have the process and ideas **explained**, also the risk part of the project management process will have to be properly and robustly managed. This is currently quite reactive and ad hoc in many instances*". P11 suggests for further training on the processes and ideas of the framework which was also considered in the implementation plan for the proposed framework.

9.4.2.1.4 Impact of the Proposed Framework

Most of the participants agreed that the proposed framework can impact on the performance of construction project delivery, see appendix F. However, one participant, P9 did not fully agree. P9 notes that it's a 50-50 chance of impacting on the performance of construction performance, "…. *only because there is NEC which bridges those gaps within the industry*". According to P9, New Engineering Contract (NEC), which is a series of contracts designed to manage projects from start to finish in the UK regulates project management with the aim of preventing costly disputes. Hence, considering that procurement, as well as the contractual arrangements serves as a bridge in the execution of a project, P9 didn't seem quite sure of the impact of the framework.

Furthermore, the participants were asked: Do you think the proposed framework could be adopted/adapted in your organisation? Eight participants agreed that the framework can be adopted in their organisation. Whereas four participants stated otherwise, as shown in appendix F. For example, P2 noted that they are not fully into construction, hence, may not be adaptable in such organisation. P4 on the other hand claims that the organisation he/she works is too rigid and may not be susceptible to change in their methodological approach for the management of construction projects. This is not surprising as it was identified as one of the major barriers that hinders the adoption and integration of the AgPM methodology in the management of UK construction projects (discussed in section 7.4.5). P9 also was not sure if the framework can be adopted in their organisation, "*it is difficult to say as my organisation currently adopt more of a traditional approach with NEC due to the types of contracts awarded*". Finally, P11 suggested for training: "*training of personnel is key*" to enable the adoption of the framework in their organisation. This has been addressed in the discussion on the implementation strategy for the framework.

For the last question in this section, the participants were asked: Would you recommend the use of this proposed framework? Please give reasons for your response. Overall, the responses were positive (yes). However, one participant, P11 referred the researcher to the previous response where he/she stated that training will be required for the effective adoption of the framework.

9.4.2.1.5 Further Suggestions for Improvement

The participants have made recommendations for further improvement of the framework. These recommendations centred on the outlook of the framework, integrating lessons learnt/feedback loop, a comprehensive change management strategy and the integration of NEC contract requirements. The outlook of the framework has been enhanced. The recommendation on feedback/lesson learnt aspect has already been taken care of in the implementation strategy developed for the framework discussed in section 8.7.1. With respect to change management, organisational change is a constant in many organisations, and is driven by a number of factors including customers, markets and technology (Chartered Institute of Personnel and Development, 2023). However, most change initiatives fail to get their intended outcomes. Therefore, discussion has been provided in section 8.7.2.1 on the importance of developing a training plan for practitioners, since it is expected that some gaps in knowledge exist between the known and what is expected to be known (Ejiwale, 2019). Also, suggestions was made for continuous training, informal coaching and feedback sessions to enhance the organisation's potential and the practitioners. The recommendation that the framework should integrate NEC contracting requirements would be recommended by the researcher for further research.

9.5 Summary

This chapter has presented the validation of the TRAGILE framework that integrates the strengths of the TPM and AgPM methodologies for the management of UK construction projects. The validation was undertaken from two perspectives: first, a more philosophical perspective was explored, where the ontology of the model atoms (TPM and AgPM) is elaborated, and conclusion is made that the philosophical position of the derived TRAGILE framework is in line with that of construction practice, as discussed in section 5.3.5, so it is verified. Secondly, the practicality of the framework was considered, with the aim of identifying if the TRAGILE framework is feasible and can be used in the management of UK construction projects. To do this, structured and semi structured questions were sent to construction practitioners and academia. Findings from the validation shows that the framework is valid and credible hence, it is able to serve its intended purpose of improving the performance of UK construction project. Although there are some recommendations for further improvement on the framework, which have been addressed. The next chapter concludes the study and makes recommendation for further research.

CHAPTER 10 : CONCLUSION AND RECOMMENDATIONS

10.1 Introduction

This chapter summarises the key research findings in relation to the aim and objectives of the research. A summary of the research process adopted to accomplish the same is provided at the beginning of this chapter. The conclusions from this research findings are then presented. Recommendations for academic community as well as industry practitioners are also presented, and areas of possible further research are presented within this chapter.

10.2 Research Process Adopted – A Summary

The aim of this research is to develop a framework that integrates the strengths of the traditional and agile project management methodologies to improve the performance of UK construction projects. Six objectives were set to achieve the overall aim as follows:

1. review the current state of the UK construction industry's performance
2. examine the Traditional Project Management (TPM) methodology used within the UK construction industry, identifying its strengths and weaknesses in relation to the management of construction projects
3. evaluate the contribution of Agile Project Management (AgPM) methodology in the management of UK construction projects
4. assess the perception of construction practitioners on the use of Agile Project Management methodology for construction projects
5. identify critical barriers that hinder the adoption of Agile Project Management in the management of UK construction projects
6. explore the integration of the strengths of the TPM and AgPM methodologies for the management of UK construction projects.

The first stage of the research was a critical review of available literature relevant to the main focus areas of the research. The literature review established a background understanding of UK construction projects performance, the available methodology used in the management of construction projects, and the implications of the integration of the traditional and agile methodologies into the construction industry. Literature findings from this stage led to the collection of qualitative open-ended survey, with the aim of exploring the perceptions of UK construction industry practitioners on the use of agile methodology, which addressed objective 4 of this study. Overall, the first stage of this study addressed objectives 1, 2, 3 and 4. During the second stage of the research, a further review of UK government published construction reports to carefully identify and synthesise the recurring issues leading to poor performance of the UK construction industry as well as to enable the researcher to generate evidence for further evaluation. The third stage employed a quantitative approach to establish the strengths and weaknesses of the TPM and AgPM methodologies as well as the barriers that hinder the adoption and integration of the AgPM methodology in the management of UK construction projects. A questionnaire survey approach was adopted to gather data from a total of 88 UK construction practitioners consisting of project managers, construction project managers, site managers, quantity surveyors, contractors, consultants, architects, and engineers. The second and third stages jointly addressed objectives 4 and 5 of this research. During the fourth stage of this study, data from the questionnaire survey in the third stage was used to develop a framework for the integration of the TPM and AgPM methodologies, which fulfilled the research objective 6. The developed framework was validated based on three perspectives: philosophical perspective, practicality of the framework, and transferability of the framework. The fourth Stage has enabled the researcher to formally achieve the overarching aim and objectives of this research.

10.3 Conclusions of the Research

The main findings of this study are chapter specific, and are condensed within the respective chapters, presented as follows: the UK construction industry; construction project management methodology; integration of the TPM and AgPM methodologies. Others are barriers to the adoption and integration of the AgPM methodology; and the TRAGILE framework. Based on the above, this section seeks to synthesise the findings to address the aforementioned objectives of this study.

10.3.1 The UK construction Industry

Over the years, the UK construction industry has evolved from being a small-to-medium sized group of companies to a very specialised industry (Constructible, 2019) whose product entails services necessary to produce buildings and works. However, due to the complexity of construction projects and the fragmented state of the industry carrying out these projects, the UK construction industry has relied on the traditional methodology and practices, thus hampering its performance. Studies and UK construction reports have emphasised the issue of ongoing poor performance of UK construction projects. Findings from this study also identified 10 major issues that lead to the poor performance of UK construction projects:

1. changing requirements of construction projects
2. shortage of skilled labour
3. fragmentation
4. hierarchical leadership and management style of the industry
5. reliance on traditional methods
6. documentation issues
7. client dissatisfaction
8. improperly assessed project needs
9. inaccurate budget
10. prolonged planning and negotiation.

In managing construction projects, decisions are usually made based on information from the client, assumptions, and the personal experiences of the construction project team members. Consequently, changes to the project requirements almost become inevitable when the client gains more clarity on the project. However, in managing changes in construction projects, several issues, including delays and overruns, become imminent due to the rigid structure of the traditional methodology. The impact of delays and overruns due to changing requirements of UK construction projects is one major area that has been emphasised by several studies. In fact, in the UK construction industry, delays and overruns seem to have become a norm since quite a good number of construction projects usually go beyond the scheduled period and budget (McKinsey and Company, 2020). For example, in 2019, the UK Industry Performance Reports revealed that 33% of construction projects exceeded its scheduled budget, and only about 60% of projects were completed on time. To further establish the normality of overruns and delays in the industry, Construction Product Association in 2021 predicted certain degree of delays and overruns for the UK construction industry in the coming year.

Studies have also linked some issues leading to the poor performance of UK construction projects with the deep structural issue (fragmentation) within the industry and the bureaucracies associated with the traditional management methods. The issue of fragmentation in the UK construction industry can be narrowed to two aspects within the traditional construction processes: (1. the process employed in executing construction projects, which takes place independently and in a sequential approach whilst the designers and contractors work in isolation without any interface with the construction team. (2. the structure of construction projects itself. Furthermore, the industry's reliance on traditional processes and practices for the management construction projects has also contributed to the poor performance of construction projects. Findings indicate that the UK construction industry seems to have settled for the traditional, rigid, and bureaucratic methodology for the management of construction projects due to several barriers, including (and not limited to) the rigid, inflexible organisational structure; poor management support; organisational culture; management control; cost of transition; lack of confidence in their ability to scale; apprehensiveness for change; and the predominance of the traditional methodology. Figure 10-1 presents a diagrammatic representation of the current state of the UK construction industry.

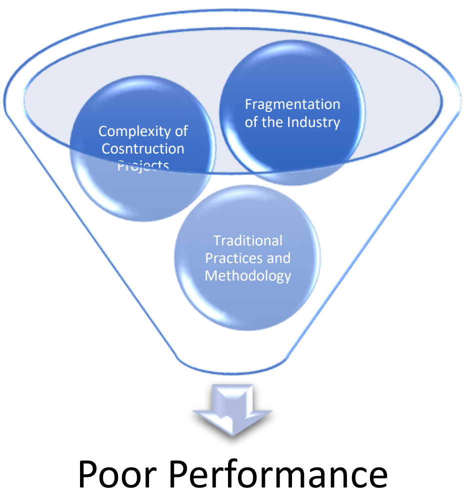

Figure 10-1: State of the UK Construction Industry

10.3.2 Construction Project Management Methodology

The TPM methodology has been reckoned as the well spring of formality and has been adopted in managing construction projects for several decades. Some of the strengths of the TPM methodology include clearly defined objectives, clearly defined deliverables, focus on quality, comprehensive documentation, and good control of project processes. However, due to the rapid growth of complex projects in the construction industry and the increased demand for innovation, the TPM methodology has been criticised for being unable to resolve all the widespread and deep-seated issues associated with construction projects' complexities. In this study, the six key weaknesses identified with the adoption of the TPM methodology include high cost of restart, *de facto* methodology, rarely updated project plans, rigid structure, process centric, and minimal client involvement in a project. Furthermore, owing to its rigid nature and the adoption of strict linear processes for planning, executing, and controlling, sole adoption of the TPM methodology has led to several problems and failures in the management of UK construction projects.

A major concern about the TPM methodology was raised by Brooks (1987), which stated thus: "*How can a system which is based on freezing requirements work in times of uncertainty*?'' This statement has been over three decades, and still seems valid. Studies have constantly criticised the TPM methodology for its waterfall approach, wherein once a phase is completed, it is rarely revisited. Besides, some of the characteristics and assumptions on which the principles of the TPM methodology operate have been debunked by scholars as being flawed. Examples include the assumption that projects are foreseeable and straightforward with clearly defined boundaries; the assumption that that the environment and the project requirements remain stable once the project begins; emphasis on time and cost management, leading to an unrealistic management approach. However, the UK construction industry has relied on this traditional, rigid, normative methodology for the management of both simple and complex projects, wherein all requirements are fixed, giving no room for changing requirements. Consequently, the PRINCE2 methodology which follows the precepts of the TPM methodology is considered a *de facto* methodology for the management of UK construction projects.

Findings revealed that this reservedness of the UK construction industry with respect to the adoption of new management methodology lies in a range of factors, including the seemingly exorbitant cost associated with the adoption of new methods and technologies, training requirements, and the apprehensiveness to break away from the traditional system that is deeply ingrained within the structure of the industry. This gives credence to Wolstenholme's (2009) argument that if the UK construction industry is to meet up with the demands in the coming years, and if any change is to be enacted, a great deal of work has to be done since no significant change has been made despite several publications. This makes it is necessary for the integration of a radical, an agile, an all-embracing methodology in the management of UK construction projects, which is fit and competitive for the changing business environment.

10.3.3 Integration of the TPM and AgPM Methodologies

In the past years, the AgPM methodology has grown to become a norm in project management as the ideal methodology that substitutes the traditional plan-driven methodology. Unlike the TPM methodology that puts all the weight of the project on the shoulder of the project manager, the AgPM methodology functions in a collaborative approach, and aims to respond quickly to the changing requirements. Ideally, the AgPM methodology can be described as a reaction to rigid, plan based TPM methodology. The AgPM methodology addresses the challenges of an unpredictable project environment by relying on the project team members and their creativity rather than on the processes and tools provided for the management of the project. Considering that project requirements sometimes change, the AgPM methodology utilises incremental delivery, embracing change, and involves the clients in order to accommodate changes in a project life cycle.

Although the UK construction industry may seem as the least suitable area for the adoption and implementation of the AgPM methodology, with a few changes it is not impossible to integrate the AgPM methodology into the management of construction projects. Studies have highlighted the benefits of adopting agile in several sectors such as the use of agile methods in the IT industry to improve communication, flexibility, customer collaboration, attention to excellence. Likewise, evidence suggests that that these benefits can be realised in construction project management. The key benefits of the AgPM methodology identified in this study are as follows:

- efficient communication
- team ownership and accountability
- team engagement and commitment
- adaptive flexible planning and continuous improvement
- frequent evaluation and resolution of issues
- collaboration and transparency
- focus on specific needs of customers
- attention to technical excellence
- greater expertise and resource effectiveness
- increased productivity and morale
- closer engagement with stakeholders.

A more detailed inspection shows that these benefits of the AgPM methodology are hinged on the values of agile project management that fosters innovation, efficiency, and continuous learning while building a strong and autonomous team. There has been an obvious shift in what is expected from organisations, customers, and employees in the past few years, coupled with technological innovations which have made it even easier for customers to compare and switch to a better performing organisation that values mindset, customer experience, engagement and work-life balance (Kriegenbergh, 2021). Hence, effective communication (interaction among the team members) is considered as one of the greatest tools necessary for project success in the UK construction industry. Studies reveal that effective communication is one of the best ways to increase cooperation and clarity in all aspects of a project's life cycle. Thus, it is regarded as the foundation for teamwork and collaborative relationship with stakeholders. Nevertheless, effective communication and interaction within the traditional construction setting has posed to be a major challenge due to the nature of the industry that is characterised by fragmentation, complexities, and several parties (client, consultant, contractor, authorities) involved in a project.

Another agile value focuses on customer feedback, that is, customer collaboration over contract negotiation. This value accentuates on collaboration between customers and project team, encouraging the need to learn of them and understand their challenges via collaboration. The fact is that negotiation is great for business. However, negotiation should never get in the way of helping the clients and meeting their needs as with the TPM methodology that functions in proxy of clients. Collaboration ensures that the clients, the stakeholders, and the project team work together throughout the entire project life cycle rather than just agreeing to a compromise. Besides, the needs of the customers are usually met when they collaborate with the project team because the customers would have more opportunity to make inputs as required. Narrowing it down to the UK construction context, it should be noted that collaboration, cooperation, or transparency within a construction project team is very crucial for project development. The UK construction industry has been often plagued with a range of project execution issues, particularly surrounding collaboration, trust, transparency and regulation. Therefore, integrating the collaborative strengths of the AgPM methodology in managing UK construction projects would mean that the construction team would work closely and together towards achieving a project's goal.

The fourth agile value is about being – flexible — responding to change over following a plan. The business world of today is rapidly changing in many forms, hence an urgent need for project managers to be strategic, prepared, and be able to think on the go rather than think in advance. In view of this, the famous quote by Dwight D. Eisenhower, "In preparing for battle I have always found that plans are useless, but planning is indispensable," is applicable in illustrating the importance of flexible thinking and planning in the face of change. This suggests that the ability of the project team to frequently respond to changing project requirements (on the go) is crucial for a project's success. In addition, flexibility and adaptability is considered as a modern approach to prepare project teams for coping with uncertainty and smoothing project schedules.

One of the major differences between the TPM and AgPM methodologies is in their speed and proactive adaptability to change. Speed in this context underlines the ability of an organisation to respond quickly to the customers' changing requirements while adaptability relates to the ability of the organisation to quickly reconfigure based on the changing circumstances. Likewise, findings have demonstrated that flexibility and adaptability is one of the core behavioural competencies that underpin effective project management performance. Therefore, in this evolving era, where there is an increasing need for manoeuvrability in project management, integrating the strengths of the AgPM methodology in managing construction projects will provide an effective mechanism for the identification, evaluation, and resolution of issues, aligning the project's objectives with those of its customers.

10.3.4 Barriers to the Adoption and Integration of the AgPM Methodology

Despite all the publications and studies on the benefits associated with the adoption and integration of the AgPM methodology in managing construction projects, its acceptance has been hindered by several barriers. Findings from literature review revealed several factors that have hindered the adoption of the AgPM methodology in the management of UK construction projects. Hence, a set of barriers was presented to the research participants in this study, and data analysis findings showed that the five major barriers, with mean scores of 3.30 and above, include organisational resistance to change; training needs; lack of skills and experience with agile methods; poor management support; inconsistent processes and practices of traditional construction management.

10.3.4.1 Organisational Resistance to Change

The UK construction industry is usually typified by its resistance to change, and this singular element has led to many issues for the industry. The concept of resistance to change is founded on Lewin's (1947) unfreezing, moving, and freezing model of organisational change, which states that there are driving forces that seek to either bring about or resist change in every organisation. The introduction of change in an organisation could be daunting, and scholars are of the opinion that there may be some potential positive factors that trigger an organisation's resistance to change. For example, Ford *et al* (2008) allege that thoughtful resistance to change is more significant than unquestioning acceptance in sustaining an organisational change. That is to say, the ability of the UK construction practitioners (cognitive dimension of resistance) to thoughtfully process the change as well as their perceived capability to effectively function in the proposed change and eventually resist it is more significant than gullibly accepting. Also, changes in an organisation may result to an increase in anxiety of the workers. Hence, workers, particularly the older (and experienced) ones, are afraid that the impact of change (e.g., in technology) may result in them being left behind.

Considering that there might be some potential positive rationale behind the UK construction industry's resistance to change, the question is: Will the UK construction industry modernise and become innovative in terms of acceptance to changes in the management approach of construction projects or stay roughly the same? Several concerns have been raised about the lack of innovative changes in the industry compared to other industries. For example, reports from Construction Excellence (2021) highlight a number of areas, such as productivity, profitability, and an aging and un-diverse workforce, that would potentially challenge the UK construction industry's performance as workload recovers if substantial change is not enacted. However, rather than emphasising the apprehensiveness for change, studies have suggested that for the adoption of the AgPM methodology, there should first be a change in organisational culture, then change in the mindset of the project team, and the provision for adequate training to support the team's transition process.

10.3.4.2 Skills and Experience with Agile; Training Needs

Despite recent economic challenges in the UK, construction has remained a vital sector for the economy and a key driver of economic growth and employment. Therefore, a thriving, competitive, efficient, modern construction industry is essential to the UK's economic prosperity. However, the relevant skills necessary for the construction workforce to adapt and flow with current innovative changes in the industry are limited. This limitation of skills and paucity of training in the industry has led to a lag in the attainment of a wide-ranging innovative advancement in construction project management. Technology and modern methods of construction management are rapidly evolving the skill sets required to keep pace in managing construction projects. Likewise, the complexity of construction projects are increasingly shaped by new enabling management methodologies and new demands from businesses. Notwithstanding, the UK construction industry does not seem to be leveraging fully the opportunities and benefits unlocked by the modern methods of construction with respect to the adoption of agile methodology due to shortage of skilled workforce and the need for training.

The concept of continuous learning and personal development should become a fundamental operating concept within organisations at every level as well as throughout every project and business process. Even so, the one-off nature of projects in the UK construction industry has further exacerbated innovative learning and adoption of innovative changes. Hence, learnings acquired from a project are most times limited to that project and the team involved, considering the rarity of practitioners with an actual skill in the use of AgPM methodology (see section 7.4.4), coupled with the peculiarity of the post Brexit era where questions are being raised about the availability of labour and skills (UK Industry Performance Report, 2021). It is important that the UK construction industry considers and improves the skills available to its practitioners by widening its talent pool, thus attracting individuals who might not have previously found the industry attractive. Therefore, in the considerations of training and upskilling of UK construction practitioners, the cost and time involved should be considered as investment.

10.3.4.3 Poor Management Support

Management support is very crucial in the facilitation and implementation of innovative changes in the UK construction industry. Management support can enhance the project team's ability to accept change in the following ways:

- It can reduce to the barest minimum the apprehensiveness of the workforce against change and help overcome internal resistance with the introduction of agile methodology in the industry.
- It can aid in influencing the agile adoption process by stimulating change of mindset via communication and reinforcement of the values and vision of the industry.
- It can enhance the development of a positive perception towards the adoption of innovative changes as well as in providing the needed resources and monitory support.

Even though it appears that the senior management team members within the UK construction industry are aware of the enormous benefits associated with the adoption of the AgPM methodology in managing construction projects, their support has not necessarily improved, but rather has been limited. Findings also reveal that the issue of inadequate commitment from top management in the UK construction industry stems from the traditional organisational culture and structure ingrained in the industry. Also, it appears that the senior management team within the UK construction industry does not really have a good understanding of the agile concept and the benefits associated with its adoption, hence the uneasiness and poor support. Therefore, to remain competitive it may be required for the senior management team in the UK construction industry to explore the benefits associated with the adoption of agile in the UK construction industry and consider enhancing their competencies as well.

10.3.4.4 Inconsistent Processes and Practices

Project management practices have progressively gained visibility to organisations as an emerging tool for organisational success. Studies have also demonstrated the value of efficient project management practices in delivering tangible and intangible benefits to construction organisations. However, project, and in particular construction project, has endured as a highly problematic endeavour due to all the issues associated with its management. Findings from this study showed that the general practices and processes adopted in the management of construction projects are inconsistent. Even though the UK construction industry has the potential to become innovative and agile, the inconsistent practices and processes are reckoned to be insufficient in controlling and managing the unprecedented challenges associated with UK construction projects. Hence, this accentuates the need for construction practitioners to rethink and improve the construction process as well as deviate from being reactive to being more proactive and promote sustainable practices. Utilising best practices in managing UK construction project will not only lead to improved performance but will also enhance added business values and greater benefit realisation as well as improve management activities. Figure 10-2 presents a summary of the major barriers, identified in this study, that hinder the adoption and integration of AgPM methodology in the UK construction industry.

Figure 10-2: Summary of the major barriers hindering the adoption of AgPM in the UK construction industry

10.3.5 The TRAGILE Framework

Over the years, the preferred methodology for the management of UK construction projects has been the traditional plan-driven methodology. However, studies have revealed that the TPM methodology sometimes is not the most appropriate methodology for the management of construction projects. This is due to the complexities of construction projects and the need for successive changes, where agile approaches might be more adequate. Some of the weaknesses of the traditional methodology in managing construction projects as well as the potential benefits of integrating the AgPM methodology have been discussed. More so, an assessment of the perception and interest of UK construction practitioners on the use of agile methodology was conducted, and findings revealed that the UK construction practitioners are quite aware of the availability of an alternative methodology (agile) that can be integrated to improve the performance of construction projects. Also, there seems to be an appetite (readiness) from the UK construction practitioners to embrace the potential benefits of agile in managing construction projects. However, due to the rigid and hierarchical organisational structure within the UK construction industry and the apprehensiveness for change from the practitioners of the TPM methodology, the adoption of AgPM methodology has remained stunted, and projects have continued to underperform despite substantial publications on the applicability of agile methodology to construction.

This study however believes that some aspects of construction projects still require the rigour and elements of the TPM methodology. Besides, the goal of this study is not to propose an entirely new methodology (agile) in managing construction projects, considering the abovementioned barriers. Rather, this study emphasises a gradual transformation of the UK construction industry from the proclivity of the TPM methodology to a more agile methodology, thereby retaining the benefits associated with the traditional methodology. PMBOK (2017) also suggests that organisations may adopt the AgPM methodology in one of the following ways: (1. by adopting a formal agile approach, whereby the entire team learns and understands the AgPM methodology; or (2. by implementing changes in the current (TPM) practices in such a way that suits construction project context. Hence, in line with the second adoption approach proposed by PMBOK (2017), and in alignment with Gustavsson (2016) and McBreen's (2002) suggestion, that some aspects of the traditional methodology be retained, and some parts changed while introducing a new methodology, this study proposed and integrated the strengths of the TPM and AgPM methodologies in a framework for the management of UK construction projects and consequently aiding in the improvement of UK construction's project performance.

As mentioned previously, the TRAGILE framework will be beneficial for a gradual introduction and implementation of the agile methodology in construction project management. This is possible by the integration of the strengths of the AgPM methodology, which on one hand deals with the introduction of a more iterative (flexible) approach to construction management to improve learning among project teams, and on the other hand by the introduction of a more incremental approach to accelerate the return on investment. Another potential benefit of the TRAGILE framework is that it will provide insights to contractors undertaking complex multi-disciplinary projects for the first time to ensure the best possible results. The TRAGILE framework can be useful, particularly with the new models of construction procurement and integrated project delivery methods, discussed in section 3.4.3, where timely interaction among members of project teams is of utmost importance for successful delivery (Mohamed and Moselhi, 2019). Furthermore, the collaborative nature of the framework allows short feedback loop which facilitates change management and faster resolution to issues. Thus, minimising issues at the later stages of the project.

The applicability of the TRAGILE framework would depend on the organizational structure. Siloed organizational structures would normally have greater resistance to such flexibility (Mohamed and Moselhi, 2019) and the introduction of a new management system can be faced with challenges. Hence, a collaborative organisational structure have been suggested for the effective implementation of the TRAGILE framework. Also, another setback to the applicability of the TRAGILE framework is that current construction industry practices have been developed to ensure contractual risk avoidance, which is considered a barrier to agile application (Owen and Koskela, 2006).

10.4 Limitations of the Study

Every research project would experience some limitations, considering that it was conducted in a predefined time frame and with limited resources. Apart from the time constraints, disruptions to study by the COVID-19 pandemic, three major limitations of this study have been identified, and are elaborated briefly.

- This study was limited because of the lack of scholarly resource data for the development of the TRAGILE framework such as this in applied construction projects. There was no empirical data to substantiate or refute claims made in this study, but the claims were made based on interpretation of the scholarly findings from available literature.
- Another major limitation of this study relates to the number of survey participants for creating transferability of the findings. When conducting a study of this nature, it is important to have sufficient sample size in order to draw valid conclusions. Besides, statistical analysis requires larger sample size to ensure that the sample is considered representative of a population and that the statistical result can be generalised to a larger population. However, it was a bit difficult to define a population and obtain a very high response rate from the research participants. Hence, purposeful sampling technique was employed to identify and select a group of individuals who have various years of experience within the UK construction industry.

10.5 Recommendations and Future Work

Evidence based on the findings from this study suggest that the scope of this study is extensive and multidimensional for achieving agility in any organisation. Hence, the TRAGILE framework sets the cornerstone of a new journey of areas which could be further investigated. The following recommendations will enhance the adoption of the AgPM methodology and the achievement of agility in the UK construction industry.

10.5.1 Recommendations for Stakeholders

- The developed TRAGILE framework stems from the collaborative efforts of different stakeholders. Therefore, regardless of scope in a construction project, stakeholders should work together as a team in understanding the project requirements, the roles and responsibilities of each stakeholder, and for the purpose of achieving agility in a construction project.
- There is need for the UK government to provide effectual policy and regulation that encourages the adoption of innovative idea as this in a construction project. On this basis thereof, it is recommended that the UK government ensures adequate provision of an effective legal system that protects the interests of stakeholders and properly guide innovative activities within the construction industry.
- Specialised steps can be undertaken by the government and stakeholders in the industry in promoting the strategies of the TRAGILE framework, i.e., how the framework can be shared and further improved with a wider community. Subsequently, future work on setting up ideal strategic vehicles (such as working groups, conferences, journals, or workshops) can be undertaken.

10.5.2 Recommendations for Future Research

There are several areas of focus that may lead to future research. Since this study is based on theory and on the available literature, the framework has not been placed into practice. Hence, the following recommendations are noteworthy:

- An avenue for future research would be to perform side-by-side comparison tests of similar projects utilising the TPM methodology and the proposed TRAGILE framework to evaluate the true impact of the framework on construction projects' performance.

- This study has discussed the theoretical idea of a formal training plan in order to adapt to the TRAGILE framework from a predominant TPM methodology, so an important area for future research would lie in developing a formal training module/plan for the UK construction industry to adapt to the TRAGILE framework. Thus, closing the gap in the capability of the UK construction industry from the TPM methodology that has been in operation for a lengthy time as well as allowing for an easier transition to the proposed TRAGILE framework.
- A formally published training plan will enable the UK construction industry to establish best practices and benchmarking opportunities for other organisations to utilise.
- The TRAGILE framework for the integration of the TPM and AgPM methodologies developed in this study is solely for construction project delivery and does not include aspects of procurement and contract arrangements. Further research could be carried out on:
    - the implication of procurement and contract strategies on the implementation of the TRAGILE framework.
    - The adoption and application of the TRAGILE framework from the perspective of project management (e.g., from that of a project manager appointed to manage the whole project process; from the perspective of a construction firm appointed to deliver the building contract, etc.).

References

Aarthipriyaa, V, Chitra, G and Poomozhi, S. (2020). Risk and its impacts on time and cost in construction projects. *Journal of Project Management*. 5(245–254). DOI: 10.5267/j.jpm.2020.6.002

Abawi, K. (2017). *Data Collection methods (Questionnaire & Interview).* Training in Sexual and Reproductive Health Research Geneva Workshop.

Abbas, H. F and Erzaij, K. R. (2019). Study of the complexity factors associated with the theory of complexity in Iraqi construction projects. *Periodicals of Engineering and Natural Sciences*. 7(4). DOI:10.21533/pen.v7i4.987.

Abbasbhai, M. J and Patel, A. S. (2020). Factor Affecting Performance of Construction Projects. *International Research Journal of Engineering and Technology (IRJET),* 7(6).

Abdulhai, R, Kaul, A and Prabhakar, G. (2019). Mann Whitney U-Test. [Online] Retrieved from: https://users.wpi.edu/

Abdul-Kadir, M. R and Price., A. D. F. (1995). Conceptual Phase of Construction Projects. *International Journal of Project Management.* 13(1). doi.org/10.1016/0263-7863(96)81776-5

Abolafia, M. Y. (2010). Narrative construction as sensemaking: How a Central Bank Thinks. *Organization Studies*, 3, 349–367. DOI: 10.1177/0170840609357380

Abrahamsson, P, Salo, O, Ronkainen, J and Warsta, J. (2002). *Agile Software Development Methods: Review and Analysis*, VTT Publication, Finland.

Abrahamsson, P, Warsta, J, Siponen, M. T and Ronkainen, J. (2003). New Directions on Agile Methods: A Comparative Analysis. *Proceedings of 25th International Conference*. 244-252

Abudi, G. (2011). *Developing a project management best practice*. Paper presented at PMI® Global Congress 2011—North America, Dallas, TX. Newtown Square, PA: Project Management Institute.

Abusalah, M and Tait, J. (2018). *Innovation Management in Construction - Practical Approach*. In: 13th Pipeline Technology Conference, Berlin.

Academic Dictionary. (2021). *Michael Latham*. Retrieved from: https://en-academic.com/

Active Collab. (2020). *Project Management Methodologies and Frameworks*. Retrieved from: https://activecollab.com/

Adam, A and Lindahl, G. (2017). Aggregation of factors causing cost overruns and time delays in large public construction projects: Trends and implication. *Engineering Construction & Architectural Management,* 24(3). DOI:10.1108/ECAM-09-2015-0135

Adams, J. R and Barnd, S. E. (2008). *Project Management Handbook*, 2nd ed. Wiley Online Library.

Adamson, D. M. and Pollington, A. H. (2006). *Change in the construction industry: an account of the UK construction industry reform movement 1993-2003*. Routledge.

Addis, M. (2016) Tacit and Explicit Knowledge in Construction Management. *Construction Management and Economics,* 34(7-8). DOI:10.1080/01446193.2016.1180416

Adeleke, B. L, Yahya, W. B and Usman, A. (2015). A comparison of some test statistics for multivariate analysis of variance model with non-normal responses. *Journal of Natural Sciences Research*, 5(15), pp. 1–9.

Adeleye, E. O. and Yusuf, Y. Y. (2006). Towards Agile Manufacturing Models of Competition and Performance Outcomes. *International Journal Agile Systems and Management,* pp. 93-110. DOI:10.1504/IJASM.2006.008861

Adenowo, A. A. and Adenowo, B. A. (2020). Software Engineering Methodologies: A Review of the Waterfall Model and Object-Oriented Approach. *International Journal of Scientific & Engineering Research.* 4(7).

Adjei, D, and Rwakatiwana, P. (2010). Application of Traditional and Agile Project Management in Consulting Firms: A Case Study of PricewaterhouseCoopers.

- Adom, D, Hussein, E, K and Agyem, A. J. (2018). Theoretical and Conceptual Framework: Mandatory Ingredients of a Quality Research. *International Journal of Scientific Research.* 7(1): 438-441

Afuah, A. N., and Bahram, N. (1995). The hypercube of innovation. *Res. Policy*, 24. 51-76. doi.org/10.1016/0048-7333(93)00749-J

Aga, D. A, Noorderhaven, N and Vallejo B. (2016). Transformational Leadership and Project Success: The Mediating Role of Teambuilding. *International Journal of Project Management,* 34(5). doi.org/10.1016/j.ijproman.2016.02.012

Agapiou, A; Price, A. D. F. and McCaffer, R. (1995). Planning Future Construction Skill Requirements: Understanding Labour Resource Issues. *Construction Management and Economics*. 13(2). DOI:10.1080/01446199500000017

Agarwal, R., Chandrasekaran, S., & Sridhar, M. (2016). *The digital future of construction*. Voices.

Agile Alliance (2001). *Manifesto for Agile Software Development*. Retrieved From https://www.agilealliance.org

Agile Transformation Inc. (2019). *Barriers to Agile Adoption.* Retrieved from: https://agilityhealthradar.com

AgileCxO. (2021). Introducing the Agile Performance Holarchy. Retrieved from: https://agilecxo.org/ [Assessed 21 Apr. 21]

Aguanno, K. (2004). *Managing agile projects*. Multi–Media Publications Inc.

Ahimbisibwe, A, Daellenbach, U and Cavana, R. N. (2017). Empirical comparison of traditional plan-based and agile methodologies: Critical Success Factors for Outsourced Software Development Projects from Vendors' Perspective. *Journal of Enterprise Information Management*, 30(3). DOI 10.1108/JEIM-06-2015-0056

Ahmad, M and Dhafr, N. (2002). Establishing and Improving Manufacturing Performance Measures. *Robotics and Computer-Integrated Manufacturing*.

Ahmad, S., Wasim, S., Irfan, S., Gogoi, S., Srivastava, A., & Farheen, Z. (2019). Qualitative vs. Quantitative Research. *population*, *1*, 2. doi.org/10.1016/S0736-5845(02)00007-8.

Ahmady, G. A, Mehrpour, M and Nikooravesh, A. (2016). *Organizational Structure.* Proceedings from 3rd International Conference on New Challenges in Management and Organization: Organization and Leadership, 2 May 2016, Dubai, UAE.

Ahmed, S. M. Kamalesh, P., Rizwan, U. F., Syed, M. (2010) An investigation of the leadership style of construction managers in South Florida. *Journal of Building Performance*, pp 2180-2106.

Ahmed, S and El-Sayegh, S. (2021). Critical Review of the Evolution of Project Delivery Methods in the Construction Industry. Buildings 2021, 11, 11. https://dx.doi.org/10.3390/buildings11010011

Ahmed, M. N., and Mohammed, S. R. (2018). Agile Quality Management Framework in Construction Projects (AQMFCP). *International Journal of Engineering and Technology* (UAE), 7(20), 307-309. DOI:10.14419/ijet.v7i4.20.25944

Ahuja R, Sawhney A, Jain M, Arif M and Rakshit S. 2018. Factors influencing BIM adoption in emerging markets—the case of India. *Int J Construction Management.* 20(1):1–12. doi.org/10.1080/15623599.2018.1462445

Ajayi, O. M., Akinsiku, O. E., and Salami, T. O. (2018). *Implementation of total quality management of construction companies in Lagos state, Nigeria*. University of Lagos.

Ajayi, S. O and Oyedele, L, O. (2017). Policy imperatives for diverting construction waste from landfill: experts' recommendations for UK policy expansion. *Journal of Clean Production,* 147, p. 57-65. doi.org/10.1016/j.jclepro.2017.01.075

Ajayi, S. O, Oyedele, L. O, Akinade, O. O, Bilal, M, Owolabi, H. A, Alaka, H. A. and Kadiri, K. O. (2016). Reducing waste to landfill: A need for cultural change in the UK construction industry. *Journal of Building Engineering*, 5, pp. 185-193. doi.org/10.1016/j.jobe.2015.12.007

Ajayi, S. O, Oyedele, L. O, Bilal, M, Akinade, O. O, Alaka, H. A, Owolabi, H. A. and Kadiri, K. O. (2015). Waste Effectiveness of the Construction Industry: Understanding the Impediments and Requisites for Improvements. *Journal of Resources, Conservation and Recycling.* 102, 101-112. doi.org/10.1016/j.resconrec.2015.06.001

Ajayi, S. O. (2016). *Design, Procurement and Construction Strategies for Minimizing Waste in Construction Projects*. Research Repository, University of the West of England.

Akanksha, Rakheja, A, Kapur, L and Ahuja, K. (2013). Agile Methodologies and Its Processes. *International Journal of Computational Engineering Research*, 3(9).

Akhtar, I. (2016). Research Design-Research in Social Science. *Interdisciplinary Perspectives*, *3*(4), 68-84. doi.org/10.2139/ssrn.2862445

Akintoye A, Goulding J, Zawdie G. 2012. *Construction innovation and pro-cess improvement.* Chichester: Wiley Blackwell.

Akomah, B. B, Ahinaquah, L. K and Mustapha, Z. (2020). Skilled Labour Shortage in the Building Construction Industry within the Central Region. *Baltic Journal of Real Estate Economics and Construction Management,* 8(83–92). DOI: https://doi.org/10.2478/bjreecm-2020-0006

Aksan, N, Kısac, B, Aydın, M and Demirbuken, S. (2009). Symbolic Interaction Theory. *Procedia - Social and Behavioural Sciences*, 1(1). doi.org/10.1016/j.sbspro.2009.01.160

Al Hadithi, B. I, Al-Attar, T. S, Al-Neami, M. A, AbdulSahib, W. S. (2018). An investigation into factors causing delays in highway construction projects in Iraq. MATEC Web Conference. doi.org/10.1051/matecconf/201816202035

Al Rasch, F. (2019). Methodologies in Project Management. *Academia. doi.org/10.32893/IJBMR.2019/AMII.19/11.11*

Al-Ababneh, M. M. (2020). Linking Ontology, Epistemology and Research Methodology. *Science and Philosophy*, 8(1). DOI:10.23756/sp.v8i1.500

Alami, A. (2021). *Degree of Agility: How Much to Agile?* Modern Analyst Media LLC. Retrieved from at: https://www.modernanalyst.com/

Alarcón, L. F, Grillo, A, Freire, J and Diethelm, S. (2001). Learning from Collaborative Benchmarking in the Construction Industry. *Proceedings of 9th Annual Conference of the International Group of Lean Construction March 1–10*.

Alashwal, A., and Hamzah, A. R. (2014). *Developing a conceptual framework of fragmentation in construction*. Department of Quantity Surveying, Faculty of Built Environment, University of Malaya.

Albadarneh, A, Albadarneh, I and Qusef, A. (2015). *Risk Management in Agile Software Development: A Comparative Study*. Proceedings from IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT). DOI:10.1109/AEECT.2015.7360573

Albrecht, J. (2017). *GIS Project Management*. City University of New York - Hunter College. ResearchGate.

Alford, J. M and Carsten, C. (2017). Strategy in the Public and Private Sectors: Similarities, Differences and Changes. *Administrative Sciences* 7(4):35 DOI:10.3390/admsci7040035

Al-Hajj, A and Zraunig, M. M. (2018). The Impact of Project Management Implementation on the Successful Completion of Projects in Construction. *International Journal of Innovation, Management and Technology*, 9(1). doi: 10.18178/ijimt.2018.9.1.781

Ali, A, Wang, H, Soomro, M. A. and Islam, T. (2020). Shared Leadership and Team Creativity: Construction Industry Perspective. *Journal of Construction Engineering and Management*, 146(10). DOI:10.1061/%28ASCE%29CO.1943-7862.0001920

Ali, A. K. (2019). A case study in developing an interdisciplinary learning experiment between architecture, building construction, and construction engineering and management education. *Engineering Construction & Architectural Management*, 25(9). DOI 10.1108/ECAM-07-2018-0306

Ali, J, Chew, T. G and Tang, T. C. (2004). Knowledge Management in Agile Organizations. *Sunway College Journal* 1, 13–20

Alias, Z., Zawawi, E. M. A., Yusof, K., & Aris, N. M. (2014). Determining critical success factors of project management practice: A conceptual framework. *Procedia-Social and Behavioural Sciences*, *153*, 61-69. doi.org/10.1016/j.sbspro.2014.10.041

Aliber, J. (2018). The benefits of co-locating design and construction teams. Retrieved from: https://www.hfmmagazine.com/

Alin, P., Maunula, A. O., Taylor, J. E., and Smeds, R. (2013). Aligning Misaligned Systemic Innovations: Probing Inter-Firm Effects Development in Project Networks. *Project Management Journal*, *44*(1), 77–93. https://doi.org/10.1002/pmj.21316

Aljohani, A, Ahiaga-Dagbui, D and Moore, D. (2017). Construction Projects Cost Overrun: What Does the Literature Tell Us? *International Journal of Innovation, Management and Technology*, 8(2). doi: 10.18178/ijimt.2017.8.2.717

Alleman, G. B. (2005). Agile Project Management Methods for IT projects. In Carayannis, E. G., Kwak, Y. H and Anbari, F. T., 2005. The Story of Managing Projects: An Interdisciplinary Approach (pp. 324–334). *Westport, CT: Praeger*. Retrieved from http://site.ebrary.com/id/10348088.

Alnsour, B. H. (2014). The Use of Virtual Project Teams for Project Management in Jordanian Corporations. *Eurasian Journal of Business and Management,* 2(2). DOI: 10.15604/ejbm.2014.02.02.004.

Al-Saeed, Y, Edwards, D and Scaysbrook, S. (2020). Automating Construction Manufacturing Procedures using BIM Digital Objects (BDOs): Case Study of Knowledge Transfer Partnership Project in UK. *Construction Innovation.* DOI:10.1108/CI-12-2019-0141

Al-Saqqa, S., Sawalha, S. and AbdelNabi, H., 2020. Agile Software Development: Methodologies and Trends. *International Journal of Interactive Mobile Technologies, 14*(11). DOI:10.3991/ijim.v14i11.13269

Alsehaimi, A, Koskela, L and Tzortzopoulos, P. (2013). Need for Alternative Research Approaches in Construction Management: Case of Delay Studies. *Journal of Management in Engineering,* 29(4). (407 - 413). http://dx.doi.org/10.1061/(ASCE)ME.1943-5479.00001...

Alshayeb, M. and Li, W. (2005). An Empirical Study of System Design Instability Metric and Design Evolution in an Agile Software Process. *Journal of Systems and Software,* 74(3). DOI:10.1016/j.jss.2004.02.002

Alsulamy, S. (2015). *Developing a Performance Measurement Framework for Municipal Construction Projects in Saudi Arabia*. Edinburgh Napier University.

Altschuld, J. W., and Watkins, R. (2014). *A primer on needs assessment: More than 40 years of research and practice.* In J. W. Altschuld and R. Watkins (Eds.), Needs assessment: Trends and a view toward the future (pp. 5-18). New Directions for Evaluation, no. 144.

Alwan, Z, Jones, P and Holgate, P. (2017). Strategic Sustainable Development in the UK Construction Industry, Through the Framework of Strategic Sustainable Development, Using Building Information Modelling. *Journal of Cleaner Production,* 140 (1). DOI:10.1016/j.jclepro.2015.12.085

Alzahrani J, Emsley M. 2013. The impact of contractors' attributes on construction project success: A post construction evaluation. *International Journal of Project Management*. 31(2). DOI:10.1016/j.ijproman.2012.06.006

Ambler, S. (2002). *Agile Modelling: Effective Practices for Extreme Programming and the Unified Process*. John Wiley & Sons.

Ambler, S. W., and Lines, M. (2012). *Disciplined agile delivery: A practitioner's guide to agile software delivery in the enterprise*. IBM press.

Amorim, A. C., da Silva, M. M., Pereira, R., & Gonçalves, M. (2021). Using agile methodologies for adopting COBIT. *Information Systems*, https://doi.org/10.1016/j.is.2020.101496 .

Anantatmula, V. S. (2010). Project Manager Leadership Role in Improving Project Performance. *Engineering Management Journal*, 22(1). DOI:10.1080/10429247.2010.11431849

Andersen, E. S. (2006). *Perspectives on Projects*. Paper Presented at PMI® Research Conference: New Directions in Project Management, Montréal, Québec, Canada. Newtown Square, PA: Project Management Institute.

Anderson, E. W, Fornell, C and Mazvancheryl, S. K. (2004). Customer Satisfaction and Shareholder Value. *Journal of Marketing*, 68 (4). DOI:10.1509/jmkg.68.4.172.42723

Anderson, F. (2019). *Measuring Innovation in Construction*. In: Building Tomorrow: Innovation in Construction and Engineering. London: Routledge.

Anfara, V. A., & Mertz, N. T. (2015). *Setting the stage*. Theoretical frameworks in qualitative research, 1-20.

Aninkan, D. O. (2018). Organizational Change, Change Management, and Resistance to Change – An Exploratory Study. *European Journal of Business and Management*, 10(26).

Antunes, R and Gonzalez, V. (2015). A Production Model for Construction: A Theoretical Framework. *Journal of Buildings.* 5, 209-228. DOI:10.3390/buildings5010209

Anwer, F, Aftab, S and Ali, I. (2017). Proposal of Tailored Extreme Programming Model for Small Projects. *International Journal of Computer Applications*, 171(7). DOI:10.5120/ijca2017915112

Anwer, F, Aftab, S, Shah, S. S and Waheed, U. (2017). Comparative Analysis of Two Popular Agile Process Models: Extreme Programming and Scrum. *International Journal of Computer Science and Telecommunications*. 8(2).

Arain, F. M, Assaf, S. and Low, S. P. (2004). Causes of Discrepancies Between Design and Construction. *Architectural Science Review*, 47(3). https://doi.org/10.1080/00038628.2000.9697530

Arantes, A and Ferreira, L. M. (2020). Underlying Causes and Mitigation Measures of Delays in Construction Projects: An Empirical Study. *Journal of Financial Management of Property and Construction*, 25(2). DOI:10.1108/JFMPC-03-2019-0029

Aouad, G, Ozorhon, B and Abbott, C. (2010). Facilitating innovation in construction: Directions and implications for research and policy. *Constr Innov.*10(4):374–394.

Arayici, Y, and Aouad, G. (2010). Building information modelling (BIM) for construction lifecycle management. *Construction and Building: Design, Materials, and Techniques*, *2010*, 99-118.

Arayici, Y, and Coates, P. (2012). A system engineering perspective to knowledge transfer: A case study approach of BIM adoption. In book: Virtual Reality - Human Computer Interaction (pp.179-206). Publisher: InTech. DOI:10.5772/3333

Archibald, R. D, Filippo, I. D and Filippo, D. D. (2012). The Six-Phase Comprehensive Project Life Cycle Model Including the Project Incubation/Feasibility Phase and the Post-Project Evaluation Phase. *PM World Journal*. 1(5).

Archibald, R. D., Di Filippo, I., & Di Filippo, D. (2012). The six-phase comprehensive project life cycle model including the project incubation/feasibility phase and the post-project evaluation phase. *PM World Journal*, *1*(5), 1-40.

Arditi, D, Akan G. T, Gurdamar S. (1985). Reasons for delays in public projects in Turkey. *Construct Manage Econ*, 3(2):171–181

Arefazar, Y., Nazari, A., Hafezi, M. R., and Maghool, S. A. H. (2022). Prioritizing agile project management strategies as a change management tool in construction projects. *International Journal of Construction Management*, *22*(4), 678-689.

Arefazar, Y, Nazari, A, Hafezi, M. R and Maghool, S. A. H. (2019). Prioritizing agile project management strategies as a change management tool in construction projects. *International Journal of Construction Management*. 22(2). DOI:10.1080/15623599.2019.1644757

Arell, R. (2023). Sustainability and Agile. Agile Alliance. Retrieved from: https://www.agilealliance.org/sustainability-and-agile/

Armenia, S, Dangelico, R. M, Nonino, F and Pompei, A. (2019). Sustainable Project Management: A Conceptualization-Oriented Review and a Framework Proposal for Future Studies. *Sustainability*. 11(9). DOI:10.3390/su11092664

Armitage, A. (2007). Mutual research designs: Redefining mixed methods research design. In: *Paper presented at the British Educational Research Association Annual Conference* (Vol. 5, p. 8).

Arslan, G. and Kivrak, S. (2008). Critical factors to company success in the construction industry. *World Academy of Science, Engineering and Technology*, 45(1), pp. 43-46.

Arthur, A., and Hancock, B. (2009). *Introduction to the research process*. NIHR RDS for the East Midlands.

Arvidsson, M and Rogestedt, L. (2019). *Applying Metrics in Agile; Development of Performance Indicators to Support Agile Development Team*. Chalmers University of Technology.

Ash, R. C and Pittman, P. H. (2008). Towards Holistic Project Scheduling Using Critical Chain Methodology Enhanced with PERT Buffering. *Int. J. Project Organisation and Management,* 1(2). DOI:10.1504/IJPOM.2008.022191

Ashirwadam, J. (2014). *Communication Research Methods- Methods of Data Analysis*. New Delhi: Rawat Publications

Ashtian, B; Jalali, G; Aryanezhad, M and Makui, A. (2007). A New Approach for Buffer Sizing in Critical Chain Scheduling. *2007 IEEE International Conference on Industrial Engineering and Engineering Management*, Singapore, 2007, pp. 1037-1041. doi: 10.1109/IEEM.2007.4419350

Ashworth, A and Perera, S. (2018). *Contractual procedures in the construction industry*, Routledge.

Assaf S, Al-Hejji S. (2006). Causes of delay in large construction projects. *International Journal of Project Management*. 24(4):349–357. https://doi.org/10.1016/j.ijproman.2005.11.010

Association for Project Managers. (2015). *The Practical Adoption of Agile Methodologies*. Retrieved from: https://www.apm.org.uk/

Association for Project Managers. (2019). *Introduction to Project Planning. APM Knowledge* Retrieved from: https://www.apm.org.uk

Association for Project managers. (2020). *The agility construct on project management theory.* Retrieved from: https://www.apm.org.uk/

Association for Project Managers. (2020). *What is a life cycle?* Retrieved from: https://www.apm.org.uk

Astels, D., Miller, G.G., and Novák, M. (2002). *A Practical Guide to eXtreme Programming*. AbeBooks

Ateş, C, Kaymaz Ö, Kale H. E and Tekindal, M. A. (2019). Comparison of Test Statistics of Nonnormal and Unbalanced Samples for Multivariate Analysis of Variance in terms of Type-I Error Rates. *Comput Math Methods Med*. 15:1-8. doi: 10.1155/2019/2173638.

Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria. *International Journal of Project Management.* 17(6). https://doi.org/10.1016/S0263-7863(98)00069-6

Atkinson, R., Crawford, L., and Ward, S. (2006). Fundamental Uncertainties in Projects and the Scope of Project Management. *International Journal of Project Management*. 24(8). https://doi.org/10.1016/j.ijproman.2006.09.011

Atkinson, R. J, Tennakoon, M and Wedawatta, G. (2022). Use of new models of construction procurement to enhance collaboration in construction projects: the UK construction industry perspective. *Journal of Financial Management of Property and Construction*, 28(1), pp. 45-63

Augustine, S. (2005). *Managing agile projects*. Prentice Hall PTR.

Australian Bureau of Statistics. (2018). 4125.0 - *Gender Indicators, Australia, Sep 2018—Economic Security*. Retrieved from: https://www.abs.gov.au/ausstats/abs

Aven, T. (2016). Risk assessment and risk management: Review of recent advances on their foundation. *European Journal of Operational Research*, 253(1). DOI:10.1016/j.ejor.2015.12.023

Azanha, A, Tiradentes, A, R, Argoud, T, Junior, B. J and Antoniolli, P. D. (2017). Agile project management with Scrum: A case study of a Brazilian pharmaceutical company IT project. *International Journal of Managing Projects in Business*, 10(1). DOI:10.1108/IJMPB-06-2016-0054

Aziz, R. F and Hafez, S. M. (2013). Applying lean thinking in construction and performance improvement. *Alexandria Engineering Journal,* 54(2). DOI:10.1016/j.aej.2013.04.008

Aziz, R. F, Abdel-Hakam, A. A. (2016). Exploring delay causes of road construction projects in Egypt. Alexandria Eng J. 55(2):1515–39. doi: https://doi.org/10.1016/j.aej.2016.03.006.

Aziz, R. F. (2013). Ranking of Delay Factors in Construction Projects After Egyptian Revolution. *Alexandria Engineering Journal*. 52(3). DOI:10.1016/j.aej.2013.03.002

Aziz, R. F. (2013). RPERT: Repetitive-Projects Evaluation and Review Technique. *Alexandria Engineering Journal*. 53(1). DOI:10.1016/j.aej.2013.08.003

Baccarini, D. (1996). The concept of project complexity a review. *International Journal of Project Management,* 14(4). DOI:10.1016/0263-7863(95)00093-3

Baccarini, D., and Collins, A. (2003). *Critical success factors for projects.* Proceedings of the 17th ANZAM Conference.

Bachman, D. (2020). *The economic impact of COVID-19 (novel coronavirus).* Deloitte Insights.

Badewi, A. (2016). The impact of project management (PM) and benefits management (BM) practices on project success: Towards developing a project benefits governance framework. *International Journal of Project Management*, 34(4), 761–778. http://doi.org/10.1016/j.ijproman.2015.05.005

Badi, S., Ochieng, E., Nasaj, M., & Papadaki, M. (2021). Technological, organisational and environmental determinants of smart contracts adoption: UK construction sector viewpoint. *Construction Management and Economics*, *39*(1), 36-54. DOI:10.1080/01446193.2020.1819549

Bafadal, I, Nurabadi, A, Soepriyanto, Y and Gunawan, I. (2020). Primary School Principal Performance Measurement. *Advances in Social Science, Education and Humanities Research,* volume 487. DOI:10.2991/assehr.k.201112.004

Bahadur, M. (2020). *Project definition, Lifecycle and role of Project Managers*. Utah State University. ResearchGate.

Bahceci, D and Holmgren, L. (2014). Agile Perspectives in Construction Projects – How to Improve Efficiency in the Design Phase. Retrieved from: http://www.wsp-pb.com

Baker, B. N, Fisher, D and Murphy, D. C. (1997). *Factors Affecting Project Success*. Project Management Handbook. 2nd ed. John Wiley & Sons, Inc.

Baker, B. N, Fisher, D and Murphy, D. C. (1997). *Project Management in Public Sector: Success and Failures Patterns Compared to Private Sector Projects*. 2nd ed. John Wiley & Sons, Inc.

Bakhit, H and Villmer, F. (2019). *Agile Methodology for Physical Product Development: Limitations and Solutions*. Production Engineering and Management. Proceedings of 9th International Conference. Trieste, Italy.

Bal, M., Bryde, D., Fearon, D., and Ochieng, E. (2013). Stakeholder engagement: Achieving sustainability in the construction sector. *Sustainability*, *5*(2), 695-710. DOI:10.3390/su5020695

Baldwin JR, Manthei JM, Rothbart H, Harris RB. 1971. Causes of delay in the construction industry. *Journal of the Construction Division*. 97(2):177–187.

Ball, M. (2014). Rebuilding Construction: Economic Change in the British Construction Industry. Retrieved from: https://books.google.co.uk

Ballard, G. (1994). *The last planner*. In Conference of the Northern California Construction Institute, Monterey, California, 1-8.

Ballard, G. (2000). *The last planner system of production control*. Birmingham: The University of Birmingham.

Ballard, G., and Tommelein, I. (2021). 2020 Current Process Benchmark for the Last Planner (R) System of Project Planning and Control. Technical Report, Project Production Systems Laboratory (P2SL), University of California, Berkeley, California, USA. doi.org/10.34942/P2F593.

Ballesteros-Pérez, P. B, Larsen, G. D and González-Cruz, M. C. (2018). Do Projects Really End Late? On The Shortcomings of the Classical Scheduling Techniques. *Journal of Technology and Science Education*, 8(1). DOI:10.3926/jotse.303

Banner, S. (2016). *Measuring performance delivered through others*. National Audit Office. Retrieved from: https://www.nao.org.uk.

Barlow, J. (2000). Innovation and Learning in Complex Offshore Construction Projects. *Research Policy*. 29(7-8). doi.org/10.1016/S0048-7333(00)00115-3.

Barmby, J. G. (1961). The Applicability of PERT as a Management Tool. *IRE Transactions on Engineering Management*, 9(3). DOI: 10.1109/IRET-EM.1962.5007682

Barrett, P., and M. Sexton. (2006). Innovation in small, project-based construction firms. Br. J. Manage. 17 (4). DOI:10.1111/j.1467-8551.2005.00461.x

Barros, A, Sousa, S and Nunes, E. (2020). Performance indicators in the construction industry: a study with Portuguese companies. *5th International Conference on New Advances in Civil Engineering (ICNACE 2019)*. DOI 10.1088/1757-899X/800/1/012008

Basari, M.A.M.D and Shamsudin, M. F. (2020). Does Customer Satisfaction Matters? *Journal of Undergraduate Social Sciences and Technology*. 2(1).

Basili, V. R and Lanubile, F. (1999). Building Knowledge Through Families of Experiments. *IEEE Transactions on Software Engineering*, vol. 25, pp. 456-473. DOI:10.1109/32.799939

Basili, V. R. (1996). *The Role of Experimentation in Software Engineering: Past, Present and Future*. Presented at Keynote address in 18th International Conference on Software Engineering (ICSE18), Berlin, Germany, 1996.

Baskerville, R., Pries-Heje, J and Madsen, S. (2011). Post-agility: What follows a decade of agility? *Information and Software Technology*, 53(5). DOI:10.1016/j.infsof.2010.10.010

Bassil, Y. (2012). A Simulation Model for the Waterfall Software Development Life Cycle. *International Journal of Engineering & Technology*, 2(5).

Bassioni, H., Price, A and T. Hassan. (2003). *The Development of a Comprehensive Business Performance Measurement Framework*, Postgraduate Researchers of the Built Environment (PROBE) Conference, 18–19 November, Glasgow, Scotland, pp. 447–456.

Bassioni, H., Price, A. and T. Hassan (2004a) *The Integrated Use of the Balanced Scorecard and the EFQM Excellence Model in Construction*, Working Paper, Loughborough University, Loughborough, UK.

Bauld, S. (2015). *Procurement Perspectives: Reviewing delivery methods in construction*. ConstructConnect Canada, Inc.

Baumberger, C., Beisbart, C. and Brun, G. (2017). What is understanding? An overview of recent debates in epistemology and philosophy of science.

Explaining understanding: New perspectives from epistemology and philosophy of science, pp.1-34.

BBC. (2018, August 2). *Bank of England Raises UK Interest Rates*. Retrieved from: https://www.bbc.co.uk/news/business-45043776.

Beard, B. (2021). Your (org) Journey becoming Agile. Retrieved from LinkedIn: https://www.linkedin.com/

Beatham, S., Anumba, C. and Thorpe, T. (2004). KPI: A Critical Appraisal of their use in Construction. *Benchmarking*, 11(1), pp. 93-117. DOI:10.1108/14635770410520320

BEC - Byggeriets Evaluerings Center 2018 Available from: http://www.byggeevaluering.dk/.

Beck, K and Gamma, E. (2000). *Extreme Programming Explained: Embrace Change* Retrieved from: https://books.google.co.uk

Beck, K, Beedle, M, van Bennekum, A, Cockburn, A, Cunningham, W, Fowler, M, Grenning, J, Highsmith. (2001). *Manifesto for Agile Software Development*. Agile Alliance. 2001.

Beck, K. (1999). *Embracing Changes with Extreme Programming*. IEEE Computer, October, pp. 70-7.

Behn, R. D. (2003). Why Measure Performance? Different Purposes Require Different Measures. *Public Administration Review*, 63(5), 586-606. doi.org/10.1111/1540-6210.00322

Behn, R. D. (2005). Resistance to Measurement. *Public Management Report*, 3(3).

Belassi, W and Tukel, O, I., 1996. A New Framework for Determining Critical Success/Failure Factors in Projects. *International Journal of Project Management.* 14(3). doi.org/10.1016/0263-7863(95)00064-X

Bell, E, Bryman, A and Harley, B. (2019). *Business Research Methods.* 5th Ed. Oxford University Press.

Bell, J. T., 2017. *Extreme Programming*. Department of Computer Science University of Illinois, Chicago.

Bellamy, N. (2015). *2 - Principles of clinical outcome assessment*, Editor(s): Marc C. Hochberg, Alan J. Silman, Josef S. Smolen, Michael E. Weinblatt, Michael H. Weisman, Rheumatology (Sixth Edition), Mosby, Belling S. (2020). *Agile History. In: Succeeding with Agile Hybrids*. Apress, Berkeley, CA.

Benjaoran, B. (2008). A Cost Control System Development: A Collaborative Approach for Small and Medium-Sized Contractors. *Journal of International Management.* 27(3). DOI:10.1016/j.ijproman.2008.02.004

Benmerikhi, M. (2014). *What are the terms for various ontological positions? Are realism and relativism ontological positions? If yes, what do they mean*? Retrieved from ResearchGate.

Bennett, F. L. (2003). *The management of Construction: A Project Life Cycle Approach.* Routledge, London.

Bennett, N and Lemoine, G. J. (2014). What a Difference a Word Makes: Understanding Threats to Performance in a VUCA World. *Business Horizons*, 57(3).

Bentley, C. (2010). *PRINCE2: A Practical Handbook*. 3rd ed. Routledge, London.

Bergmann, A, Posch, P. (2018). Mandatory Sustainability Reporting in Germany: Does Size Matter? *Sustainability*, 10, 3904. doi.org/10.3390/su10113904

Bergmann, T and Karwowski, W. (2019). *Agile Project Management and Project Success: A Literature Review*. Springer International Publishing AG.

Berryman, D. R. (2019). Ontology, Epistemology, Methodology, and Methods: Information for Librarian Researchers, *Medical Reference Services Quarterly*, 38(3). DOI:10.1080/02763869.2019.1623614

Berryman, M, and Cheung, W. (2020). Great Western railway electrification, UK: data challenges and visual solutions. In *Proceedings of the Institution of Civil Engineers-Civil Engineering,* 173(6), pp. 11-18). Thomas Telford Ltd.

Besner, C., and Hobbs, B. (2006). The perceived value and potential contribution of project management practices to project success. *Project Management Journal*, 37(3), 37–48. DOI:10.1177/875697280603700305

Besner, C., and Hobbs, B. (2008). Project management practice, generic or contextual: A reality check. *Project Management Journal*, 39(1), DOI:10.1002/pmj.20033

Besner, C., and Hobbs, B. (2012). An empirical identification of project management toolsets and a comparison among project types. *Project Management Journal*, 43(5), DOI:10.1002/pmj.21292

Besner, C., and Hobbs, B. (2012b). *Contextualization of project management practice and best practice*. Newtown Square, PA: Project Management Institute.

Best, J. W and Kahn, J. V. (1998). *Research in Education.* 8th ed. Library of Congress

Best, R and de Valence, G. (1999). *Getting it Right at the Start. Building in Value: Pre-design Issues.* Best, R. and de Valence, G. (Eds.). London, pp. 1-9

Betta, J and Boronina, L. (2018). *Transparency in Project Management – from Traditional to Agile*. ResearchGate

Betts, M., and Lansley, P. (1993). Construction Management and Economics: A Review of Ten Years. *Construction Management and Economics*, 11(4).

Bevilacqua, M; Ciarapica, F. E. and Giacchetta, G. (2009). Critical Chain and Risk Analysis Applied to High-Risk Industry Maintenance: A Case Study. *International Journal of Project Management,* 27(4). DOI:10.1016/j.ijproman.2008.06.006

Bhuvan, U. (2016). *The Art of Agile Practice: A Composite Approach for Projects and Organizations*. CRC Press

Bick, S, Spohrer, K, Hoda, R, Scheerer, A and Heinzl, A. (2017). Coordination challenges in large-scale software development: A case study of planning misalignment in hybrid settings. *IEEE Transactions on Software Engineering*, 44(10).

Biggins, D, Lene, H. and Trollsund, F. (2016). *Applying a Life Cycle Approach to Project Management Methods*. EURAM 2016.

Biggs, S. E., Banks, T. D., Davey, J. D and Freeman, J. E. (2013). Safety leaders' perceptions of safety culture in a large Australasian construction organisation. *Safety Science*, 52(4). DOI:10.1016/j.ssci.2012.04.012

Bignell, V and Fortune J. (1984). *Understanding Systems Failures*. Manchester, University of Manchester Press

Bilau, A. A, Witt, E and Lill, I. (2018). *Research methodology for the development of a framework for managing post-disaster housing reconstruction*. Proceedings from 7th International Conference on Building Resilience; Using scientific knowledge to inform policy and practice in disaster risk reduction, ICBR2017, 27 – 29 November 2017, Bangkok, Thailand.

Blaikie, N and Priest, J. (2017). *Social Research: Paradigms in Action*. Polity Press

Blankenship, J, Bussa, M and Millett, S. (2011). *Pro Agile Net Development with Scrum*. Springer

Blaikie, N. (2007). *Approaches to Social Enquiry: Advancing Knowledge*. Polity Press.

Blayse, A. M., and K. Manley. (2004). Key Influences on Construction Innovation. *Construction Innovation*, 4 (3). DOI:10.1191/1471417504ci073oa

Blind, K. (2012). The Impact of Regulation on Innovation. *Nesta Working* 12(2).

Blitz, J, Edwards, J, Mash, B and Mowle, S. (2016): Training the trainers: beyond providing a well-received course, *Education for Primary Care*, DOI: 10.1080/14739879.2016.1220237

Boehm, B. (2004). Balancing Agility and Discipline: A Guide for the Perplexed. In: Ramamoorthy, C.V., Lee, R., Lee, K.W. (eds) Software Engineering Research and Applications. SERA 2003. Lecture Notes in Computer Science, vol 3026. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-540-24675-6_1

Boehm, B. (2012). *Get Ready for Agile Methods, with Care*. University of Southern California Centre for Software Engineering.

Boehm, B. W. (1988). A Spiral Model of Software Development and Enhancement. *IEEE Computer*, pp. 61-72.

Boerman, M. P, Lubsen, Z, Tamburri, D. A. and Visser, J. (2015). Measuring and Monitoring Agile Development Status.

Boes, A, Kämpf, T, Langes B and Lühr T. (2014). Informatisierung und neue Entwicklungstendenzen von Arbeit. *Arbeits- und Industriesoziologische Studien*, 7(1).

Bogdan, R. C and Biklin S. K., 1998. *Qualitative Research for Education: An Introduction to Theory and Methods.* 3rd ed. Boston: Allyn and Bacon

Bohari, A. A. M, Bidin, Z. A, Rais, S. L. A and Saferi, M. M. (2019). Exploratory Research as the way forward towards a green procurement practices for the construction industry; Research Methodology. *IOP Conference Series: Earth and Environmental Science*. 385(1). DOI:10.1088/1755-1315/385/1/012054

Bolpagni, M. (2013). The implementation of BIM within the public procurement: A model-based approach for the construction industry.

Boothman, C and Craig, N. (2016). *Five Star Status in the UK House Building Sector: A Realistic Indication of Customer Satisfaction or Pure Fantasy?* In: P W Chan and C J Neilson (Eds.) Proceedings of the 32nd Annual ARCOM Conference, 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management. Vol 2,

Bosch-Rekveldt, M, Jongkind, Y, Mooi, H, Bakker, H and Verbraeck, A. (2011). Grasping Project Complexity in Large Engineering Projects: The TOE (Technical, Organizational and Environmental) Framework. *International Journal of Project Management,* 29(6). DOI:10.1016/j.ijproman.2010.07.008

Bossink, B. A. G. (2004). Managing Drivers of Innovation in Construction Networks. *Journal of Construction Engineering and Management.* 130(3). DOI:10.1061/(ASCE)0733-9364(2004)130:3(337)

Boucaud, A. A. (2017). *A Correlational Study Examining the Relationship Between Restorative Practices and School Climate in Selected Elementary Schools in a Large Mid-Atlantic Urban School District.* Concordia University, St. Paul. Retrieved from https://digitalcommons.csp.edu/cup_commons_grad_edd/127 Bourdieu, P. (1990). *In other words: Essays towards a reflexive sociology*. U.S.A: Stanford University Press.

Bourdieu, P. (2017). *Habitus. In Habitus: A sense of place*. 2nd ed. Routledge.

Bourke, P. (2018). *What next? How Brexit may impact the UK aviation industry.* Retrieved from: https://apex.aero/

Bourn, J. (2001). *Modernising Construction (HC87 Session 2000-2001).* London: National Audit Office.

Bourne, M, Neely, A, Mills, J and Platts, K. (2003a). Implementing performance measurement systems: a literature review. *International Journal of Business Performance Management,* 5(5). DOI:10.1504/IJBPM.2003.002097

Bowen, G. A., 2017. Document Analysis as a Qualitative Research Method. *Qualitative Research Journal,* 9(2):27-40. DOI:10.3316/QRJ0902027

Boyd, D., and Bentley, D. (2012). A critique of conceptions of design and management in construction projects. *Construction Management and Economics,* 30(6), 441-454. DOI:10.1080/01446193.2012.688136

Bradbury, H. (2015). *The SAGE Handbook of Action Research*. Sage

Bradford, S. and Cullen, F. (eds). 2012. *Research and Research Methods for Youth Practitioners,* London: Routledge.

Braun, V and Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology,* 3(2). DOI:10.1191/1478088706qp063oa

Bredillet, C, N., 2013. *Agile Project Management: Essentials from the Project Management Journal*. John Wiley & Sons, Incorporated, Hoboken

Brents, R. (2021). *The Parable of The Flow and Agile*. Retrieved from LinkedIn: https://www.linkedin.com/

Bresnen, M. J, Bryman, A, Beardsworth, A, Ford, J and Keil, E. (1986). Leader Orientation of Construction Site Managers. *Journal of Construction Engineering and Management*, 118(3). DOI:10.1061/(ASCE)0733-9364(1986)112:3(370)

Brinkkemper, S. (1996). Method engineering: Engineering of information systems development methods and tools. *Information and Software Technology*, 38(4). DOI:10.1016/0950-5849(95)01059-9.

Brong, G.R. (2020). *Great Big Agile: An OS for Agile Leaders*. American Society for Quality, Milwaukee.

Brown, A. D. and Phua, F. T. T. (2011). Subjectively construed identities and discourse: towards a research agenda for construction management. *Construction Management and Economics*, 29(1). doi.org/10.1080/01446193.2010.531028

Brownlee, D. (2019). *4 Project Management Trends on The Horizon…Are You Ready?* Forbes

Bruchansky, C, Robertson, B, Rosile, G. A, Dondé, G, Dekoszmovszky, J, Schneider, N and Samuels, S. (2020). *Leadership Beyond Hierarchy*. ResearchGate.

Brümmer, R and Szogas, C. (2006). *Employability: Selbstverantwortung fordern Schlüsselkompetenzen fördern Eine ganzheitliche Sicht*. In Employability management (pp. 149-164). Wiesbaden: Gabler.

Brunero, S. J., Jeon, Y. H., and Foster, K. (2015). The Journey of Positioning Self as Both Mental Health Nurse and Qualitative Researcher: A Critical Reflection. *Journal of psychiatric and mental health nursing,* 22(7). DOI:10.1111/jpm.12238

Bryant, A and Charmaz, K. (2007). *The SAGE Handbook of Grounded Theory*. London: Sage.

Bryman A and Bell, E. (2015). *Business Research Methods*. 4th edition, Oxford University Press.

Bryman, A and Bell, E. (2007). *Business Research Methods* (2nd ed.). New York: Oxford University Press.

Bryman, A. (2008). *Social research Methods*, 4th edition, Oxford, Oxford University Press.

Bryman, A. (2012). *Social Research Methods,* (5th ed.). Oxford: Oxford University Press.

Bryman, A. (2017). *Quantitative and Qualitative Research: Further Reflections on their Integration.* In Mixing Methods: Qualitative and Quantitative Research Routledge.

Bryman, A., 2008. *Social Research Methods*. 3rd ed. New York: Oxford University Press.

Buckley, P. J, Pass, C. L and Prescott, K. (1988). Measures of international competitiveness: a critical survey. *Journal of Marketing Management*, 4(2). DOI:10.1080/0267257X.1988.9964068

Budacu, E. N and Pocatilu, P. (2018). Real Time Agile Metrics for Measuring Team Performance. *Informatica Economică*, 22(4).

Buehring, S. (2020). *PRINCE2® principles: Free eBook. Knowledge Train*. Retrieved from: https://www.knowledgetrain.co.uk/

Buganova, K and Simickova, J. (2020). *Increasing the Organization's Resilience Through Project Risk Management*. In: Pinto da Costa, E, Anjos, M and Przygoda, M. (2020). Book of Proceedings, Economic and Social Development. 52nd International Scientific Conference on Economic and Social Development.

Bui, T. T and Sjölenius, D. (2018). *Investigation of Enablers and Barriers for Enterprise Agility: A Study from Traditional Organizations in Sweden*. Chalmers University of Technology.

Buick, F., Blackman, D., and Johnson, S. (2018). Enabling Middle Managers as Change Agents: Why Organisational Support Needs to Change. *Australian Journal of Public Administration*, *77*(2), DOI:10.1111/1467-8500.12293

Building Britain. (2001). *The Stationery Office*. Retrieved from: https://webarchive.nationalarchives.gov.uk

Burek, P. (2008). Creating clear project requirements: differentiating "what" from "how" Paper presented at PMI® Global Congress 2008—North America, Denver, CO. Newtown Square, PA: Project Management Institute.

Burgan, S. C and Burgan, D. S. (2014). *One size does not fit all: Choosing the right project approach.* Paper presented at PMI® Global Congress 2014—North America, Phoenix, AZ. Newtown Square, PA: Project Management Institute.

Burger, R., 2017. Learn About Agile Construction Management. *The small business institute.* Retrieved from: https://www.thebalancesmb.com/

Burger, R., 2018. Agile Construction Management. *The small business institute* Retrieved from: https://www.thebalancesmb.com

Burmistrov, A, Siniavina, M and Iliashenko, O., 2018. Project Management Life Cycle Models to Improve Management in High-rise Construction. *E3S Web of Conferences.* DOI:10.1051/e3sconf/20183303005

Burnard, V and Muse, A. (2014). *Cost led Procurement Guidance: Guidance for the procurement and management of capital projects*. Cabinet Office, UK government.

Burns, R.B., 2000. *Introduction to Research Methods*. (3rd ed.) Sage, London

Burrell, G. and Morgan, G. (1979). *Sociological Paradigms and Organisational Analysis*. Pearson Education.

Busetto, L., Wick, W., and Gumbinger, C. (2020). How to use and assess qualitative research methods. *Neurological Research and practice*, *2*(1), DOI:10.1186/s42466-020-00059-z.

Bushuiev, D and Kozyr, B. (2020). Hybrid Infrastructure Project Management Methodologies. *Innovative Technologies and Scientific Solutions for Industries*, 1(11). DOI:10.30837/2522-9818.2020.11.035

Business Sweden. (2017). Construction in the UK: Regaining Confidence Brick by Brick. The Swedish Trade and Invest Council. Retrieved from: https://www.business-sweden.se

Business Wire. (2012). *Agile management tools promote successful agile projects according to survey. Business Wire*, A Berkshire Hathaway Company. Web. Retrieved from http://www.businesswire.com

Busse, J, Humm, B, Lubbert, C, Moelter, F, Reibold, A, Rewald, M, Schluter, V, Seiler, B, Tegtmeier, E and Zeh, T. (2015). Actually, What Does "Ontology" Mean? A Term Coined by Philosophy in the Light of Different Scientific Disciplines. *Journal of Computing and Information Technology*. 23(1). DOI:10.2498/cit.1002508

Byers-Heinlein, K., Bergmann, C., and Savalei, V. (2022). Six solutions for more reliable infant research. *Infant and Child Development*, *31*(5), DOI:10.1002/icd.2296.

Bygballe, L. E and Ingemansson, M. (2011). Public Policy and Industry Views on Innovation in Construction. *The IMP Journal*, 5(3).

Bygballe, L. E. (2014). The logic of innovation in construction. *Industrial Marketing Management*, 43(3). DOI:10.1016/j.indmarman.2013.12.019

Cabrera-Nguyen, P. (2010). Author Guidelines for Reporting Scale Development and Validation Results in the Journal of the Society for Social Work and Research. *Journal of the Society for Social Work and Research*, 1(2). DOI: 10.5243/jsswr.2010.8

Cabinet Office and Efficiency and Reform Group (2014). *New models of construction procurement*. https://www.gov.uk/

Calo, K. M, Estevez, E and Fillottrani, P. (2010). A Quantitative Framework for the Evaluation of Agile Methodologies. *Journal of Computer Science and Technology*, 10 (2).

Cambridge Dictionary. (2020). Meaning of "agility". https://dictionary.cambridge.org/

Cambridge Dictionary. (2020). Meaning of "new". https://dictionary.cambridge.org/

Cambridge Dictionary. (2020). Meaning of "performance". https://dictionary.cambridge.org/

Cambridge Dictionary. (2020). Meaning of "predictability". https://dictionary.cambridge.org/

Candy, P. C. (1989). Constructivism and the Study of Self-direction in Adult Learning. *Studies in the Education of Adults*, 21(2). doi.org/10.1080/02660830.1989.11730524

Canty D. 2015. *Agile for Project Managers.* New York: CRC Press

Cao, Y and Zhao, L. (2011). Intellectual Property Management Model in Enterprises: A Technology Life Cycle Perspective. *International Journal of Innovation and Technology Management*, 8(2). DOI:10.1142/S0219877011002283

Caracelli, V. J. (2006). Enhancing the Policy Process Through the Use of Ethnography and Other Study Frameworks: A Mixed-Method Strategy. *Research in the Schools*. 13(1).

Carpenter, N and Bausman, D. C. (2016). Project Delivery Method Performance for Public School Construction: Design-Bid-Build versus CM at Risk. *J. Constr. Eng. Manag.*, 142(10), pp. 1–10.

Carr, K. (2017). Agile Project Management Vs. Traditional Project Management Retrieved from: https://www.knowledgehut.com

Carrillo, P. M, Robinson, H, L, Al-Ghassani, A, M and Anumba, C. J. (2004). Knowledge Management in UK Construction: Strategies, Resources and Barriers. *Project Management Journal*, 35(1). DOI:10.1177/875697280403500105

Carrión-Garcia, A., Grisales, A., and Papic, L. (2017). Deming's Chain Reaction Revisited. *International Journal of Productivity and Quality Management*, 21(2). DOI:10.1504/IJPQM.2017.10004640

Cartlidge, D. (2017). *New Aspects of Quantity Surveying Practice*. 4th ed. Routledge, London.

Caspar, R. A, Lessler, J. T and Gordon B. (1999) *Reducing Survey Error through Research on the Cognitive and Decision Processes in Surveys*. Short course presented at the 1999 Meeting of the American Statistical Association. Research Triangle Institute.

Cavaleri, S., and Reed, F. (2008). Leading dynamically complex projects. *International Journal of Managing Projects in Business*, 1(1). DOI:10.1108/17538370810846423

CC Pace, (2011). Agile Project Management. Retrieved from: https://www.ccpace.com/

CCI - Centre for Construction Innovation. (2018). *KPI Engine*. Retrieved from: http://www.kpiengine.com/EngineHome/index.php

Cervone, H. F., 2010. Understanding Agile Project Management Methods Using Scrum. *OCLC Systems & Services*, 27(1). DOI:10.1108/10650751111106528

Ceschi, M, Sillitti, A, Succi, G and De Panfilis, S. (2005). "Project management in plan-based and agile companies," in *IEEE Software*, 22(3), doi: 10.1109/MS.2005.75.

Chalil, K. (2020). *Statistical Methods for Development Research*. Central University of South Bihar.

Champagne, A. B. (2015). Facts, Concepts, Principles, and Theories in Science, Assessment of: An Overview. In: Gunstone R. (eds) Encyclopaedia of Science Education. *Springer*

Chan, A. P, Scott, D and Chan, A. P., 2004. Factors Affecting the Success of a Construction Project. *Journal of construction engineering and management.* 130(1). DOI:10.1061/(ASCE)0733-9364(2004)130:1(153)

Chan, C.T.W. (2007). Fuzzy procurement selection model for construction projects. *Construction Management and Economics*, 25(6), pp. 611-618.

Chan, I. Y. S., Liu, A. M. M., and Fellows, R. (2014). Role of leadership in fostering an innovation climate in construction firms. *Journal of Management in Engineering*, 30(6). DOI:10.1061/(ASCE)ME.1943-5479.0000271

Chan, P. W. and Liang, V. (2012). *Ordering Identities: exploring the emergence and consequences of researcher identity*, Proceedings of the European group for organisational studies conference (EGOS), Helsinki, Finland. July, pp. 61- 73.

Chandra, S. and Kumar, K.N., 2018. Exploring factors influencing organizational adoption of augmented reality in E-commerce: an empirical analysis using the technology organization-environment model. *Journal of electronic commerce research*, 19 (3), 237–265

Chan, I. Y, Liu, A M. (2012). Antecedents of innovation climate in construction firms in Hong Kong. *International Journal of Construction Management*, 12(4):37–46

Chartered Institute of Builders, 2014. The Real Face of Construction: A Socio-Economic Analysis of The True Value of The Built Environment. Retrieved from: https://policy.ciob.org

Charvat, J., 2003. *Project Management Methodologies: Selecting, Implementing, and Supporting Methodologies and Processes for Projects*. John Wiley and Sons

Chaudhari, V and Bhangale, P. B. (2015). Effective Organizational Structure for Construction Industry: Case Study. *International Journal of Latest Technology in Engineering, Management & Applied Science - IJLTEMAS*, 4(7).

Checkland, P. B. (1981). *Systems Thinking, Systems Practice*. Wiley Online Library

Chen, H. T., 2006. *A Theory-Driven Evaluation Perspective on Mixed Methods Research*. Research in the Schools. Mid-South Educational Research Association

Chen, L., 2010. Waterfall Model. Retrieved from: solomon.ipv6.club.tw/

Cheng, M. I., Dainty, A. R., and Moore, D. R. (2006). What makes a good project manager?. *Human resource management journal*, *15*(1), 25-37. DOI:10.1111/j.1748-8583.2005.tb00138.x

Chetty, P., 2016. Importance of Research Approach in a Research. Retrieved from: https://www.projectguru.in [Accessed 26 Jun. 19]

Cheung, S. O, Suen, H. C and Cheung, K, K. (2004). PPMS: a web-based construction project performance monitoring system. *Automation in construction* 13, 361-376

Chien, K.-F., Wu, Z.-H., and Huang, S.-C. (2014). Identifying and assessing critical risk factors for BIM projects: Empirical study. *Automation in Construction*, 45, 1–15. doi.org/10.1016/j.autcon.2014.04.012

Chileshe, N., and Kikwasi, G. J. (2014). Risk assessment and management practices (RAMP) within the Tanzania construction industry: Implementation barriers and advocated solutions. *International Journal of Construction Management*, 14(4). DOI:10.1080/15623599.2014.967927

Chilisa, B. and Kawulich, B. (2012). Selecting a research approach: Paradigm, methodology and methods. In book: Doing Social Research: A global context (pp.51-61). Chapter: Selecting a research approach: Paradigm, methodology and methods. McGraw Hill. Editors: C. Wagner, B. Kawulich, M. Garner

Chin, C. M and Spowage, A. C. (2012). Project Management Methodologies: A Comparative Analysis. *Journal for the Advancement of Performance Information and Value*, 4(1). DOI:10.37265/japiv.v4i1.102

Chin, G., 2004. Agile Project Management. How to Succeed in the Face of Changing Project Requirements. American Management Association. Retrieved from: https://books.google.co.uk/books?

Chinda, T. (2016). Investigation of factors affecting a construction waste recycling decision. *Civ. Eng. Environ. Syst*. 33(3). DOI:10.1080/10286608.2016.1161030

Chinyio, A. (2020). *Improving Client Satisfaction in Construction Projects: the case of Saudi Arabia*. Retrieved from: https://wlv.openrepository.com

Chitkara, K. K., 1998. *Construction Project Management*. Tata McGraw-Hill

Cho, J. (2009). A Hybrid Software Development Method for Large-scale Projects: Rational Unified Process with Scrum. *Issues in Information Systems*, 10(2). DOI:10.48009/2_iis_2009_340-348

Cho, J. (2018). Architecture, Engineering, and Construction Interdisciplinary Senior Interdisciplinary Project Educational Model. *American Society for Engineering Education.* DOI:10.18260/1-2--29814

Choi, Y and Yu, Y. (2014). The influence of perceived corporate sustainability practices on employees and organizational performance. *Sustainability*, 6(1). DOI:10.3390/su6010348.

Choudhry, R. M., Aslam, M. A., Hinze, J. W., & Arain, F. M. (2014). Cost and schedule risk analysis of bridge construction in Pakistan: Establishing risk guidelines. *Journal of Construction Engineering and Management*, 140(7). DOI:10.1061/(ASCE)CO.1943-7862.0000857

Chow, T and Cao, D. B., 2008. A survey Study of Critical Success Factors in Agile Software Projects. *Journal of Systems and Software*, 81(6). DOI:10.1016/j.jss.2007.08.020

Christopher, M., 2000. ‘The Agile Supply Chain in Volatile Markets. *Journal of Industrial Marketing Management*, 29(1). doi.org/10.1016/S0019-8501(99)00110-8

Chua, A. Y. K., 2009. Exhuming IT Projects from Their Graves: An Analysis of Eight Failure Cases and Their Risk Factors. *Journal of Computer Information Systems*. 49(3).

Cicmil, S and Hodgson, D. (2006). New possibilities for project management theory: A critical engagement. *Project Management Journal*, 37(3). DOI:10.1177/875697280603700311

Cicmil, S, Cooke–Davies, T, Crawford, L and Richardson, K. (2009). *Exploring the complexity of projects: Implications of Complexity Theory for project management practice*. Newtown Square, PE: Project Management Institute.

Cicmil, S., Williams, T., Thomas, J and Hodgson, D., 2006. Rethinking Project Management: Researching the Actuality of Projects. *International Journal of Project Management*, 28(4). doi.org/10.1016/j.ijproman.2006.08.006

CII - Construction Industry Institute. (2018). *10-10 Metrics*. Retrieved from: http://www.construction-institute.org.

CIOB. (2007). Innovation in Construction: Ideas are the currency of the future. Retrieved from: https://policy.ciob.org/

CIOB. (2007). Leadership in the construction industry. Retrieved from: https://www.ciob.org/

CIOB. (2014). *Code of Practice for Project Management for Construction and Development*, 5th ed. Wiley Blackwell.

CIOB. (2014). *The Real Face of Construction: A Socio-Economic Analysis of The True Value of The Built Environment*. Retrieved from: https://policy.ciob.org

CIOB. (2016). *Productivity in Construction: Creating a Framework for the Industry to Thrive.* Retrieved from: https://policy.ciob.org/

CIOB. (2020). *The Real Face of Construction 2020*. Retrieved from: https://policy.ciob.org/

Ciric, D., Lalic, B., Gracanin, D., Palcic, I., and Zivlak, N. (2018). Agile Project Management in New Product Development and Innovation Processes: Challenges and Benefits Beyond Software Domain. In *2018 IEE International Symposium on Innovation and Entrepreneurship (Tems-Isie) (Pp. 1–9).*

CITB. (2018). *Building Engagement: Encouraging Leadership in Construction.* Retrieved from: http://centaur.reading.ac.uk/

CITB. (2020). *2020 Vision – The Future of UK Construction.* Retrieved from: https://www.citb.co.uk/

Cockburn, A. (2000). Selecting a Project's Methodology. *Humans and Technology Technical Report.*

Cockburn, A. and Highsmith, J. (2001). Agile Software Development 2: The People Factor. *IEEE Computer*.

Cockburn, A., 2002. *Agile Software Development*. Retrieved from: https://dl.acm.org

Codreanu, A. (2016). A VUCA Action Framework for a VUCA Environment. Leadership Challenges and Solutions. *Journal of Defence Resource Management*, 7(2).

Coghlan, D., 2019. *Doing Action Research in Your Own Organization*. SAGE

Cohen, D, Lindvall, M and Costa, P., 2004. *An Introduction to Agile Methods*. Advances in Computers, 62, 1-66. https://doi.org/10.1016/S0065-2458(03)62001-2

Cohen, L and Manion, L., 2007. *Research Methods in Education*. (6th ed.) London: Routledge

Cohen, L, and Manion, L., 1994. *Research Methods in Education*. (4th ed.) London: Routledge

Cohen, W. M, Goto, A., Nagata, A., Nelson, R.R. and Walsh, J.P. (2002). R&D spillovers, patents and the incentives to innovate in Japan and the United States. *Research Policy*, 31(8–9). DOI:10.1016/S0048-7333(02)00068-9

Cohn M. 2005. *Agile Estimating and Planning*. Upper Saddle River, NJ, USA: Prentice Hall.

Cohn, M. (2011), *Succeeding with Agile: Software Development Using Scrum*. Addison-Wesley, Upper Saddle River, NJ.

Cohn, M., 2015. Product Backlog Refinement (Grooming). Retrieved from: https://www.mountaingoatsoftware.com

Collyer, S, Warren, C, Hemsley, B and Stevens, C. (2010). Aim, fire, aim – Project planning styles in dynamic environments. *Project Management Journal*, 41(4), DOI:10.1002/pmj.20199

Collyer, S., 2009. Project Management Approaches for Dynamic Environments. *International Journal of Project Management*. DOI:10.1016/j.ijproman.2008.04.004

Colomo-Palacios, R., Casado-Lumbreras, C., Soto-Acosta, P., Garcıa-Penalvo, F.J. and Tovar-Caro, E. (2014). Project managers in global software development teams: a study of the effects on productivity and performance", *Software Quality Journal*, 22(1), pp. 3-19.

Columbia University. (2022). Content Analysis. Columbia University Mailman School of Public Health, *Population Health Methods*.

Conboy, A. (2009). Title agility from first principles: Reconstructing the Concept of agility in information systems development. *Information Systems Research*,20, 329–354.https://doi.org/10.1287/isre.1090.0236

Conforto, E. C and Amaral, D. C. (2016). Agile project management and stage-gate model-A hybrid framework for technology-based companies: *Journal of Engineering and Technology Management*, 40(1). DOI:10.1016/J.JENGTECMAN.2016.02.003

Conforto, E. C, Amaral, D. C, da Silva, S. L, di Felippo, A and Kamikawachi, D. S. L. (2016). The Agility Construct on Project Management Theory. *International Journal of Project Management.* 34(4). DOI:10.1016/j.ijproman.2016.01.007

Conforto, E. C., Salum, F., Amaral, D. C., da Silva, S. L., & de Almeida, L. F. M. (2014). Can Agile Project Management be Adopted by Industries Other than Software Development? Project Management Journal, 45(3), 21–34. https://doi.org/10.1002/pmj.21410

Connaughton J and Collinge W (2018) Delivering More for Less under the IPI Model – Trialling IPI on a Live Construction Project: Learning from Advance II at Dudley College. University of Reading, Reading, UK.

Construction Excellence. (2020). *Construction innovation: does it matter*? Retrieved from: https://constructingexcellence.org.uk/

Construction Excellence. (2020). *Our Ambition for UK Construction*. Retrieved from : https://www.constructingexcellencesw.org.uk/

Construction Industry Institute. (2022). *Project Controls*. Retrieved from: https://www.construction/

Construction Excellence. (2020). Construction Industry KPIs –UK Industry Performance Report. Retrieved from: https://constructingexcellence.org.uk/

Construction Industry: Statistics and Policy, 2018. By Rhodes, C. House of Commons Library. Retrieved from: https://www.parliament.uk/commons-library

Construction Leadership Council. (2019). *Industry Skills Plan for the UK Construction Sector 2021 – 2025*. https://www.constructionleadershipcouncil.co.uk/

Construction News. (1996). How Latham fell into the Banwell trap. Retrieved from: https://www.constructionnews.co.uk/

Construction News. (2022). Nine out of 10 large projects ‘behind schedule’. https://www.constructionnews.co.uk/

Construction Planet News, (2018). *How Much Did Delays Cost Construction in 2017?* Retrieved from: https://cpnonline.co.uk/

Construction Product Association. (2021). *Double-digit Growth Forecast for Construction in 2021, but with Major Supply and Demand Risks Ahead*. Retrieved from: https://www.constructionproducts.org.uk/

Contasfor, Egan, J and Williams, D. (2015). [Summary of] "Rethinking Construction"" - The Report of The Construction Task Force. Ice Briefing Sheet. *Proceedings of the Institution of Civil Engineers - Municipal Engineer*. 127(4).

Conțu. (2020). *Organizational performance – theoretical and practical approaches; study on students' perceptions.* Proceedings of the 14th International Conference on Business Excellence2020. DOI: 10.2478/picbe-2020-0038, pp. 398-406.

Cook, T and Campbell, D., 1979. Q*uasi-Experimentation: Design and Analysis Issues for Field Settings*. Houghton Mifflin: Boston.

Cooke J. 2012. *Everything you want to know about Agile: how to get Agile results in a less-than-Agile organization*. Ely, Cambridgeshire: IT Governance Ltd.

Coon, J. J., van Riper, C. J., Morton, L. W., & Miller, J. R. (2020). Evaluating nonresponse bias in survey research conducted in the rural Midwest. *Society & Natural Resources*, *33*(8), 968-986.

Cooper, R, Kagioglou, M, Aouad, G, Hinks, J, Sexton, M and Sheath, D., 1998. *The Development of a Generic Design and Construction Process*. University of Salford.

Cooper, R. G and Sommer, A. F. (2016). From Experience: The Agile–Stage-Gate Hybrid Model: A Promising New Approach and a New Research Opportunity. *Journal of Production and Innovation management*, 33(5).

Cooper, R. G. (2016). Agile–Stage-Gate Hybrids: The Next Stage for Product Development. *Research-technology Management.* 59(1), 21–29. Crossref.

Correia, F and Abreu, A., 2017. An Overview of Critical Chain applied to Project Management. ISEL, Polytechnic Institute of Lisbon. Research Gate.

Corry, E, Pauwels, P, Hu, S, Keane, M and O'Donnell, J. (2015). A Performance Assessment Ontology for the Environmental and Energy Management of Buildings. *Automation in Construction*, 57(2015).

Costa J M, Horta I, Guimarães N, Nóvoa M H and Cunha J F 2007. icBench – A benchmarking tool for Portuguese construction industry companies. *Int. J. for Housing Science*, 31 33-41.

Costa, D., Formoso, C., Kagioglou, M. and Alarcón, L. (2004) *'Performance measurement systems for benchmarking in the construction industry'*, Proceedings for IGLC-12, Copenhagen, Denmark.

Cottrell, W. D.,1999. Simplified Program Evaluation and Review Technique (PERT). *Journal of Construction Engineering & Management*, 125(1), p. 16

Courpasson, D., and Valles, S. (2016). *Resistance studies: A critical introduction*. In D. Courpasson & S. Valles (Eds.), Sage handbook of resistance (pp. 1–28). London, England: Sage Publications.

Courpasson, D., Dany, F., and Clegg, S. R. (2012). Resisters at work: Generating productive resistance in the workplace. *Organization Sciences*, 23(3), 801–819.

Coventry University. (2021). *Common paradigms in Research*. Retrieved from: https://www.futurelearn.com/

Cox, A. (1996) Relational competence and strategic procurement management. *European Journal of Purchasing and Supply Management*, 2(1), 57–70.

Cox, A. and Townsend, I., 1998. *Strategic Procurement in Construction*. Redwood Books.

Cox, R. F, Issa, R. R and Ahrens, D. (2003). Management's Perception of Key Performance Indicators for Construction. *Journal of Construction Engineering and Management*, 129(2). pp. 142–151.

Crawford, L. M. (2020). *Conceptual and Theoretical Frameworks in Research. In: Foundations in Research Design*. Sage

Creswell, J. W and Clark, V. L. P. (2011). *Designing and Conducting Mixed Methods Research.* Sage

Creswell, J. W. (2012). *Educational research: planning, conducting, and evaluating quantitative and qualitative research*. 4th edition, Boston: Pearson.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage publications.

Creswell, J. W. and Creswell, J. D., 2012. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. London: SAGE

Creswell, J. W., 1998. *Qualitative Inquiry and Research Design: Choosing Among Five Traditions.* Thousand Oaks, CA: Sage.

Creswell, J. W., 2003. *Research Design: Qualitative, Quantitative and Mixed Methods Approaches.* London: Sage. 2nd ed. Thousand Oaks: Sage

Creswell, J. W., 2009. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE.

Creswell, J.W and Poth, C. N., 2017. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches.* London: Sage

Crispin, L and House, T., 2003. *Testing Extreme Programming*. Retrieved from: https://books.google.co.uk

Cristóbal, J. R, Diaz, E, Carral, L, Fraguela, J. A, and Iglesias, G. (2019). Complexity and Project Management: Challenges, Opportunities, and Future Research. *Hindawi Complexity Journals*. 2019.

Crotty, M. (2003). *The Foundations of Social Research: Meaning and Perspective in the Research Process.* Thousand Oaks, CA: Sage.

Crotty, M., 1989. *The Foundations of Social Research*. London: Sage

Crotty, M., 1998. *The Foundations of Social Research. London: Meaning and perspective in the research process.* London: Sage.

Crotty, R. (2012). *The Impact of Building Information Modelling: Transforming Construction*, SPON Press, Oxon.

Crowe, A. (2012). *The PMI-ACP exam: How to pass on your first try.* Kennesaw, GA:Velociteach.

Crowley, A. (1998). Construction as a manufacturing process: Lessons from the automotive industry. Computers and Structures, 14(5), pp. 389-400.

Cruz, A. and Alves, A. C. (2022). Traditional, Agile and Lean Project Management - A Systematic Literature Review. *The Journal of Modern Project Management, 8*(2). https://doi.org/10.19255/JMPM02407

Cugola, G and Ghezzi, C. (1998). Software Processes: A Retrospective and a Path to the Future. *Software Process Improvement and Practice*, vol. 4, pp. 101123, 1998.

Currall, S. C, Towler, A. J. (2003). *Research Methods in Management and Organizational Research: Toward Integration of Qualitative and Quantitative Techniques. In: Tashakkori, A and Teddlie, C, (eds.) Handbook of Mixed Methods in Social & Behavioural Research. (pp. 513-526).* Sage Publications.

Curtis, E. A., Comiskey, C., & Dempsey, O. (2016). Importance and use of correlational research. *Nurse researcher*, 23(6).

Dalcher, D. (2014a). Who needs project requirements? *PM World Journal*, 3(4).

Dalcher, D. (2015). For whose benefit? Reclaiming the role of users in projects. *PM World Journal*, 4(1).

Dalton J. (2019) *Using the Agile Performance Holarchy. In: Great Big Agile*. Apress, Berkeley, CA.

Dalton, J. (2018). *Great Big Agile: An OS for Agile Leaders*. Apress, Berkeley, CA.

Damawan, A. H and Azizah, S. (2019). Resistance to Change: Causes and Strategies as an Organizational Challenge. 5th ASEAN Conference on Psychology, Counselling, and Humanities (ACPCH 2019). *Advances in Social Science, Education and Humanities Research*, volume 395.

Dammak, A., 2015. Research Paradigms: Methodologies and Compatible Methods. *Semantic Scholar*.

Daneshgari P. 2010. *Agile Construction for the Electrical Contractor*. LLC. Sudbury, MA: Jones and Bartlett Publishers.

Daniel, J. F and John, D. F. (2008). Agile Project Management - Agilism versus Traditional Approaches. *Journal of Computer Information Systems, 49:2, 10-17.*

Darko, A, Chan A. P. C, Ameyaw, E. E, He, B. J and Olanipekun, A. O. (2017). Examining issues influencing green building technologies adoption: The United States green building experts' perspectives. *Energy and Building*. 144(320-332).

Darshan, E., Arun Kumar, C.J., Rajeeva S.J., and Narayana G. (2017). Analysis of risk management in residential building using Primavera Web Software.

International Journal of Advance Research and Innovative Ideas in Education, 3(4).

Davidson, C. (2013). Innovation in Construction – Before the Curtain Goes Up. *Construction Innovation*, 13(4).

Davis, B and Radford, D., 2014. *Going beyond the Waterfall: Managing Scope Effectively Across the Project Lifecycle*. J. Ross Publishing, Plantation. Available from: ProQuest eBook Central

Davis, D. (2020). *Presenting Research Reflexivity in your PhD Thesis*. University of Salford.

Davis, S and Albright, T. (2004). An Investigation of the Effect of Balanced Scorecard Implementation on Financial Performance. *Management Accounting Research*, 15(2). pp. 135–153.

Davis, W. H. (2015). *Agile Metrics in Action: How to Measure and Improve Team Performance*. Manning Publications.

Dawood, N, Sikka, S, Marasini, R and Dean, J (2006). Development of key performance indicators to establish the benefits of 4D planning. In: Boyd, D (Ed) Proceedings 22nd Annual ARCOM Conference, 4-6 September 2006, Birmingham, UK, Association of Researchers in Construction Management, 709-718.

de Best, R. (2021). Construction industry in the UK - statistics & facts. *Statista*

de Borba, J. C. R., Trabasso, L. G., and Pessoa, M. V. P. (2019). Agile management in product development. *Research-Technology Management* 62(5): 63–67. Crossref.

De Grip, A. (2015). The importance of informal learning at work. IZA World of Labour 2015: 162. doi: 10.15185/izawol.162

de Melo, R.S.S, Do, D, Tillmann, P, Ballard, G. and Granja, A.D. (2016). Target value design in the public sector: evidence from a hospital project in San Francisco, CA. *Architectural Engineering and Design Management*, 12(2).

De Vaus, D. A., 2006. *Research Design in Social Research*. London: SAGE

De Valence, G. (2010). Innovation, procurement and construction industry development. *Australas J Constr Econ Build*. 10(4):50–59

Debbie, 2017. The 4 Most Popular Project Management Methodologies In The Building And Construction Industry. Retrieved from: http://pickensconstruction.com

DeCarlo, D. (2004). *eXtreme Project Management*. San Francisco: Jossey–Bass

Delputte, S., 2013. The EU as an Emerging Coordinator in Development Cooperation: Perspectives from Sub-Saharan Africa. *Afrika focus — Volume 26, Nr. 1, 2013 — pp. 99-107*

Demeke, B and Tao, C. (2020). Concept & Perspectives of Organizational Performance Measurement: Literature Review. *International Journal of Academic Multidisciplinary Research (IJAMR),* 4(8).

Demir, S. T and Theis, P. (2016). *Agile Design Management - The Application of Scrum in the Design Phase of Construction Projects*. In 24th Annual Conference of the International Group for Lean Construction, Boston, USA (pp. 13–22).

Demir, S. T. (2013). AgiLean PM – *A Unifying Strategic Framework to Manage Construction Projects.* Liverpool John Moores University

Demirkesen, S. and Ozorhon, B. (2017). Impact of integration management on construction project management performance. *International Journal of Project Management*, 35(8).

Demski, J. (2022). *A Complete Guide to Agile Construction Project Management*. Quickbase

Denhardt, R., Denhard, J., Aristigueta, M. (2009). *Managing Human Behavior in Public and Nonprofit Organizations*. Sage Publications, Inc., Thousand Oaks, CA.

Dennerlein, J. (2013). *Advancing worker health, safety, and well-being*. Harvard's Centre for Work, Health and Well–being. Retrieved from: https://centerforworkhealth.sph.harvard.edu/

Denscombe, M. (2008). Communities of Practice A Research Paradigm for the Mixed Methods Approach. *Journal of Mixed Methods Research Volume 2 Number 3.*

Depaire, B. (2019). *Traditional Project Management.* Bookdown

Department for Business Innovation and Skills. (2013). UK Construction: An Economic Analysis of the Sector Retrieved from: https://assets.publishing.service.gov.uk

Department for Business Innovation and Skills. (2013). Supply Chain Analysis into the Construction Industry. A Report for the Construction Industrial Strategy. Retrieved from: https://assets.publishing.service.gov.uk/

Department of Economic and Social Affairs. (2008). International Standard Industrial Classification of All Economic Activities. Revision 4 Retrieved from: https://unstats.un.org

Design Build Institution of America (DBIA), (2015). *Choosing a Project Delivery Method: A Design-Build Done Right Primer.* A Design-Build Institute of America Publication.

Devi, T. R and Reddy, V. S. (2012). Work Breakdown Structure of the Project. *International Journal of Engineering Research and Applications* ((IJERA)

Dew Jr, J.K. and Foreman, M.W. (2020). *How do we know? An introduction to epistemology*. InterVarsity Press.

Dewey, J. (1931). *The development of American Pragmatism*, Included in Dewey J (1931) Philosophy and civilization, Minton, Balch & Co, New York.

Dewey, J. (2010). *The School and Society and The Child and The Curriculum*. Chicago, IL: University of Chicago Press

Dhir, S., Kumar, D. and Singh, V.B. (2019). Success and failure factors that impact on project implementation using agile software development methodology. In Hoda, M., Chauhan, N., Quadri, S. and Srivastava, P. (Eds). *Software Engineering. Advances in Intelligent Systems and Computing*, Springer, Singapore, Vol. 731

Dhoke, A., 2013. The Structure of PRINCE2 Method. Retrieved from: https://www.slideshare.net/projectingit/prince2-structure-16416412

Dickinson, M., R. Cooper, P. McDermott, and D. Eaton. 2005. “An analysis of construction innovation literature.” In Proc., 5th Int. Postgraduate Research Conf. Salford, UK.

Dillman, D. A., J. D. Smyth, and L. M. Christian. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method*. Hoboken, New Jersey: John Wiley & Sons

Dillman, D. A. (2007). *Mail and Internet Surveys - the Tailored Design Method*. New York: Wiley

Ding, J, Wang, N and Hu, L. (2018). Framework for Designing Project Delivery and Contract Strategy in Chinese Construction Industry based on Value Added Analysis. *Adv. Civ. Eng*., pp. 1–14.

Dingsøyr, T., Nerur, S., Balijepally, V. and Moe, N. B. (2012). A Decade of Agile Methodologies: Towards Explaining Agile Software Development. *Journal of Systems and Software*, 85(6), 60–71.https://doi.org/10.1002/joe.21656

Dinnen, J., 2014. Clearly Define Your Research Strategy. *MacKenzie Corporation* Retrieved from: https://www.mackenziecorp.com

Disterer, G., 2002. Management of Project Management and Experiences. *Journal of Knowledge Management Vol. 6(5), pp. 512-520*]

DIUS (2008). *Innovation Nation*. Department for Innovation, Universities & Skills, London.

Dixit, S, Mandal, S. N, Thanikal, J. V and Saurabh, K. (2019). Evolution of Studies in Construction Productivity: A Systematic Literature Review (2006–2017). *Ain Shams Engineering Journal*. 10(2019).

Dodgson, J. E. (2019). Reflexivity in Qualitative Research. *Journal of Human Lactation*, 35(2).

Domínguez, E, Pérez, B, Rubio, L, A and Zapata, M, A. (2019). A taxonomy for key performance indicators management. *Computer Standards & Interfaces* 6(2019), 24-40.

Donaldson, J and Franck, K. L. (2016). *Needs Assessment Guidebook for Extension Professionals*. University of Tennessee Institute of Agriculture.

Dromey, J, Morris, M and Murphy, L., 2017. Building Britain's Future? The Construction Workforce After Brexit. *Institute for Public Policy Research*

Drucker, P. F. (2007). *Management: Tasks, Responsibilities, Practices*. Abingdon, Oxon: Butterworth-Heinemann.

Drury-Grogan, M. L. (2014). Performance on Agile Teams: Relating Iteration Objectives and Critical Decisions to Project Management Success Factors. *Information and Software Technology*, 56(5).

DTI (2007). *Innovation in Services.* Department of Trade and Industry, London.

Dubey, R., Gunasekaran, A., Bryde, D. J., Dwivedi, Y. K., and Papadopoulos, T. (2020). Blockchain technology for enhancing swift-trust, collaboration and resilience within a humanitarian supply chain setting. *International journal of Production research, 58*(11), 3381-3398.

Dubois, A and Gadde, L. E. (2000). Supply strategy and network effects—purchasing behaviour in the construction industry. *European Journal of Purchasing & Supply Management*, 6(3), 207-215.

Dubois, A and Gadde, L. E. (2002). The construction industry as a loosely coupled system: implications for productivity and innovation. *Construction Management and Economics*, 20(7), pp. 621-631.

Dudovskiy, J., 2018. The Ultimate Guide to Writing a Dissertation in Business Studies. A Step-by-Step Assistance. Retrieved from: https://researchmethodology.net

Dulaimi M F., Nepal M P., & Park M. (2005) A hierarchical structural model of assessing innovation and project performance. *Construction Management and Economics.* 23(6)

Dulaimi, M, Khalfan, M. M. Mcdermott, P. (2006). Innovating for supply chain integration within construction. *Constr Innov*. 6(3):143–157

Dunbar, R. L. M., Garud, R., & Raghuram, S. (1996). A frame for deframing in strategic analysis. *Journal of Management Inquiry*, 5(1), 23–34.

Duncan, H. (2015). *Osborne's Huge Ambitions*. Daily Mail. Retrieved from: https://www.pressreader.com/

Duncan, W. R. (1996). *A Guide to the Project Management Body of Knowledge*. Project Management Institute.

Dunne, D.D. and Dougherty, D. (2016). Abductive reasoning: How innovators navigate in the labyrinth of complex product innovation. *Organization Studies*, *37*(2), pp.131-159.

Dunne, R. (2021). Public VS Private Sector Employment: 6 Advantages of Working on Both Sides. Retrieved from: https://www.adriasolutions.co.uk/

Durdyev, S., Ihtiyar, A., Banaitis, A. & Thurnell, D. (2018). The construction client satisfaction model: a PLS-SEM approach. *Journal of Civil Engineering and Management*, 24(1).

Dykstra, A., 2011. *Construction Project Management: A Complete Introduction*. Kirshner Publishing.

Easterby-Smith, M. P. V., Thorpe, R. and Jackson, P. (2008). *Management Research: Theory and Research*. 3rd ed. London: Sage.

Eastman, C., Teicholz, P., Sacks, R., & Liston, K. (2011). BIM Handbook: *A Guide To Building Information Modelling For Owners, Managers, Designers, Engineers, And Contractors Second Edition.* New Jersey: John Wiley & Sons, Inc.

Ebiloma, D and Rimtip, M. N. (2019). Factors Affecting the Success or Failure of Project Management Methodologies (PMM) Usage in the UK and Nigerian Construction Industry. *International Journal of Innovation and Sustainability*, *3*, 17-28.

Eby, K., 2018. Demystifying the 5 Phases of Project Management. Smart Sheet Retrieved from: https://www.smartsheet.com

Eccles, R. G, Ioannou, I, Serafeim, G. (2014). The impact of corporate sustainability on organizational processes and performance. *Manag. Sci*. 60, 2835–2857.

Eddles-Hirsch, K., 2015. Phenomenology and Educational Research. *International Journal of Advanced Research*

Edeki, C. (2015). Agile Software Development Methodology. *European Journal of Mathematics and Computer Science*, 2(1)

Edmonds, J. (2010). How training in project management can help businesses to get back on track. *Industrial and commercial training*, 42(6).

Edwards, D. J, Parn, E, Love, P. E. and El-Gohary, H. (2017). Research note: machinery, manumission, and economic machinations. *Journal of Business Research*, 70, pp. 391-394.

Edwards, D.J, Parn, E. A, Sing, C. P and Thwala, W. D. (2019). Risk of Excavators Overturning: Determining Horizontal Centrifugal Force when slewing freely suspended loads. *Engineering Construction and Architectural Management,* 26(3), pp. 479-498

Edwards, D. (2018). *The metaphysics of truth*. Oxford University Press.

Egan, J. (1998). *Rethinking Construction*. London: Department of Trade and Industry.

Egan, J. (2002). *Accelerating Change, Strategic Forum for Construction*, London.

Ehlers, K. (2011). *Agile Software Development as Managed Sensemaking*. Stellenbosch University

Ejiwale, J. (2019). Minimizing skills and training gaps through professional development course. *Journal of Education and Learning (EduLearn),* 13(3).

Eklund, U, Olsson, H. H and Strøm, N. J. (2014). *Industrial Challenges of Scaling Agile in Mass-Produced Embedded Systems*. In: Dingsøyr T., Moe N.B., Tonelli R., Counsell S., Gencel C., Petersen K. (eds) Agile Methods. Large-Scale Development, Refactoring, Testing, and Estimation. XP 2014. Lecture Notes in Business Information Processing, vol 199. Springer, Cham. https://doi.org/10.1007/978-3-319-14358-3_4

El Asmar, M, Hanna, A. S. and Loh, W. (2013). Quantifying Performance for the Integrated Project Delivery System as Compared to Established Delivery Systems. *J. Constr. Eng. Manag*. 139(11), pp. 1–14.

El-Diraby, T. E., and O'Connor, J. T. (2004). Lessons learned in designing research methodology in field-based construction research. *J.Profl. Issues Eng. Educ. Pract.*, 130(2), 109–114.

El Hajjar, S, T. (2018). Statistical Analysis: Internal-Consistency Reliability and Construct Validity. *International Journal of Quantitative and Qualitative Research Methods*, 6(1).

Elbeltagi, E. (2009). Lecture Notes on Construction Project Management. Retrieved from: http://osp.mans.edu.eg

Ellis, G. (2022). Design-Build Construction: A Comprehensive Guide. https://constructionblog.autodesk.com/

Emmerson H. (1962). *Survey of Problems Before the Construction Industries*, HMSO, London.

Enegbuma WI, Aliagha GU, Ali KN. 2015. Effects of perceptions on BIM adoption in Malaysian construction industry. *J Technol*. 77 (15):69–75

Engelhardt, N. (2019). Comparison of agile and traditional project management: Simulation of process models. *Acta academica karviniensia*, *19*(2), 15-27.

Engward, H and Davis, G. (2015). Being Reflexive in Qualitative Grounded Theory: Discussion and Application of a Model of Reflexivity. *Journal of advanced nursing*, 71(7).

Epstein, S. (2015). The Seven Key Characteristics of a Project. *LinkedIn*. Retrieved from: https://www.linkedin.com

Erixon, F. (2018). The Economic Benefits of Globalization for Business and Consumers. *European Centre for International Political Economy (ECIPE)*. https://ecipe.org/

Erwin, D., Garman, A., 2010. Resistance to organizational change: linking research and practice. *Leadership Org. Dev. J*. 31 (1), 39–56

Evans, C. (2012). *The Forward of the Book- Everything You Want to Know about Agile: How to Get Agile Results in a less-than-agile Organization*. IT Governance Ltd. ProQuest eBook Central

Fagerberg, J. 2004. *Innovation: A guide to the literature*. Oxford, UK: Oxford University Press.

Faichi Solutions. (2016). *Why Project Management is so Important for Business Results*? Retrieved from: https://www.faichi.com/

Faisandier, A, Roedler, G and Adcock, R. (2020). Stakeholder Needs and Requirements. Systems Engineering Body of Knowledge (SEBOK). Retrieved from: https://www.sebokwiki.org/

Fance, R., 2010. Wrapping PRINCE2® around Agile You can, but should you? *UXC Consulting*. Retrieved from: https://cs.anu.edu.au

Farmer, M. (2016). *The Farmer Review of the UK Construction Labour Model: Modernise or Die*. Construction Leadership Council (CLC).

Farmer, M. (2021). *Five years on from Modernise or Die, where are we now*? CIOB

Farooq, G and Bubshait, A. A. (2001). *Working Practices of Design Offices with Owners and Contractors in Construction Projects*. Paper presented at Project Management Institute Annual Seminars & Symposium, Nashville, TN. Newtown Square, PA: Project Management Institute

Fasaghandis, H. S and Wilkinson, S. (2019). *A Review on Leadership Styles and Innovation and their Impact on Productivity*. In Built to Thrive: Creating Buildings and Cities that Support Individual Well-Being and Community Prosperity. Proceedings of the 43rd Australasian Universities Building Education Association (Aubea) Conference.

Feigenbaum, E. (2017). Disadvantages of Critical Path Analysis. *Bizfluent*. Retrieved from: https://bizfluent.com [Accessed 02 Jan. 19]

Feilzer, M. Y. (2010). Doing Mixed Methods Research Pragmatically: Implications for the Rediscovery of Pragmatism as a Research Paradigm. *Journal of Mixed Methods Research* 4(6).

Fenton, N. (2001). Viewpoint Article: Conducting and Presenting Empirical Software Engineering. *Empirical Software Engineering*, vol. 6, pp. 195200, 2001.

Fernandes, D. J and Fernandes, J. D. (2008). Agile Project Management - Agilism versus Traditional Approaches. *Journal of Computer Information Systems*

Fernandez-Solis, F. L. (2012). Building Construction: Interdisciplinary Capstone Projects. *American Society for Engineering Education*,

Fernandopulle N. (2021). To what extent does hierarchical leadership affect health care outcomes? *Med J Islam Repub Iran*. doi: 10.47176/mjiri.35.117. PMID: 34956963; PMCID: PMC8683790.

Fernie, S; Leiringer, R and Thorpe, T. (2006). Rethinking Change in construction: a critical perspective. *Building Research and Information*

Ferrada, X., & Serpell, A. (2014). Selection of construction methods for construction projects: A knowledge problem. *Journal of Construction Engineering and Management*, *140*(4), B4014002.

Ferrada, X., Serpell, A., and Skibniewski, M. (2013). Selection of construction methods: A knowledge-based approach. *The Scientific World Journal*, *2013*.

Fertalj, K and Katiü, M. (2008). An Overview of Modern Software Development Methodologies. *Central European Conference on Information and Intelligent Systems; Varazdin*

Fewings, P. (2012). *Construction Project Management: An Integrated Approach*. Routledge, London

Fewings, P., and Henjewele, C. (2019). *Construction project management: an integrated approach*. Routledge.

Fiedler, S. (2010). Managing resistance in an organizational transformation: A case study from a mobile operator company. *International Journal of Project Management*, 28(4), 370–383.

Fiedler, S., 2010. Managing resistance in an organizational transformation: a case study from a mobile operator company. *Int. J. Proj. Manag*. 28, 370–383.

Fielden, S. L., Davidson, M. J., Gale, A. W., and Davey, C. L. (2000). Women in construction: The untapped resource. *Construction Management and Economics*, 18(1), 113–121. https://doi. org/10.1080/014461900371004s.

Finch, C. (2018). Advantages and Disadvantages of PERT. *Bizfluent.* Retrieved from: : https://bizfluent.com [Accessed 04 Mar. 19]

Fink, D. (2006). Value decomposition of e-commerce performance. Benchmarking: *An International Journal*, 13(1/2), 81-92.

Finlay, L. (2002). Negotiating the swamp: the opportunity and challenge of reflexivity in research practice. *Qualitative Research 2*(2).

Fisher, J. W. (1988). *Building for Tomorrow: Global Enterprise and the U.S. Construction Industry*. Washington D.C: National Academy Press.

Flanagan, R, Jewell, C., Ericsson, S. and Henricsson, J.P.E. (2005) *Measuring Construction Competitiveness in Selected Countries*, Final Report, School of Construction Management and Engineering, the University of Reading.

Flanagan, R, Lu, W, Shen, L and Jewell, C. (2007). Competitiveness in construction: a critical review of research. *Construction Management and Economics*, 25(9).

Fleming, P., and Spicer, A. (2003). Working at a cynical distance: Implication for power, subjectivity and resistance. Organization, 10(1), 157–179.

Flick, U. (2015). *Introducing Research Methodology: A Beginner's Guide to Doing a Research Project*. *Sage*

Flood, G. (1999). *Beyond Phenomenology: Rethinking the Study of Religion*. London: Cassell.

Flora, H.K. and Chande, S.V., 2014. A systematic study on agile software development methodologies and practices. *International Journal of Computer Science and Information Technologies*, *5*(3), pp.3626-3637.

Fondahl, J. W. (1962). *A Non-Computer Approach to the Critical Path Method for the Construction Industry*. Stanford, Calif., Dept. of Civil Engineering, Stanford University.

Forbes, L. H and Ahmed, S. M. (2011). *Modern Construction Lean Project Delivery and Integrated Practices.* Taylor and Francis Group, LLC

Ford, J., Ford, L., & D’amelio, A. (2008). Resistance to change: The rest of the story. *Academy of Management Review*, 33(2), 362–377

Fornell, C, Morgeson, F. V and Hult, T. M. (2016). Stock Returns on Customer Satisfaction Do Beat the Market: Gauging the Effect of a Marketing Intangible. *Journal of Marketing*. 80 (5)

Fornell, C, Morgeson, F. V, Hult, T. M and VanAmburg, V. (2020). *ACSI: Is Satisfaction Guaranteed?* Springer Nature Switzerland AG.

Fortune, J and Peters, G., 1990. The Formal System Paradigm for Studying Failures. *Technology Analysis and Strategic Management*

Fortune, J and White, D., 2005. Framing of Project Critical Success Factors by a Systems Model. *International Journal of Project Management*

Fortune, J and White, D., 2009. The project-specific Formal System Model. *International Journal of Managing Projects in Business*

Foulkes, A and Ruddock, L., 2007. Defining the Scope of the Construction Sector. *Proceedings of the 8th IPGR Conference*. Retrieved from: http://www.irbnet.de

Fowler, M and Highsmith, J., 2001. *The Agile Manifesto*. Retrieved from: http://users.jyu.fi/~mieijala/kandimateriaali/Agile-Manifesto.pdf

Fraser, J, Fahlman, D, Arscott, J and Guillot, I. (2018). Pilot Testing for Feasibility in a Study of Student Retention and Attrition in Online Undergraduate Programs. *International Review of Research in Open and Distributed Learning*, 19(1).

Fraser, S and Robinson, C. (2004). *Paradigms and philosophy*. In S. Fraser, V. Lewis, S. Ding, M. Kellett and C. Robinson (Eds.), Doing Research with Children and Young People. London: Sage.

Freeman C. (1989) *The economics of industrial innovation.* Cambridge, Mass: MIT Press

Freeman, C. (1991) Networks of innovators: a synthesis of research issues. *Research Policy,* 20(5).

Freshwater, D. (2016). Writing, Rigour and Reflexivity in Nursing Research. *Journal of Research in Nursing,* 10(3).

Frijns, P., Van Leeuwen, F., and Bierwolf, R. (2017, June). Project management-a more balanced approach. In *2017 IEEE Technology & Engineering Management Conference (TEMSCON)* (pp. 234-238). IEEE.

Flumerfelt, S., Bella Siriban-Manalang, A., and Kahlen, F. J. (2012). Are agile and lean manufacturing systems employing sustainability, complexity and organizational learning?. *The Learning Organization*, *19*(3), 238-247.

Gafoor, K. A. (2012). *Considerations in the Measurement of Awareness*. National Seminar on Emerging trends in education. University of Calicut, Kerala, India.

Ganis, M., 2010. Agile Methods: Fact or Fiction. *ResearchGate*

Gann, D. M. (1996). Construction as a manufacturing process? Similarities and d ifferences between industrialized housing and car production in Japan. *Construction Management and Economics*, 14(5), 437-450.

Gann, D. M., and Salter, A. (2000). “Innovation in project-based, service enhanced firms: The construction of complex products and systems.” *Res. Policy*, 29(7), 955–972.

García de Soto, B., Agustí-Juan, I., Joss, S., and Hunhevicz, J. (2022). Implications of Construction 4.0 to the workforce and organizational structures. *International Journal of Construction Management*, *22*(2), 205-217.

Garcia, H., 2019. The Phases of Construction Projects. Retrieved from: https://careertrend.com/info-8090320-phases-construction-projects.html

Garcia, R., and R. Calantone. (2002). A critical look at technological innovation typology and innovativeness terminology: A literature review.” *J. Prod. Innovation Manage.* 19 (2).

Gardiner, A. (2003). Implementing PRINCE2 in business change environment.

Gardiner, P. D. (2014). *Creating and Appropriating Value from Project Management Resource Assets using an Integrated Systems Approach*. 27th IPMA World Congress.

Gareis, R. (2004). *Management of the Project Orientated Company*. In P. W. G.

Morris & J. K. Pinto (Eds.), The Wiley guide to managing projects (pp. 123–143). New York, NY: John Wiley & Sons

Garud, R., Dunbar, R., and Bartel, C. (2011a). Dealing with unusual experiences: A narrative perspective on organizational learning. *Organization Science*, 3(22), 587–601

Gemino, A, Reich, B. H and Serrador, P. M. (2020). Agile, Traditional, and Hybrid Approaches to Project Success: Is Hybrid a Poor Second Choice? *Project Management Journal*, 00(0).

George, C. (2020). The Essence of Risk Identification in Project Risk Management: An Overview. *International Journal of Science and Research (IJSR)*

George, T and Merkus, J. (2021). Explanatory Research | Definition, Guide, & Examples. Retrieved from: https://www.scribbr.com/

Geraldi, J. G. (2008). The balance between order and chaos in multi-project firms: A conceptual model. *International Journal of Project Management*, 26(4), 348-356.

Geraldi, J. G. (2008). The Balance Between Order and Chaos in Multi-Project Firms: A Conceptual Model. *International Journal of Project Management*

Gerrish, K and Lacey, A. (2010). The Research Process in Nursing. Retrieved from: https://www.wiley.com

Ghadamsi, A and Braimah, N. (2012). *The influence of procurement methods on project performance: A conceptual framework. Conference*. Presented in The CIB International Conference: Management of construction: Research to practice, 26-29 June, 2012, Montreal, Canada.

Ghaffari, M and Emsley, M. W. (2015). Current Status and Future Potential of the Research on Critical Chain Project Management. *PM World Journal*

Ghalayini, A. M. and Noble, J. S. (1996). The changing basis of Performance Measurement. *International journal of operations and production management*, 16, pp63-80.

Ghimire, D and Charters, S. (2022). The Impact of Agile Development Practices on Project Outcomes. *Software* 2022, 1, 265–275.

Giang, D, T and Pheng, L. S., 2011. Role of construction in Economic Development: Review of Key Concepts in the Past 40 Years. *Habitat International*

Giangreco, A., Peccei, R., 2005. The nature and antecedents of middle manager resistance to change: evidence from an Italian context. *Int. J. Hum. Resour. Manag.* 16 (10), 1812–1829.

Gidado, K. (1996). Project complexity: The focal point of construction product planning. *Construction Management and Economics*, 14(3), 213-225.

Gil N, Tether B. 2011. Project risk management and design flexibility: Analysing a case and conditions of complementarity. *Res Policy*. 40(3):415–428.

Gilb, T. (1988). *Principles of Software Engineering Management*. Wokingham, UK: Addison-Wesley.

Gilchrist, M, Samuels, P and Marshall, E. (2014). *Pearson Correlation*. Loughborough University Mathematics Learning Support Centre and Coventry University Mathematics Support Centre.

Gill, J and Johnson, P. (2002). *Research Methods for Managers*. London: Sage Publishing.

Gill, J and Johnson, P. (2002). *Research Methods for Managers*. London: Sage Publishing.

Gill, P, Steward, K, Treasure, E and Chadwick, B., 2008. *Methods of data collection in qualitative research: interviews and focus groups*. Retrieved from:: https://www.nature.com/articles/bdj.2008.192

Glass, R. L. (2001). Agile Versus Traditional: Make Love, Not War. *Cutter IT Journal* 14(12).

Gledson, B. J and Greenwood, D. (2017). The Adoption of 4D BIM in the UK Construction Industry: An Innovation Diffusion Approach. *Engineering, Construction and Architectural Management.* 24(6)

Gledson, B. J and Phoenix, C. (2017). Exploring organisational attributes affecting the innovativeness of UK SMEs. *Construction Innovation*, 17(2).

Gledson, B. J, Henry, D and Bleanch, P. (2012). *Does size matter? Experiences and perspectives of BIM implementation from large and SME construction contractors.* In: 1st UK Academic Conference on Building Information Management (BIM) 2012, 5-7 September 2012, Northumbria University, Newcastle upon Tyne, UK.

Gledson, B. J. (2017) *Innovation Diffusion Within the UK Construction Sector: A study of the adoption of 4D BIM*. Doctoral thesis, Northumbria University.

Glen, S. (2020). *Alternate Forms Reliability*. Retrieved from https://www.statisticshowto.com/alternate-form-reliability/

Glenigan. (2018). *Construction Industry KPI Report*. Benchmark your business with the latest industry performance analysis. Glenigan

Glenigan. (2021). *Construction Industry Forecast 2021-2022*. https://www.glenigan.com/

Globerson, S., 2000. *PMBOK and the Critical Chain*. Research Gate

GMB Union. (2019). Gender equality in construction will take 200 years. Retrieved April 21, 2020. Retrieved from:

https://www.gmb.org.uk/news/genderequality-constructi on-will-take-200-years

Gobin, B. A. (2014). A Quantitative Framework for assessing Agile Ontology Engineering Methodologies. *Proc. International Conference on Web and Information Systems*.

Goldkuhl, G. (2012). Pragmatism vs interpretivism in qualitative information systems research. *European Journal of Information Systems* 21: 135–46. [CrossRef]

Goldkuhl, G., 2004. Meanings of Pragmatism: Ways to Conduct Information Systems Research. International Conference on Action in Language, Organisations and Information Systems (ALOIS-2004). Retrieved from http://www.vits.org

Goldkuhl, G., 2012. Pragmatism vs interpretivism in qualitative information systems research. *European journal of information systems*, 21, 135–146.

Goldratt, E. M. and Cox, J., 1984. *The Goal. New York*: North River Press.

Goldratt, E. M., 1997. *Critical Chain*. New York: North River Press.

Goles, T. and Hirschheim, R., 2000. *The paradigm is dead, the paradigm is dead … long live the paradigm: the legacy of Burell and Morgan*. Omega, 28, 249–268.

Golesh, D, Girei, Z. J and Ibrahim, F. (2019). The Role of Logic in Research. *International Journal of Scientific & Engineering Research*, 10(10).

Goncalves Filho, A. P., Waterson, P., and Jun, G. T. (2021). Improving accident analysis in construction–Development of a contributing factor classification framework and evaluation of its validity and reliability. *Safety science*, *140*, 105303.

González, P, González, V, Molenaar, K. and Orozco, F. (2013). Analysis of Causes of Delay and Time Performance in Construction Projects. *Journal of Construction Engineering and Management*, 140(1).

Gonzalez, K. (2023). Construction Procurement: A Complete Guide. https://www.workyard.com/

Goodfellow-Smith, M. E., Rogers, C. D., & Tight, M. R. (2019). Infrastructure value maximisation: finance and insurance appraisal. *Infrastructure Asset Management*, *7*(2), 103-110.

Gorod, A., Hallo, L., and Nguyen, T. (2018). A systemic approach to complex project management: Integration of command-and-control and network governance. *Systems Research and Behavioral Science, 35*(6), 811-837.

Gorse, C. A, Emmitt, S. and Lowis, M. (1999). *Problem Solving and Appropriate Communication Media.* In: Hughes, W.P. (ed) Procs 15th Annual ARCOM Conference, Liverpool John Moores University,15 -17 September 1999, Reading: ARCOM.

Gould, F. E. (2012). *Managing the Construction Process: Estimating, Scheduling, and Project Control;* Prentice Hall: Boston, MA, USA, 2012. (In English)

Goulden, D., 2017. *Project Management Execution Phase: Best Practices*. Retrieved from: https://www.clarizen.com

Goulding, C. (1999). Consumer research, interpretive paradigms and methodological ambiguities. *European Journal of Marketing*, 33(9/10), pp. 859-873.

Government Construction Strategy (2012). *Final Report to Government by the Procurement/Lean Client Task Group*. https://www.gov.uk/

Goyder, J., L. Boyer, and G. Martinelli. (2006). *Integrating exchange and heuristic theories of sur-vey nonresponse.* Bulletin of Sociological Methodology/Bulletin de Methodologies Sociologique92 (1):28–44. doi:10.1177/075910630609200104

Graham, N. (2012). *Planning a PRINCE2 Project in a Day for Dummies*. John Wiley & Sons, Incorporated, New York.

Graham, P, Nikolova, N and Sankaran, S. (2020). Tension Between Leadership Archetypes: Systematic Review to Inform Construction Research and Practice. *Journal of Management in Engineering,* 36(1).

Grandori, A. (2010). A rational heuristic model of economic decision making. *Rationality and Society,* 22, 477–504.

Grant, C and Osanloo, A. (2014). Understanding, Selecting, and Integrating a Theoretical Framework in Dissertation Research: Creating the Blueprint for 'House'. *Administrative Issues Journal: Connecting Education, Practice and Research, pp. 12-22.*

Gravesande, J, Richardson, J, Griffith, L and Scott, F. (2019). Test-retest reliability, internal consistency, construct validity and factor structure of a falls risk perception questionnaire in older adults with type 2 diabetes mellitus: a prospective cohort study. *Archives of Physiotherapy*, 9(14).

Gray, J. (2018). *A Comparative Analysis of Agile Project Management Methodologies*. University of North Carolina, Wilmington.

Grebić, B. (2019). Traditional vs Agile Project Management in the Service Sector. *European Project Management Journal*, 9(2).

Green Building Council. (2017). The State of Sustainability in the UK Built Environment. Retrieved from: https://www.ukgbc.org/

Green Building Council. (2020). Maximising social value from infrastructure projects. Retrieved from: https://www.ukgbc.org/

Green, B. (2016). How do we do more? *Construction Research and Innovation*. 7(2).

Green, S. (2016) Modernise or not, *Construction Research and Innovation*, 7:4, 24-27, DOI: 10.1080/20450249.2016.11874059

Green, S. D. (2011). *Making sense of construction improvement*. Sussex: John Wiley & Sons.

Greenhalgh, B., and Squires, G. (2011). '*Chapter 2: Clients of the construction industry'.* In Greenhalgh, B., and Squires, G. (2011). Introduction to Building Procurement. Routledge. DOI:10.1201/9781003155355-2.

Gregor D, M. B. A. (2021). *Agile and Traditional Project Management: Comparing Agile, Traditional and Hybrid Project Management Practices*. Heriot-Watt University Edinburgh.

Gren, L and Lenberg, P. (2019). Agility is responsiveness to change: An essential definition. *IEEE Software*

Griffiths, M. (2007). Developments in agile project management. Proceedings of the PMI Global Congress. Retrieved from http://leadinganswers.typepad.com /files/developments-in-agile-project- management---mike-griffiths.pdf

Griffiths, M. (2004). Using Agile Alongside the PMBOK. PMI Global Congress Proceedings. Retrieved from: http://leadinganswers.typepad.com

Grover, V. (2015). Research Approach: An Overview. Retrieved from: https://www.researchgate.net

Groves, R. M., and E. Peytcheva. (2008). The impact of nonresponse rates on nonresponse bias: A meta-analysis. *Public Opinion Quarterly*, 72(2):167–89. doi:10.1093/poq/nfn011.

Grubbs, F. E., 1962. Letter to the Editor - Attempts to Validate Certain PERT Statistics or 'Picking on PERT. *Operations Research*

Gruca, T. S. and Rego, L. L. (2005). Customer Satisfaction, Cash Flow, and Shareholder Value. *Journal of Marketing*, 69 (3)

Gruneberg, S. (2018). *A Strategic Approach to the UK Construction Industry*. 1st ed. Routledge, London.

Gu, N and London, K. (2010). Understanding and facilitating BIM adoption in the AEC industry. *Automation in Construction,* 19(8).

Guba and Lincoln, 1994. *Competing Paradigm in Qualitative Research*. In Denzin, N. & Lincoln, Y. (Eds.). Handbook of qualitative research (PP.99-136). Sage Publications

Gunduz, M and Almuajebh, M. 2020. Critical Success Factors for Sustainable Construction Project Management. *Sustainability*, 12 (1990).

Guntur. (2019). A Conceptual Framework for Qualitative Research: A Literature Studies. *Capture*, 10(210

Guo, S., Shen, B., Choi, T. M., and Jung, S. (2017). A review on supply chain contracts in reverse logistics: Supply chain structures and channel leaderships. *Journal of Clean Production*. 144, 387-402

Gustavsson, T., 2016. Benefits of Agile Project Management in a Non-Software Development Context: A Literature Review In: Project Management Development – Practice and Perspectives: Conference Proceedings

Guy, M. (2019). Types of Data & Measurement Scales: Nominal, Ordinal, Interval and Ratio. *Retrieved from Types of Data & Measurement Scales: Nominal, Ordinal, Interval and Ratio website: https://www. mymarketresearchmethods. com/types-of-data-nominal-ordinal-interval-ratio*.

Haas, K. B. (2008). The Blending of Traditional and Agile Project Management. *PM World Today*, 9(5).

Habib, M. M, Pathik, B. B, and Maryam, H. (2014). *Research Methodology - Contemporary Practices: Guidelines for Academic Researchers*, Cambridge Scholars Publisher.

Haddow, A., 2018. Top 3 Challenges Facing the UK Construction Industry in 2019 Retrieved from: http://datumpoint.org.uk

Haider, Q. (2019). *Nuclear Fusion: Holy Grail of Energy*. In book: Nuclear Fusion.

Håkansson, H and Ingemansson, M. (2013). Industrial renewal within the construction network. *Constr Manag Econ* 31:40–61. https ://doi.org/10.1080/01446193.2012.737470

Halamzie, F., 2013. Management of Software Projects: Classic, Agile, Lean and Systemic. Retrieved from: https://books.google.co.uk

Halbesleben, J. R., and M. V. Whitman. (2013). Evaluating survey quality in health services research: A decision framework for assessing nonresponse bias. *Health Services Research*, 48(3):913–30. doi:10.1111/1475-6773.12002

Halcomb, E. J and Hickman, L., 2015. *Mixed Methods Research. Faculty of Science, Medicine and Health – Papers*. University of Wollongong

Hall, D. M., Whyte, J. K., and Lessing, J. (2020). Mirror-breaking strategies to enable digital manufacturing in Silicon Valley construction firms: a comparative case study. *Construction management and economics, 38*(4), 322-339.

Hällgren, M and Wilson, T. L., 2008. The Nature and Management of Crises in Construction Projects: Projects-as-Practice Observations. *International Journal of Project Management* [

Hamid, S. S, Nasir, M. H, Othman, M and Ahmad, R. (2015). Factors Limiting the Implementations of Agile Practices in the Software Industry: A Pilot Systematic Review. *Indian Journal of Science and Technology*. 8(30).

Hammer, M. (1990). *Reengineering Work: Don't Automate, Obliterate*. Harvard Business Review.

Hammond, M. (2017). *Reflexivity*. Education Studies, University of Warwick

Han F. 2013. Defining and evaluating agile construction management for reducing time delays in construction. Retrieved from: https://digitalrepository.unm.edu.

Han, F and Bogus, S. M. (2013). *Defining an Agile Construction Management System*. 4th Construction Specialty Conference, Montréal, Québec

Handzic, M and Bassi, A. (2017). *Knowledge and Project Management: A Shared Approach to Improve Performance*. Volume 5. Springer.

Hansen, M.T. and Birkinshaw, J. (2007). *The innovation value chain*. Harvard business review, 85(6).

Harper, D., 2018. Cartels and construction – *what you need to know*. The Construction Industry Council (CIC)

Harral, R. (2019). *Construction needs to change*. *But change must be client led*. Retrieved from: https://www.building.co.uk/

Harrison, F and Lock, D., 2017. *Advanced Project Management: A Structured Approach*. Routledge

Harrits, G. S., 2011. More Than Method? A Discussion of Paradigm Differences Within Mixed Methods Research. *Sage. Journal of Mixed Methods Research*

Hartley, J. (2013). Some thoughts on Likert-type scales. *International Journal of Clinical and Health Psychology* (2013) 13, 83−86.

Hartmann, A, Reymen, I.M.M.J. and van Oosterom, G. (2008) Factors constituting the innovation adoption environment of public clients, *Building Research & Information*, 36(5).

Harvey, L., 2019. Social Research Glossary: Ethnomethodology. *Quality Research International*

Hasan, A, Baroudi, B, Elmualim, A and Rameezdeen, R. (2018). Factors Affecting Construction Productivity: A 30 Year Systematic Review. *Engineering, Construction and Architectural Management*, 25(7).

Hashim, B. (2017). Pragmatic Approach to Research. Slide Share. Retrieved from: https://www.slideshare.net

Hasan, R., Chowdhury, S. A., and Akter, J. (2021). Construction project monitoring: The cost and schedule control by Earned Value Method (EVM). *Journal of Technology Management and Business*, *8*(1), 1-9.

Hassan, A. S. A, Nordin, N and Azamin, A. A. (2020). A Review of Contextual Factors Influencing Performance Measurement System Adoption in the Construction Industry. *American Based Research Journal*, 9(1).

Hassanein, E. E and Hassanien, S. A. (2020). Cost Efficient Scrum Process Methodology to Improve Agile Software Development. *International Journal of Computer Science and Information Security (IJCSIS),* 18(4).

Hathcoat, J. D, Meixner, C and Nicholas, M. C., 2019. *Ontology and Epistemology*. Springer

Haughey, D. (2014). A Brief History of Project Management. Retrieved from: https://www.projectsmart.co.uk/

Hayashi Jr, P., Abib, G., and Hoppen, N. (2019). Validity in qualitative research: A processual approach. *The Qualitative Report*, *24*(1), 98-112.

Hayes, B, Bonner, A and Douglas, C., 2013. An Introduction to Mixed Methods Research for Nephrology Nurses. *Renal Society of Australasia Journal, 9, 8-14*

Hayhow, S., Edwards, D.J., P€arn, E.A., Aigbavboa, C. and Hosseini, M.R. (2019), "Construct-it: a board game to enhance built environment students' understanding of the property lifecycle", *Industry and Higher Education*, 3(33)

Heale, R and Twycross, A., 2017. What is a case study? *Evidence-Based Nursing* 21(1). DOI:10.1136/eb-2017-102845

Health and Safety Executive, 2015. Construction Phase Plan (CDM 2015): What you need to know as a busy builder. Retrieved from: http://www.hse.gov.uk/pubns/cis80.pdf

Hegazy, M. and Hegazy, S., 2012. The development of key financial performance indicators for UK construction companies. *Accounting, Accountability & Performance*, *17*(1/2).

Henderson, R.M. and Clark, K.B. (1990). Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly,* 35, pp. 9-30.

Hendrickson, C. (2008). *Project Management for Construction*. 2nd ed. Carnegie Mellon University, Pittsburgh.

Henson, R., and Roberts, J. (2006). Use of exploratory factor analysis in published research: Common errors and some comment on improved practice. *Educational and Psychological Measurement*, 66, 393-416. doi:10.1177/0013164405282485

Henson, K. and Asenievich, K. (2014). Mind the Gap: Tackling the Construction Skills Shortage. Retrieved from: http://www.klhsustainability.com/media/thought-leadership?start=3

Herroelen, W, Leus, R and Demeulemeesteret, E. (2001). Critical Chain Project Scheduling: Do Not Oversimplify. *Katholieke Universiteit Leuven*

Hidalgo, E. S and Morell, M. F. (2019). Co-designed strategic planning and agile project management in academia: case study of an action research group. *Palgrave Communications*, 5(151).

Higham, A and Thomson, C. (2015). An Evaluation of Construction Professionals Sustainability Literacy in Northwest England. *In*: Raidén, A B and Aboagye-

Nimo, E (Eds) *Procs 31st Annual ARCOM Conference*, 7-9 September 2015, Lincoln, UK, Association of Researchers in Construction Management, 417-426.

Highsmith J. 2004. *Agile project management: Creating innovative products*. Boston, Addison Wesley: Boston, MA, USA.

Highsmith, J. R., 2010. Agile Project Management: Creating Innovative Products Retrieved from: https://books.google.co.uk

Hillebrandt P. M, 2000. *The Nature of Construction Economics. In: Economic Theory and the Construction Industry*. Palgrave Macmillan, London

Hillygus, D. S. (2015). *The practice of survey research: Changes and challenges*. New directions in public opinion, 56–75. New York: Routledge

Hinde, D. (2017). *PRINCE2 Study Guide: 2017 Update*, 2nd ed. Wiley.

Hirsch, J. (2013). 10 Steps To Successful Requirements Gathering. Retrieved from: https://www.phase2technology.com

Hirschheim, R., 1985. Information Systems Epistemology: An Historical Perspective. *Research Methods in Information systems*, 13-35.

HM Government (2013), *Construction 2025*. Industrial Strategy: Government and Industry in Partnership. HM Government, London.

HM Government. (2007). *Planning for a Sustainable Future*. White Paper. Retrieved from: www.gov.uk

HM Government. (2012*). Industrial strategy: government and industry in partnership: building information modelling.* London: Blackwell.

Hock, D. W., 1995. The chaordic organization: Out of control and into order. *World Business Academy Perspectives*, 9 (1), 1– 9.

Hoda, R and Noble, J. (2014). Self-Organizing Roles on Agile Software Development Teams. *IEEE Transactions On Software Engineering*, 39(3).

Hoda, R. and Murugesan, L.K. (2016). Multi-level agile project management challenges: a self-organizing team perspective. *Journal of Systems and Software*, Vol. 117, pp. 245-257.

Hoezon, M, Reymen, I and Dewulf, G. (2016). *The problem of communication in construction.* University of Twente

Holmström, H, Fitzgerald, B, Agerfalk, P. J and Conchuir, E. O. (2006). Agile Practices Reduce Distance in Global Software Development. *Information Systems Management,* 23(3).

Holroyd, T. M. (2003). *Buildability: Successful Construction from Concept to Completion*. Thomas Telford, London.

Holt, G. D and Goulding, J. S. (2016). The "ological-triad": Considerations for Construction Management Research. *Journal of Engineering, Design and Technology*, 15(3).

Holt, G. D. (2015). British construction business 1700-2000: Proactive innovation or reactive evolution? *Constr. Innovation* 15 (3).

Horta, I and Camanho, A 2014 Competitive positioning and performance assessment in the construction industry. *J. Expert Systems with Applications: An Int. Journal*

House of Commons, 2008. Construction matters: Ninth Report of Session 2007–08 Retrieved from: https://publications.parliament.uk

Howell, G. A, and Ballard, G., 1998. Implementing Lean Construction: Understanding and Action. Retrieved from: https://www.researchgate.net

Howick, S. M, Ackermann, F, Eden, C, Williams, T. M, Meyers, R. (2009) *System dynamics and disruption and delay in complex projects.* In: Encyclopaedia of complexity and systems science. Springer. ISBN 9780387758886.

Hron, M and Obwegeser, N. (2018). Scrum in Practice: An Overview of Scrum Adaptations. Proceedings of the 51st Hawaii International Conference on System Sciences 2018

Hughey, D. (2009). Comparing Traditional Systems Analysis and Design with Agile Methodologies Retrieved from: http://www.umsl.edu/~hugheyd/is6840/waterfall.html

Hughes, W., Champion, R. and Murdoch, J. (2015) *Construction Contracts*. 5th ed. Oxon: Routledge.

Hulett, D. T. (2016). *Practical Schedule Risk Analysis*. Routledge

Hulshult, A. R., and Krehbiel, T. C. (2019). Using Eight Agile Practices in an Online Course to Improve Student Learning and Team Project Quality. *Journal of Higher Education Theory & Practice*, *19*(3).

Hussain, M, Nouri, S. (2012). *A Literature Review Exploring Challenges and Solutions When Implementing Agile*. University of Gothenburg.

Hussain, C, M, Paulraj, M. S and Nuzhat, S. (2022). *Source Reduction and Waste Minimization*. Vol 2. ISBN: 978-0-12-824320-6

Hussain, S., Xuetong, W. and Hussain, T. (2020). *Impact of Skilled and Unskilled Labour on Project Performance Using Structural Equation Modelling Approach.* SAGE

Hussien, A., 2017. ARGILE: A Conceptual Framework Combining Augmented Reality with Agile Philosophy for the UK Construction Industry. *Doctoral thesis, Liverpool John Moores University*

Hussin, J. M., Rahman, I. A., and Memon, A. H. (2013). The way forward in sustainable construction: issues and challenges. *International Journal of Advances in Applied Sciences*, *2*(1), 15-24.

Huston, A. (2018). Scrum Ceremonies, Made Stunningly Simple. *The Digital Project Manager.* Retrieved from: https://thedigitalprojectmanager.com

Hutagalung, W., 2006. Extreme Programming. Retrieved from: http://www.umsl.edu

Hyttinen, K. (2017). Project Management Handbook. *ResearchGate*.

Iacovidou, E, Purnell, P, Tsavdaridis, K. D and Poologanathan, K. (2021). Digitally Enabled Modular Construction for Promoting Modular Components Reuse: A UK View. *Journal of Building Engineering.*

Ibbs, C. W., and Kwak, Y. H. (2000). Calculating project management's return on investment. *Project Management Journal*, 31(2).

Icasas, P., 2014. What are the Six Phases of Waterfall Project Management? *Project Management Blog.* Retrieved from: https://explore.easyprojects.net

Igansi, L. (2014). *What are the terms for various ontological positions? Are realism and relativism ontological positions? If yes, what do they mean*? Retrieved from: https://www.researchgate.net/

Iivari, J and Hirscheim, R. (1996). Analysing Information Systems Development: A Comparison and Analysis of Eight IS Development Approaches. *Information Systems*, 21, pp. 551-575.

Iivari, J, Hirschheim, R and Klein, H. K. (2000). A Dynamic Framework for Classifying Information Systems Development Methodologies and Approaches. *Journal of Management Information Systems*

Ik, M and Azeez, A. A. (2020). Organisational Green Behavioural Change: The Role Of Change Management. In: IK, M. & Azeez, AA (2020). Organisational green behavioural change: The role of Change Management. International Journal of Entrepreneurial Knowledge, 8 (1), 34-48. *International Journal of Entrepreneurial Knowledge*, *8*(1), 34-48.

Ilieva, S, Stefanova, E, Nemchev, R and Ivanov, P., 2003. eXtreme Programming Principles & Practices. Retrieved from: https://people.ok.ubc.ca

Ilveskoski, O and Intimacy, S., 2015. Construction Management: Study Book Retrieved from: https://www.theseus.fi

Ilyas, M, Hin, C. W and Adnan, Z. (2016). Training aligned with business strategies: aiming at the 'Strategic fit'. *Journal of Scientific Research and Development*, 3(4): 150-156, 2016

Imam, H and Zaheer, M. K. (2021). Shared Leadership and Project Success: The Roles of Knowledge Sharing, Cohesion and Trust to The Team. *International Journal of Project Management.*

Imani, T. (2017). Does a Hybrid Approach of Agile and Plan-Driven Methods Work Better for IT System Development Projects? *International Journal of Engineering Research and Applications*, 7(3).

Infrastructure and Projects Authority. (2021). *Gate Review Process*. GOV.UK

Institute of Civil Engineers. (2015). Innovation: Stepping Up the Industry. Retrieved from: https://www.ice.org.uk

Institute of Civil Engineers. (2019). Reducing the gap between cost estimates and outturns for major infrastructure projects and programmes. Retrieved from: https://www.ice.org.uk/

Integrated Project Initiatives (2014), "The integrated project insurance (IPI) models project procurement and delivery guidance", available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/326716/20140702_IPI_Guidance_3_July_2014.pdf.

Integrity Software Systems Ltd. (2018). The State of the UK Construction Industry. Retrieved from: https://www.integrity-software.net

Introna, L. D and Whitley, E. A., 1997. Against Method–ism: Exploring the Limits of Method. *London School of Economics and Political Science*

Ionel, N., 2008. Critical Analysis of the Scrum Project Management Methodology. *Annals of the University of Oradea, Economic Science Series,* 17(4), pp. 435–441.

IPCC, 2019. 2019 Refinement to the 2006 IPCC guidelines for national greenhouse gas inventories. Retrieved from: https://www.ipcc.ch/

Iqbal S. 2015. *Leading construction industry to lean-agile (Leagile) project management.* London: Project Management Institute.

Isabella, L., 1990. Evolving interpretations as a change model unfolds: how managers construe key organizational events. *Acad. Manag. J*. 33, 7–41.

Isetta, S and Sampietro, M. (2018). Agile in ERP Projects. *PM World Journal*, 7(9).

ITRM Guideline CPM, 2006. Project Management Guideline. Section 4 - Project Execution and Control Phase. Retrieved from: https://www.vita2.virginia.gov

Iuga, M.V; Kifor, C.V; Rosca, L. I. (2015). *Lean information management: Criteria for selecting key performance indicators at shop floor*. ACTA University, 66, 67–72.

Jackson, M. B. (2012). Step by step. *PM Network*, *26*(6), 56–61.

Jackson, S. (2002). *Project cost overruns and risk management.* The University of Reading.

Jahr, M. (2014). A hybrid approach to quantitative software project scheduling within agile frameworks. *Project Management Journal*, 45(3).

Jallow, A, K, Demian, P, Baldwin, A. N and Anumba, C. (2014). An empirical study of the complexity of requirements management in construction projects. *Engineering, Construction and Architectural Management*. 21(5).

Jalote, P. (1997). *An Integrated Approach to Software Engineering*, Springer-Verlag, New York.

James, M and Walter, L. (2018). *Scrum Reference Card*. Retrieved from: http://scrumreferencecard.com

James, M. (2010). Six Pages About Scrum. *CollabNet, Inc.* Retrieved from: https://wiki.metropolia.fi/download

James, W. (1907). Pragmatism. *A New Name for Some Old Ways of Thinking*. Longmans, Green & Co, New York.

Jarvis, G. (1981). *Action research versus needed research for the 1980s*. In D. L. Lange (ed.), Proceedings of the National Conference on Professional Priorities, 59– 63.

Jarvis, S. (2001). *Research in TESOL: sunset or a new dawn*? TESOL Research Interest Section Newsletter, 8, 2, 1–7.

Javed, H. F and González, R. M. (2017). *Gap Analysis of Organizational Project Management Practices in Engineering Company: A Study of an Organization in Sweden, Finland and Abu-Dhabi*. Chalmers University Of Technology.

Jeffries, R., 2011. What is Extreme Programming? Retrieved from: http://ronjeffries.com

Jeschke, K. C., Kines, P., Rasmussen, L., Andersen, L. P. S., Dyreborg, J., Ajslev, J., Kabel, A., Jensen, E., and Andersen, L. L. (2017). Process evaluation of a Toolbox- training program for construction foremen in Denmark. *Safety Science*, 94, 152-160.

Jiménez, V, Afonso, P and Fernandes, G. (2020). Using Agile Project Management in the Design and Implementation of Activity-Based Costing Systems. *Sustainability*, 10352; doi:10.3390/su122410352

Jing, A. (2015). A History of the Great Wall of China. *The Chinese Relics Research Institution, China*. Retrieved from: https://www.worldscientific.com

Jin-Hai, L, Anderson, A. R and Harrison, R. T. (2003). The Evolution of Agile Manufacturing. *Business Process Management Journal*, 9(2), pp. 170-89.

Jivan, K. P, Marnewick, A. L. and Joseph, N. (2020). Influence of organizational culture in the adoption of agile. *IEEE Technology & Engineering Management Conference (TEMSCON)*, 2020, pp. 1-6, doi: 10.1109/TEMSCON47658.2020.9140091

Johansson, M. Y. (2012). Agile Project Management in The Construction Industry - An Inquiry of The Opportunities in Construction Projects.

John, B. (2018). Framework of agile management’s sprint planning in construction projects–AFD method. *International Journal for Advance Research and Development,* 3(5), 88-93.

Johnson, M and Majewska, D. (2022). *Formal, non-formal, and informal learning: What are they, and how can we research them*? Cambridge University Press & Assessment Research Report.

Johnson, R. B and Onwuegbuzie, A. J., 2004. Mixed Methods Research: A research paradigm whose time has come. *Journal of Mixed Methods Research*

Jonas. (2021). The 5 Phases of Construction Project Management and How Software Can Help. Retrieved from: https://www.jonasconstruction.com/

Jones, M., and Saad, M. (2003). *Managing Innovation in Construction*. London: Thomas Telford.

Jørgensen, M. (2016). A survey on the Characteristics of Projects with Success in Delivering Client Benefits. *Information and Software Technology,* 78(C).

Joshi, A, Kale, S, Chandel, S and Pal, D. K. (2015). Likert Scale: Explored and Explained. *British Journal of Applied Science & Technology*, 7(4): 396-403,

Joslin, R and Müller, R (2016). The Impact of Project Methodologies on Project Success in Different Project Environments. *International Journal of Managing Projects in Business*, 9(2).

Joslin, R and Müller, R. (2015). Relationships Between a Project Management Methodology and Project Success in Different Project Governance Contexts. *International Journal of Project Management*, 33(6). 1377–1392.

Joslin, R and Müller, R. (2015). Relationships Between a Project Management Methodology and Project Success in Different Project Governance Contexts. *International Journal of Project Management*, 33(6).

Jovanović, P and Berić, I., 2018. Analysis of the Available Project Management Methodologies. *Journal of Sustainable Business and Management Solutions in Emerging Economies*

Jugdev, K. and Müller, R. (2005). A retrospective look at our evolving understanding of project success. *Project Management Journal*. 36(4), pp. 19-31.

Kafle, S. C. (2019). Correlation and Regression Analysis Using SPSS. *OCEM Journal of Management, Technology and Social Sciences*.

Kagioglou, M, Cooper, R, Aouad, G, Sexton, M., 2000. Rethinking Construction: The Generic Design and Construction Process Protocol. *Engineering, Construction and Architectural Management,* 7(2), pp.141-153

Kagioglou, M., Cooper, R. and Aouad, G. (1999). *Re-engineering the UK construction industry: The process protocol.* In Second International Conference on Construction Process Re-Engineering-CPR99.

Kagioglou, M., Cooper, R. and Aouad, G., 2001, Performance management in construction a conceptual framework, *Construction Management and Economics*, Vol.19, pp. 85-95.

Kai, P, Claes, W and Dejan, B. (2009). *The waterfall model in large-scale development.* In International Conference on Product-Focused Software Process Improvement, pages 386–400. Springer.

Kalinichuk, S. (2014). Information and Communication Technology in Construction Industry. Retrieved from: https://www.scribd.com/

Kalolo, J. F., 2015. The Drive towards Application of Pragmatic Perspective in Educational Research: Opportunities and Challenges. *Journal of Studies in Education,* 5(1).

Kamal, A, L. (2019). *Research Paradigm and the Philosophical Foundations of a Qualitative Study*. DOI:10.20319/pijss.2019.43.13861394.

Kamara, J.M, Anumba, C. J and Bouchlaghem, N. (2003). *Conceptual Framework for Live Capture and Reuse of Project Knowledge.* ResearchGate

Kamat, V. R., and Martínez, J. C. (2003). *Interactive discrete-event simulation of construction processes in dynamic immersive 3D virtual worlds*. Proc., 2003 Conf. on Construction Applications of Virtual Reality, W. Y. Thabet and D. A. Bowman, eds., Virginia Polytechnic Institute and State University, Blacksburg, Va., 197–201

Kangari, R. (1988). Business Failure in Construction Industry. *Journal of Construction Engineering Management.* 114(2). https://doi.org/10.1061/(ASCE)0733-9364(1988)114:2(172)

Kannan, V, Jhajharia, S and Verma, S. (2014). Agile vs waterfall: A Comparative Analysis. *International Journal of Science, Engineering and Technology Research (IJSETR).* 3(10).

Kannan, V; Jhajharia, S and Verma, S. (2014). Agile vs waterfall: A Comparative Analysis. *International Journal of Science, Engineering and Technology Research (IJSETR),* 3(10).

Kannimuthu, M, Ekambaram, P, Raphael, B, Kuppuswamy, A. (2018). Resource unconstrained and constrained project scheduling problems and practices in a multi-project environment. *Adv Civ Eng*. https://doi.org/10.1155/2018/9579273

Kaplan, R and Norton, D. (1992). *The Balanced Scorecard - Measures that Drive Performance.* Harvard Business Review.

Kaplan, R and Norton, D. (1996). *Using the Balance Scorecard as a Strategic Management System*. Harvard Business Review.

Karabulut, A. T and Ergun, E., 2018. A New Way of Management: A Scrum Management. *International Journal of Commerce and Finance,* 4(2).

Karakhan, A. A., and Gambatese, J. A. (2017). Identification, quantification, and classification of potential safety risk for sustainable construction in the United States. *Journal of Construction Engineering and Management*, 143(7)

Karamitsos, I, Apostolopoulos, C and Al Bugami, M., 2010. Benefits Management Process Complements Other Project Management Methodologies. *Journal of Software Engineering & Applications*. 3(10). DOI:10.4236/jsea.2010.39097

Karantani, C. N. (2020). *Towards an Agile Approach for the Management of Changes*. Delft University of Technology.

Karaxha, H. (2019). Methods for Dealing with Resistance to Change. *Baltic Journal of Real Estate Economics and Construction Management*, 7(7, 290–299).

Karlesky, M and Voord, M. V., 2008. *Agile Project Management (or, Burning Your Gantt Charts).* Embedded Systems Conference Boston (Boston, Massachusetts). Retrieved from: https://www.researchgate.net

Kärnä, S, Junnonen, J and Kankainen, M. (2004). Customer Satisfaction in Construction. Researcher, *Construction Economics and Management*. Retrieved from: https://iglcstorage.blob.core.windows.net/

Karpenko, L, Zhylinska, O, Dmytrenko, H, Poprozman, N. V and Koltun, V. (2020). Synergetic Management Tools for Enterprise Economic Security. *Journal of Security and Sustainability Issues,* 9(4).

Kashyap, V. N. (2017). *Team Management in Construction Industry*. University Of Auckland.

Kasianenko, J. (2018). Convergence of Agile and Traditional Methodologies in IT Projects. *Proceedings from the 6th International Scientific Conference: Advanced Information Systems and Technologies, AIST 2018. Sumy, Ukraine.*

Kasturiwale, A and Rathod, K. (2021). Agile project management in construction industry. *International Journal of Research in Engineering and Science (IJRES) ISSN*, *9*(6), 9-11.

Katila, R., Levitt, R.E., and Sheffer, D. (2018). Systemic innovation of complex one-off products: the case of green buildings. *Organization design* (Vol. 40). 299–328.

Katz, R. L. (1974). *Skills of an Effective Administrator*. Harvard Business Review Retrieved from: https://hbr.org/1974/09/skills-of-an-effective-administrator

KATZENBACH, J. R and SMITH, D. K. (2003). *The wisdom of teams: creating the high- performance organization*. Harvard Business School Press.

Kaur, A. (2020). Organisational Change. *International Journal of Research in Engineering and Science (IJEMR)*, 10(9).

Kazi, A. S. (2005). *Knowledge Management in the Construction Industry: A Socio-technical Perspective*. Idea Group Publishing, London.

KC, R and Kautish, S. (2020). Impact of Project Management Methodologies on Project Success Rates: A Study on Foreign Aided Organizations Working In Educational Sector of Nepal. *LBEF Research Journal of Science, Technology and Management*, 2(3).

Kehe, W, Tingting, W, Yanwen, A and Wenjing, Z. (2015). *Study on the Drawing Method of Project Network Diagram*. 7th International Conference on Intelligent Human-Machine Systems and Cybernetics

Kehinde, O. M, Afolabi, O. J and Babawale, A. (2017). Application of Project Evaluation and Review Technique (PERT) In Road Construction Projects in Nigeria. *European Project Management Journal*.

Kelley, J. E., Walker, M. R and Sayer, J. S. (1989). *The Origins of CPM: A Personal History. PM Network.* Retrieved from at: https://www.pmi.org

Kelly, L. M., Goodall, J., and Lombardi, L. (2022). Developing a monitoring and evaluation framework in a humanitarian non-profit organisation using agile methodology. *Disaster Prevention and Management: An International Journal*, (ahead-of-print).

Ken, F., 2009. Agile Manifesto. Retrieved from: http://richd.me/wp-content/uploads/2011/05/Agile-Manifesto.pdf

Kennerley, M and Neely, A. 2002 A framework of the factors affecting the evolution of performance measurement system. *Int. J. of Operations and Production Mgmt*. 22(11), pp1222-1245.

Kerzner, H. (2010). *Project Management Best Practices: Achieving Global Excellence*. 2nd ed. John Wiley and Sons, New York.

Kerzner, H. (2015). *Project management best practices: Achieving global excellence*. Hoboken, NJ: John Wiley & Sons.

Kerzner, H. (2017). Project Management: *A Systems Approach to Planning, Scheduling, and Controlling. 12th ed.* John Wiley and Sons, New York.

Kerzner, H. (2018). *Project Management Best Practices: Achieving Global Excellence.* 4th ed. John Wiley and Sons, New York.

Kerzner, H., 2002. *Strategic Planning for Project Management Using a Project Management Maturity Model*. John Wiley and Sons, New York.

Khadka, K and Maharjan, S. (2017). *Customer Satisfaction and Customer Loyalty*. Centria University of Applied Sciences Pietarsaari. Retrieved from: https://core.ac.uk/

Khan, S.Z, Yang, Q, Waheed, A. (2018). Investment in intangible resources and capabilities spurs sustainable competitive advantage and firm performance. *Corporate Social Responsibility and Environmental Management,* 26(1). DOI:10.1002/csr.1678.

Khattak, S. M and Mustafa, U. (2017). Management competencies, complexities and performance in engineering infrastructure projects of Pakistan. *Engineering, Construction and Architectural Management,* 26(7).

Khizar, H. M. U., Iqbal, M. J., and Rasheed, M. I. (2021). Business orientation and sustainable development: A systematic review of sustainability orientation literature and future research avenues. Sustainable Devel-opment,29(5).

Kibirige, A. R, Kaawaase, T, Eduan, S. A and Franklin, M. T. (2019). Organizational Efficiency: A Review of the Literature. *African Journal of Educational Research and Development (AJERD)*, 12(1).

Kibler, C. (2019). *Hybrid Project Management Methodology for Commercial Construction Projects*. The College of St. Scholastica, ProQuest Dissertations Publishing. Retrieved from: https://search.proquest.com

Kilinc, N, Ozturk, G. B and Yitmen, I. (2015). *The changing role of the client in driving innovation for designbuild projects: stakeholders' perspective*. 8th Nordic Conference on Construction Economics and Organization. Procedia Economics and Finance 21 (2015) 279 – 287

Killip G. (2013b). Products, practices and processes: exploring the innovation potential for low-carbon housing refurbishment among small and medium-sized enterprises (SMEs) in the UK construction industry. *Energy Policy* 62: 522–530.

Killip, G, Owen, A, Morgan, E and Topouzi, M. (2018). A co-evolutionary approach to understanding construction industry innovation in renovation practices for low-carbon outcomes. *The International Journal of Entrepreneurship and Innovation*, 19(1).

Killough, D. (2023). 6 Construction Project Delivery Methods Compared. https://www.procore.com/

Kim, S., and Pedersen, N. J. (2018). *Strong truth pluralism.* In Pluralisms in Truth and Logic (pp. 107-130). Palgrave Macmillan, Cham.

Kines, P., Andersen, L. P. S., Spangenberg, S., Mikkelsen, K. L., Dyreborg, J., and Zohar, D. (2010). Improving construction site safety through leader-based verbal safety communication. *Journal of Safety Research*, 41(5), 399-406

Kircher, M, Jain, P, Corsaro, A and Levine, D., 2001. Distributed eXtreme Programming. ResearchGate. Retrieved from: https://www.researchgate.net

Kissi, E., Babon-Ayeng, P., & Agyekum, A. K. (2022). Benefits of Multicultural Project Team Setting: Views of Professionals in the Ghanaian Construction Industry. *EPiC Series in Built Environment*, *3*, 110-120.

Kivilä, J, Martinsu, M and Vuorinen, L. (2017). Sustainable project management through project control in infrastructure projects. *International Journal of Project Management*, 35(6).

Kivunja, C and Kuyini, A. B. (2017). Understanding and Applying Research Paradigms in Educational Contexts. *International Journal of Higher Education.* 6(5):26. DOI:10.5430/ijhe.v6n5p26

Kivunja, C. (2018). Distinguishing between Theory, Theoretical Framework, and Conceptual Framework: A Systematic Review of Lessons from the Field. *International Journal of Higher Education*, 7(6).

Klein, C. (2009). *An Agile Construction Project.* Retrieved from: https://chrisklein.wordpress.com

Kliem, R. L; Ludin, I. S and Robertson, K. L., 1997. *Project Management Methodology: A Practical Guide for the Next Millennium*. Retrieved from: https://books.google.co.uk

Klimkó, G. (2019). In: Blaskovics, B, Deák, C and Varga, A. K. (2019). *Chapters from the Academic Aspect of Project Management - Research and Teaching Methodologies*. Vol III, PMUni - International Network for Professional Education and Research in Process and Project Management.

Klinger, M and Susong, M., 2006. *The Construction Project: Phases, People, Terms, Paperwork, Processes*. Retrieved from: https://books.google.co.uk

Knudtzon, W. W., 2018. *Integrating Lean Manufacturing and Digital Technologies: A Survey of Norwegian Manufacturing Companies*. Norwegian University of Science and Technology. Retrieved from: https://buildingsmart.no

Koch, A. S., 2005. *Agile Software Development: Evaluating the Methods for Your Organization.* London, Artech House, Inc.

Koch, C, Paavola, S and Buhl, H. (2019). Social science and construction – an uneasy and underused relation, *Construction Management and Economics*, 37(6).

Koch, S. and Turk, G. (2013). Human resource related problems in agile and traditional software project process models. In Wang, J. (Ed.), *Perspectives and Techniques for Improving Information Technology Project Management*, IGI Global, Hershey, PA, pp. 1-13.

Koetzier, W, Alon, A and Hooper, K. (2012). *Stage Gates Can Kill Innovation; Risk Management Can Fuel It*. Accenture.

Koi-Akrofi, G. Y, Koi-Akrofi, J and Matey, H. A. (2019). Understanding the Characteristics, Benefits and Challenges of Agile IT Project Management: A

Literature Based Perspective. *International Journal of Software Engineering & Applications* (IJSEA), 10(5).

Kolbe, R. H and Burnett, M. S. (1991). Content-analysis research: an examination of applications with directives for improving research reliability and objectivity. *J Consumer R.* 18(2):243-250.

Koller, I, Levenson, M, R and Glück, J. (2017). What Do You Think You Are Measuring? A Mixed-Methods Procedure for Assessing the Content Validity of Test Items and Theory-Based Scaling. *Frontiers in Psychology*, https://doi.org/10.3389/fpsyg.2017.00126

Kononenko, I and Kharazii, A. (2014). The Methods of Selection of The Project Management Methodology. *International Journal of Computing*, 13(4).

Kononenko, I and Lutsenko, S. (2018). The Project Management Methodology and Guide Formation's Method. *IEEE 13th International Scientific and Technical Conference on Computer Sciences and Information Technologies (CSIT)*, Lviv, 2018, pp. 156-159. X

Kononenko, I Kharazii, A and Iranik, N. (2013). *Selection method of the project management methodology and its application.* In Proceedings of the 7th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems: Technology and Applications (IDAACS'2013), Berlin, Germany, (12-14 September 2013), pp. 578-582.

Koo, H. J, and O'Connor, J. T. (2021). Complexity Analysis of Design Deliverable Defects on Building Projects. *Journal of Management in Engineering*. 37(3).

Koolwijk, J. S. J, van Oel, C. J and Moreno, J. C. G. (2020). No-Blame Culture and the Effectiveness of Project-Based Design Teams in the Construction Industry: The Mediating Role of Teamwork. *Journal of Management in Engineering*, 36(4).

Koolwijk, J. S. J, van Oel, C. J, Wamelink, J. W. F and Vrijhoef, R. (2018). Collaboration and Integration in Project-Based Supply Chains in the Construction Industry. *Journal of Management in Engineering*, 34(3).

Koppenjan, J., Veeneman, W., van der Voort, H., ten Heuvelhof, E., and Leijten, M. (2011). Competing management approaches in large engineering projects: The Dutch RandstadRail project. International Journal of Project Management, 29(6), 740- 750.

Koskela, L and Codinhoto, R. (2014). Is agile project management applicable to construction? *Research Gate*. Retrieved from: https://www.researchgate.net

Koskela, L and Henrich, G., 1993. *Why does Production Management Fail in Construction?* Retrieved from: http://www.irbnet.de/daten/iconda/CIB9016.pdf

Koskela, L and Howell, G. (2002). *The underlying theory of project management is obsolete*. In Proceedings of the Project Management Institute Research Conference, Seattle, pp. 293–302

Koskela, L. (2020). In: Tzortzopoulos, P, Kagioglou, M and Koskela, L. (2020). *Lean Construction: Core Concepts and New Frontiers*. Routledge.

Koskela, L., 1992. Application of the New Production Philosophy to Construction. Retrieved from: http://www.leanconstruction.org/media/docs/Koskela-TR72.pdf

Koskela, L. (1993). Lean production in construction. Retrieved from: http://www.iaarc.org

Koskela, L., Vrijhoef, R. (2001) Is the current theory of construction a hindrance to innovation? *Building Research & Information*, 29(3).

Kothari, C. R. (2020). *Research Methodology Methods and Techniques*. 2nd Revised Ed.

Kotler, P and Kevin L. K. (2013). *Framework for Marketing Management: Global Edition*. Pearson Education.

Koutsogiannis, A. (2017). *Construction Project Management Processes: Everything You Need to Know*. Retrieved from: https://geniebelt.com/blog/construction-project-management-processes

Kozak-Holland, M. (2011). *The history of project management*. Oshawa, ON, Canada: Multi-Media Publications.

KPMG (2019). *Future-Ready Index- Leaders and followers in the engineering & construction industry*. Global Construction Survey

Kriegenbergh, V. (2021). Agile Manifesto: The Complete Guide. https://www.agile-arthur.com/

Krimi, I., Lafhaj, Z., and Ducoulombier, L. (2017). Prospective study on the integration of additive manufacturing to building industry—Case of a French construction company. *Additive Manufacturing*, *16*, 107-114.

Krog C. L and Govender K. (2015). The Relationship Between Servant Leadership and Employee Empowerment, Commitment, Trust and Innovative Behaviour: A Project Management Perspective. *SA Journal of Human Resource Management*, 13(1).

Krosnick J. A. and Presser S. (2010). *Question and Questionnaire Design*: Handbook of Survey Research, 2nd Ed. Emerald Group Publishing Ltd. ISBN: 978-1-84855-224-1

Kruskal, W.H. Wallis, W.A. (1952). Use of Ranks in One-Criterion Variance Analysis. *Journal of the American Statistical Association*, 47(260).

Ku, P. (2018). 4 Values of the Agile Manifesto and 12 Agile Principles Easily Explained. Retrieved from: https://medium.com

Kuada, J. (2012). Research Methodology: *A Project Guide for University Students*, Samfundslitteratur Press, Frederiksberg.

Kuhn, T. S. (1962). *The structure of scientific revolutions*. (1st Edn). Chicago, IL: University of Chicago Press

Kukhnavets, P., 2018. All We Should Know About Scrum Project Management: The Beginner’s Guide. Retrieved from: https://hygger.io

Kulatunga, U; Amaratunga, R. D. G and Haigh, R. (2014). *Performance Measurement Applications within the UK Construction Industry: A Literature Review*. Institute of Built and Human Environment, University of Salford.

Kumar, K and Welke, R. J. (1992). *Methodology Engineering: A proposal for Situation-Specific Methodology Construction.* In Challenges and Strategies for Research in Systems Development, W. W. Cotterman and J. A. Senn, Eds. New York: John Wiley & Sons, pp. 257-269.

Kumar, R., 2019. *Research Methodology: A Step-by-Step Guide for Beginners*. Sage Publications

Kumar, S. S and McArthur, J. (2015). Streamlining Building Information Model Creation Using Agile Project Management. *WIT Transactions on the Built Environment, 149, 229–240.*

Kumar, V. S. (2012). *Project managers as creative and innovative leaders*. Paper presented at PMI® Global Congress 2012—North America, Vancouver, British Columbia, Canada. Newtown Square, PA: Project Management Institute.

Kurup, D and Sidhardhan, S. K. (2015). *Agile Project Management – Benefits and Challenges.* Research Paper for ISM6316.001 Project Management University of South Florida.

Kvale, Steinar and Brinkmann, Svend (2009). *Interviews: Learning the craft of qualitative research interviewing*, 2nd ed. Thousand Oaks, CA: Sage.

Kwak, Y. H., & Anbari, F. T. (2009). Availability-impact analysis of project management trends: Perspectives from allied disciplines. *Project Management Journal*, 40(2), 94–103. doi.org/10.1002/pmj.20111

Kwak, Y-H. (2003). *Brief History of Project Management in The Story of Managing Projects: An Interdisciplinary Approach*. USA: Greenwood Publishing Group. ISBN: 1-56720-506-2.

Kylili, A, Fokaides, P. A and Jimenez, P. A. L. (2016). Key Performance Indicators (KPIs) approach in buildings renovation for the sustainability of the built environment: A review Renewable and Sustainable Energy Reviews, 56, 906-915

Laanti, M., Simila, J., and Abrahamsson, P. (2013). Definitions of agile ¨ software development and agility. In *Systems, Software and Services Process Improvement* (pp. 247–258). Springer.

Lacey, A., 2010. *The Research Process*. Wiley & Sons Inc.

Lachapelle, E., and Hundozi, B. (2018). ISO 31000:2018, Risk management–guidelines, www.pecb.com Eskander, R. F. A. (2018). Risk assessment influencing factors for Arabian construction projects using analytic hierarchy process. *Alexandria Engineering Journal*, 57(4).

Laerd Statistics. (2018). *Pearson Product-Moment Correlation.* Retrieved from: https://statistics.laerd.com/

Lalmi, A., Fernandes, G., and Souad, S. B. (2022). A conceptual hybrid project management model for construction projects. *Procedia Computer Science*, *181*, 921-930.

Landrum, N.E., Howell, J.P., Pari, L., 2000, *Leadership for strategic change, Leadership and Organisation development journal*, MCB University press. 21(3), pp150-156.

Langford, D, and Murray, M. (2008). *Construction Reports 1944-98*. John Wiley & Sons, Incorporated, Oxford.

Lappalainen, T. (2020). *Self-organizing teams and lean thinking in construction business*. UEF Repository. Retrieved from: erepo.uef.fi

Lappe, M., and Spang, K. (2014). Investments in project management are profitable: A case study-based analysis of the relationship between the costs and benefits of project. *International Journal of Project Management*, 32(4), 603–612.

Lappo, P, Andrew, H. C.T. (2004). *Assessing Agility*. Lecture Notes on Computer Science, Springer-Verlag, Germany, pp. 331-338.

Larsen, J. K, Shen, G. Q, Lindhard, S. M, Brunoe, T. D. (2016). Factors affecting schedule delay, cost overrun, and quality level in public construction projects. *J Manage Eng* 32(1). doi: https://doi.org/10.1061/(asce)me.1943-5479.0000391

Larsen, J.K, Shen, G.Q, Lindhard, S.M and Brunoe, T.D. (2015), Factors Affecting Schedule Delay, Cost Overrun and Quality Level in Public Construction Projects. *Journal of Management in Engineering*, 32(1).

Larsson, J., Eriksson, P. E., Olofsson, T., and Simonsson, P. (2015). Leadership in civil engineering: Effects of project managers' leadership styles on project performance. *Journal of Management in Engineering*, 31(6).

Lasley, V. L. (2019). *Redefining Construction "As-Built" Plans to Meet Current Kentucky Transportation Cabinet Needs*. University of Kentucky.

Lather, P. (1986). *Research as praxis*. Harvard Educational Review, 56(3)

Lature, A and Hinge, G. A. (2015). Study of Impacts due to Work Change on Performance of Construction Projects. *International Journal of Engineering Research & Technology (IJERT)*, 4(5).

Law, A. M. (2007). *Simulation modelling and analysis*, 4th Ed., McGraw-Hill, New York.

Layman, L, Williams, L and Cunningham, L., 2004. Exploring Extreme Programming in Context: An Industrial Case Study. Proceedings of the Agile Development Conference (ADC'04) Retrieved from: https://ieeexplore.ieee.org

Layton, M. C, Ostermiller, S. J and Kynaston, D. J. (2020). *Agile Project Management for Dummies*. 3rd ed. John Wiley and Sons Inc.

Layton, M. C., 2012. *Agile Project Management for Dummies Cheat Sheet*. Retrieved from: https://www.dummies.com

Lê, J. K., and Schmid, T. (2022). The Practice of Innovating Research Methods. *Organizational Research Methods*, *25*(2), 308–336.

Leach, L. P. (2014). *Critical Chain Project Management.* Boston: Artech House

Lebas, M. J. (1995). Performance Measurement and Performance Management. *International Journal of Production Economics*, 41(1-3).

Lee S, Pena-Mora F, Park M. 2006. Web-enabled system dynamics model for error and change management on concurrent design and construction projects. *Journal of Computing and Civil Engineering*. 20(4).

Lee S, Yu J, and Jeong, D. 2015. BIM acceptance model in construction organizations. *J Manage Eng.* 31 (3):4014048.

Lee, W. (2017). Sustainability of Non-profit human service organizations in a neighbourhood context. *Non-profit Management. Leadership*. 28, 11–24

Lee-Kelley, L and Loong, K. L. (2003). Turner's five-functions of project-based management and situational leadership in IT services projects. *International Journal of Project Management*, 21, 583–591.

Leffingwell, D. (2007). *Scaling software agility: Best practices for large enterprises*. Boston, MA: Addison–Wesley, Pearson Eduaction Inc.

Lehmann, J. (2003). *Virtual meetings: not just an option anymore*. Proceedings of the 2003 IEEE Managing Technologically Driven Organizations: The Human Side of Innovation and Change, pp. 443 - 447.

Lehmann, V. (2010). Connecting changes to projects using a historical perspective: Towards some new canvases for researchers. *International Journal of Project Management*, 28(4), 328-338.

Lehtinen, T. O., Mäntylä, M. V., Vanhanen, J., Itkonen, J., and Lassenius, C. (2014). Perceived Causes of Software Project Failures–An Analysis of their Relationships. *Journal of Information and Software Technology*

Lekan, A., Clinton, A., Fayomi, O. S. I and James, O. (2020). Lean thinking and industrial 4.0 approach to achieving construction 4.0 for industrialization and technological development. *Buildings*, *10*(12), 221.

Lester, S. (1999). *An Introduction to Phenomenological Research*. Taunton UK: StanLester Developments

Levine, A, Sober, E and, Wright E. O., 1987. *Marxism and Methodological Individualism.* New Left Review 162.

Levitt, R. E. (2007). CEM research for the next 50 years: maximizing economic, environmental, and societal value of the built environment. *Journal of construction engineering and management*, 133(9), 619–628.

Lewin, K. (1947). Frontiers in Group Dynamics: Concept, Method and Reality in Social Science; Social Equilibria and Social Change. *Human Relations*, 1(1), 5–41. https://doi.org/10.1177/001872674700100103

Lewis, J. P. (1995). *Fundamentals of Project Management*. AMACOM Books

LIANG, J., and Shekhar, S. (2018). Agile Adoption In Investment Banks. Retrieved from https://digitalcommons.harrisburgu.edu/pmgt_dandt/34.

Lichtenthaler, U. (2020). A Conceptual Framework for Combining Agile and Structured Innovation Processes. *Research-Technology Management*, 63(5), 42-48.

Lijauco, F, Gajendran, T, Brewer, G and Rasoolimanesh, S. M. (2019). Impacts of Culture on Innovation Propensity in Small to Medium Enterprises in Construction. *Journal of Construction Engineering and Management*. 146(3).

Lim, L. G, Tuli, K. R and Grewal, R. (2020). Customer Satisfaction and Its Impact on the Future Costs of Selling. *Journal of Marketing*, 84(4).

Lim, S., Buswell, R. A., Le, T. T., Austin, S. A., Gibb, A. G., & Thorpe, T. (2012). Developments in construction-scale additive manufacturing processes. *Automation in construction*, *21*, 262-268.

Linder, J. C., S. Jarvenpaa, and T. H. Davenport. (2003). “Toward an innovation sourcing strategy.” *MIT Sloan Manage. Rev*. 44 (4).

Lindstrom, L and Jeffries, R. (2004). Extreme Programming and Agile Software Development Methodologies. *Information Systems Management*

Lines, B. C, Sullivan, K, T, Smithwick, J. B and Mischung, J. (2015). Overcoming resistance to change in engineering and construction: Change management factors for owner organizations. *International Journal of Project Management*, 33(5).

Ling, F. Y, Dulaimi, M. F, Kumaraswamy, M and Bajracharya, A. (2003). A case study of the management of innovation implementation within a construction project organization. *Int J Constr Manage*. 3(2):79–91.

Linke, K. (2019). *Traditional and Agile Management Approaches*. University of Applied Sciences Weserbergland.

Linneberg, M. S and Korsgaard, S, K. (2019). Coding qualitative data: a synthesis to guide the novice. *Qualitative Research Journal*, 19(3) pp. 259-270

Liphadzi, M, Aigbavboa, C and Thwala, W. (2015). Leadership Styles of Construction Project Leaders—A Theoretical Perspective. *Journal of Civil Eng. Environ. Technol.* 2 (14).

Lipovetskyet, S; Dvir, D; Tishler, A and Shenhar, A. (2014). The Relative Importance of Success Dimensions in Defence Development Projects. Research Gate Retrieved from: https://www.researchgate.net/publication/262836785 DOI:10.13140/RG.2.2.19281.89440

Liu, A. M. M., and Chan, I. Y. S. (2017). Understanding the Interplay of Organizational Climate and Leadership in Construction Innovation. *Journal of Management in Engineering*, 33(5).

Liu, J and Shi, G. (2017). Quality Control of a Complex Lean Construction Project Based on KanBIM Technology. *EURASIA Journal of Mathematics Science and Technology Education*, 13(8).

Liu, J, Shahi, A, Haas, C. T, Goodrum, P and Caldas, C. H. (2014). Validation Methodologies and their Impact in Construction Productivity Research. *Journal of Construction Engineering and Management*, DOI:10.1061/(ASCE)CO.1943-7862.0000882.

Liubchenko, V. (2016). *A Review of Agile Practices for Project Management*. XIth International Scientific and Technical Conference Computer Sciences and Information Technologies (CSIT).

Liyanage, C. (2006). *The Role of Facilities Management in the Control of Healthcare Associated Infections (HAI*). School of the Built and Natural Environment, Glasgow Caledonian University.

Locatelli, G.; Littaub, P; Brookesc, N. J and Mancini, M. (2014). *Project Characteristics Enabling the Success of Megaprojects: An Empirical*

Investigation in The Energy Sector. *Procedia* - Social and Behavioral Sciences 119:625–634. DOI:10.1016/j.sbspro.2014.03.070

Lockett, M; Reyck, B. D and Sloper, A. (2008). *Managing Project Portfolios*. Business Strategy Review

Loosemore, M. (2003). *Essentials of construction project management*. UNSW Press.

Loosemore, M. (2015). *Grassroots innovation in the construction industry*. In Construction Innovation, 65–78. New York: Wiley.

Loosemore, M., and J. Richard. (2015). Valuing innovation in construction and infrastructure: Getting clients past a lowest price mentality." *Eng. Constr. Archit. Manage.* 22 (1).

López-Alcarria, A, Olivares-Vicente, A and Poza-Vilches, F. (2019). A Systematic Review of the Use of Agile Methodologies in Education to Foster Sustainability Competencies. *Sustainability*. 11(10). DOI:10.3390/SU11102915

Love, P. E., & Holt, G. D. (2000). Construction business performance measurement: the SPM alternative. *Business Process Management Journal*, 6(5).

Love, P. E., Holt, G. D., Shen, L. Y., Li, H., & Irani, Z. (2002a). Using system dynamics to better understand change and rework in construction project management systems. *International Journal of Project Management*, 20(6), 425-436.

Love, P., Edwards, D. and Wood, E. (2011). Loosening the Gordian Knot: The Role of Emotional Intelligence in Construction. *Engineering, Construction and Architectural Management*, 18(1).

Love, P.E.D., Edwards, D.J., Han, S. and Goh, Y.M. (2011), "Design error reduction: toward the effective utilization of building information modelling", *Research in Engineering Design*, 22(3).

Low, S. P. and Mok, S. H. (1999) The application of JIT philosophy to construction: a case study in site layout. Construction Management and Economics, 17, 657–68.

Lu, M and Li, H., 2003. Resource-Activity Critical-Path Method for Construction Planning. *Journal of Construction Engineering and Management*. 129(4) DOI:10.1061/(ASCE)0733-9364(2003)129:4(412)

Lu, S. L., and Sexton, M. (2010). Career journeys and turning points of senior female managers in small construction firms. *Construction Management and Economics*, 28(2), 125–139. https://doi. org/10.1080/01446190903280450.

Lu, W.S. (2006) *A system for assessing and communicating contractors' competitiveness*. Thesis submitted to the Degree of Doctor of Philosophy in the Department of Building and Real Estate, the Hong Kong Polytechnic University, Hong Kong.

Lucidchart. (2017). *What the Waterfall Project Management Methodology Can (and Can't) Do for You*. Retrieved from: https://www.lucidchart.com

Lucidchart. (2018). The 4 Phases of the Project Management Life Cycle. Retrieved from: https://www.lucidchart.com

Lucko, G and Rojas, E. M. (2010). Research Validation: Challenges and Opportunities in the Construction Domain. *Journal of Construction Engineering and Management*, 136(1).

Luqman, A. (2006). *Comparison of Configuration Management Activities Between Prince 2 & CMMI 1*.1, IEEE—ICET 2006, 2nd International Conference on Emerging Technologies Peshawar, Pakistan 13-14 November 2006.

Lyneis, J. M, Cooper, K. G and Els, S. A. (2001). Strategic Management of Complex Projects: A Case Study Using System Dynamics. *System Dynamics Review*. 17(3):237 – 260. DOI:10.1002/sdr.213

Lynn, R. (2021). *Disadvantages of Agile*. Planview, Inc.

Mac Naughton, G, Rolfe S. A and Siraj-Blatchford, I. (2001). *Doing Early Childhood Research: International Perspectives on Theory and Practice*. Australia: Allen & Unwin.

MacCrimmon, K. R and Ryavec, C. A. (1964). *An Analytical Study of the PERT Assumptions*. The RAND Corporation. Retrieved from: https://www.researchgate.net

MacDonald, S and Headlam, N. (2011). *Research Methods Handbook: Introductory Guide to Research Methods for Social Research*. The Centre for Local Economic Strategies (CLES). Retrieved from: http://www.cles.org.uk

Mack, N, Woodsong, C, Macqueen, K. M, Guest, G and Namey, E. (2011). *Qualitative Research Methods: A Data Collector's Field Guide.* Retrirved from: https://www.fhi360.org

Mackenzie, N and Knipe, S. (2006). *Research Dilemmas: Paradigms, Methods and Methodology.* Issues in Educational Research, Vol 16

MacKenzie, S, Kilpatrick, A. R and Akintoye, A. (2000). UK Construction Skills Shortage Response Strategies and an Analysis of Industry Perceptions. *Construction Management and Economics*. 18(7).

Macmillan, S, Steele, J, Kirby, P, Spence, R and Austin, S. (2002). *Mapping the Design Process During the Conceptual Phase of Building Projects*. Retrieved from: https://s3.amazonaws.com

Madanian, S., Subasinghage, M., and Tachiona, S. C. (2021). *Critical Success Factors of Agile ERP Development and Implementation Projects: A Systematic Literature Review.* Conference: A Renaissance of Information Technology for Sustainability and Global Competitiveness. 17th Americas Conference on Information Systems, AMCIS 2011, Detroit, Michigan, USA, August 4-8.

Mafakheri, F., Nasiri, F., Mousavi, M. (2008). Project agility assessment: an integrated decision analysis approach. *Prod. Plan. Control* 19, 567–576.

Maglathlin, P. (2020). *Technology Drives Innovation in the Construction Industry*. Association for General Contractors. Retrieved from: https://www.constructormagazine.com/

Magon, R. B, Thomé, A. M. T, Ferrer, A. L. C and Scavarda, L.F. (2018). Sustainability and performance in operations management research. *J. Clean. Prod.* 190, 104–117.

Magretta, J. (2012), *Understanding Michael Porter: The Essential Guide to Competition and Strategy,* Harvard Business Review Press, Boston, MA.

Mah, M. (2008). *Measuring Agile in the Enterprise*. Proceedings of the Agile Conference. Toronto, Canada

Mahamid, I. (2016). Factors contributing to poor performance in construction projects: studies of Saudi Arabia. *Australian Journal of Multi-Disciplinary Engineering*, *12*(1), 27-38.

Mahamid, I., A. Bruland, and N. Dmaidi. 2012. “Delay Causes in Road Construction Projects.” ASCE Journal of Management in Engineering 28 (3): 300–310.

Mahalakshmi, M and Sundararajan, M. (2013). Traditional SDLC Vs Scrum Methodology – A Comparative Study. *International Journal of Emerging Technology and Advanced Engineering.*

Mahamadu, A., Mahdjoubi, L., & Booth, C. A. (2014). *Determinants Of Building Information Modelling (BIM) Acceptance For Supplier Integration : A Conceptual Model.* In Procs 30th Annual ARCOM Conference (pp. 723–732).

Mahamid, I., & Dmaidi, N. (2013). Risks leading to cost overrun in building construction from consultants' perspective. *Organization, Technology & Management in Construction: An International Journal,* 5(2).

Mahendra, P. A., Pitroda, J. R. and Bhavsar, J. J. (2013). A study of risk management techniques for construction projects in developing countries. *International Journal of Innovative Technology and Exploring Engineering,* 3(5).

Maital, S and Barzani, E. (2020). *The Global Economic Impact of COVID-19: A Summary of Research.* The Samuel Neaman Institute. Retrieved from: https://www.neaman.org.il/

Maja, M. (2017). Traditional Project Management. Retrieved from: https://activecollab.com

Majchrzak M., M. Chrusciel, J. Jedrzejczyk, and L. Madeyski. (2017). Factors Influencing User Story Estimations In Large Agile Engagements: An Industrial Interview and a Conceptual Model. *Central and Eastern European Journal of Management and Economics* 4 (4): 261–280.

Malone, A. (2017). Procurement. In *BIM and Quantity Surveying* (pp. 82-102). Routledge.

Malcolm, D. G, Roseboom, J. H, Clark, C. E, and Fazar, W., 1959. 'Application of a Technique for Research and Development Program Evaluation. Retrieved from: http://mech.vub.ac.be

Malik, A., Adekoya, O. D., Ajonbadi, H. A., and Jimoh, I. (2019). Investigating the Potential Economic Impact of Brexit Decisions on Business Performance in the United Kingdom: A Case Study of the UK Construction Industry. *International Journal of Management, Accounting and Economics,* 6(4).

Malsam, W. (2018). PRINCE2: An Introduction to the Project Management Methodology. Project Manager. Retrieved from: https://www.projectmanager.com/

Manikandan S. (2011). Measures of dispersion. *Journal of pharmacology & pharmacotherapeutics*, 2(4):315-6. DOI:10.4103/0976-500X.85931

Manley, K and Mcfallan, S. (2006). Exploring the drivers of firm-level innovation in the construction industry. *Construction Management and Economics*. 24, 911–920.

Manseau, A. (2019). Construction - A Changing Industry Challenging Current Innovation Models, In Building Tomorrow: Innovation in Construction and Engineering. Retrieved from: https://www.taylorfrancis.com/

Manuti, A, Pastore, S, Scardigno, A. F, Giancaspro, M. L and Morciano, D. (2015). Formal and Informal Learning in the Workplace: A Research Review. *International Journal of Training and Development*, 19(1)

Maqbool, R, Sudong, Y, Manzoor, N, Rashid, Y. (2017). The Impact of Emotional Intelligence, Project Managers' Competencies and Transformational Leadership on Project Success: An Empirical Perspective. *Project Management Journal*, 48(3).

Marcus, G. E. (1994). '*What Comes (Just) After "Post'": The Case of Ethnography'*, in N.K. Denzin and Y.S. Lincoln (eds) Handbook of Qualitative Research. Thousand Oaks, CA: Sage.

Marić, A. (2017). Comparison of project management frameworks and tools and their impact on project success. In *2nd International Scientific Conference LEAN Spring Summit*.

Markovic, I. (2019). *Gap analysis: What it is and why it's important in project management*. TMS-Outsource.

Marle, F and Vidal, L. (2016). *Limits of Traditional Project Management Approaches when Facing Complexity*. In: Limits of Traditional Project Management Approaches When Facing Complexity. ResearchGate. Retrieved from: https://www.researchgate.net/

Marshal, C and Rossman, G. B. (2016). *Designing Qualitative Research*. 6th ed. Thousand Oaks, CA: Sage Publications.

Marshburn, D. G. (2018). *Scrum Retrospectives: Measuring and Improving Effectiveness*. SAIS Proceedings. 26.https://aisel.aisnet.org/sais2018/26

Martin, Brian R. (2011). *Nuclear and Particle Physics: An Introduction*, Wiley, ProQuest eBook Central.

Mas, A., Mesquida, A. L., & Pacheco, M. (2020). *Supporting the deployment of ISO-based project management processes with agile metrics*. Computer Standards & Interfaces, 70, 103405.

Masera, M. (2007). An Ontology Applied to The Management of the Construction Process Representing an Idef 0 Metamodel Integrated in A Planning / Design Structure Matrix. *Semantic Scholar, IRBNet*.

Mason, J. 2002. *Qualitative Researching*. 2nd ed. London: Sage

Masterman, J and Gameson, R. (2009). *Client Characteristics and Needs in Relation to their Selection of Building Procurement Systems*. Semantic Scholar.

Matavire, R and Brown, I., 2013. Profiling Grounded Theory Approaches in Information Systems Research. *European Journal of Information Systems*. 22(1):119-129, DOI:10.1057/ejis.2011.35

Mathers, N, Fox, N and Hunn, A. (2007). *Surveys and Questionnaires*. The NIHR Research Design Service for Yorkshire & the Humber

Matos, S and Lopes, E. (2013). *Prince2 or PMBOK – a question of choice.* Proceedings from: CENTERIS 2013 - Conference on ENTERprise Information Systems/PRojMAN 2013 - International Conference on Project MANagement / HCIST 2013 - International Conference on Health and Social Care Information Systems and Technologies.

Matos, S and Lopes, E., 2013. Prince2 or PMBOK – A Question of Choice. *Proceedings from International Conference on Project MANagement / HCIST*

Matovic, I. M. (2020). *Combining Agile and Traditional Project Management as a Better Approach to Project Implementation*. Proceedings from RAIS Conference Proceedings, DOI: 10.5281/zenodo.4412265.

Matt, G. (2020). *Agile methods: Fact or fiction*. Retrieved from: tcf.pages.tcnj.edu

Maurer, F., and Martel, S. (2002). Extreme programming: Rapid development for Web-based applications. *IEEE Internet computing*, (1), 86-90.

Mavi, R. K and Standing, C. (2018). Critical Success Factors of Sustainable Project Management in Construction: A fuzzy DEMATEL-ANP Approach. *Journal of Cleaner Production.* 194, DOI:10.1016/j.jclepro.2018.05.120

Maxcy, S, J. (2003). *Pragmatic threads in mixed methods research in the social sciences: The search for multiple modes of inquiry and the end of the philosophy of formalism*. In Handbook of Mixed Methods in Social and

Behavioural Research. Edited by Abbas Tashakkori and Charles Teddlie. Thousand Oaks: Sage, pp. 51–89.

Maxwell, J. (2013). *Qualitative Research Design: An Interactive Approach,* 3rd ed. Thousand Oaks, Sage.

Mc George, D and Zou, P. (2013). *Construction Management: New Directions*. 3rd Edition. Wiley-Blackwell.

McAvoy, J. and Butler, T. (2009). The role of project management in ineffective decision-making within agile software development projects. *European Journal of Information Systems*, 18(4), pp. 372-383.

McBreen, P. (2002). *Questioning Extreme Programming*. The ACM Digital Library Retrieved from: https://dl.acm.org

McCann, A. (2017). *The Relevance of Project Management Best Practice and its Application in the UK Construction Industry*. University of Salford.

McCauley, R. (2001). *Agile Development Methods Poised to Upset Status Quo*. SIGCSE Bulletin 33(4): 14 - 15.

McClure, C. (2019). *Tailoring A Project Management Methodology: Best Practices for Tailoring and Implementing a Project Management Methodology*. Applied Information Management and the Graduate School of the University of Oregon.

McCormick, M. (2012). Waterfall vs. Agile Methodology. *MPCS, Inc*. Retrieved from: http://www.mccormickpcs.com

McGrath, S. K., & Whitty, S. J. (2019). What is a program? An examination of terminology in practitioner reference documents. *Journal of Modern Project Management*, 6(3),

McInroy, N., 2011. Centre for Local Economic Strategies. Research Methods Handbook Introductory Guide to Research Methods for Social Research. Retrieved from: http://www.cles.org.uk

McKinsey and Company. (2020). *The next normal in construction: How disruption is reshaping the world's largest ecosystem*. Retrieved from: https://www.mckinsey.com/

Mead, G. H. (1938). *Philosophy of the act*, The university of Chicago Press.

Mellado, F, Lou, E. C and Becerra, C. L. C. (2019). Synthesising performance in the construction industry: An analysis of performance indicators to promote project improvement. *Engineering, Construction and Architectural Management*. 27(2).

Meng X. 2012. The effect of relationship management on project performance in construction. *International Journal of Project Management*. 30(2):188–198.

Mention, A. L. (2011). Co-operation and co-opetition as open innovation practices in the service sector: Which influence on innovation novelty? *Technovation*, 31(1). DOI:10.1016/j.technovation.2010.08.002

Mercier, A. G and Nunnally, R. S. (1965). *The Critical Path Method: Its Fundamentals*. Retrieved from: andhttps://apps.dtic.mil/dtic/tr/fulltext/u2/475339.pdf

Meredith, J. R and Shafer, S. M. (2017). *Project Management in Practice*. 7th ed. Hoboken: Willey Publications.

Mergel, I., Ganapati, S., and Whitford, A. B. (2021). Agile: A new way of governing. *Public Administration Review*, *81*(1), 161-165.

Merriam, S. B and Tisdell, E. J. (2016). *Qualitative Research: A Guide to Design and Implementation*, 4th ed. San Francisco, CA, Jossey-Bass.

Merten, W., 1966. PERT and Planning for Health Programs. Public Health Reports Retrieved from: https://www.ncbi.nlm.nih.gov

Mertens, D. M. (2014) *Research and evaluation in education and psychology: Integrating diversity with quantitative, qualitative, and mixed methods*: Sage publications.

Mertens, D. M., 2005. *Research Methods in Education and Psychology: Integrating Diversity with Quantitative and Qualitative Approaches.* (2nd ed.) Thousand Oaks: Sage.

Mertler, C. (2017). Analysing Data In: Action Research: Improving Schools and Empowering Educators. *SAGE Publications*

Mesároš, P., Behúnová, A., Mandičák, T., Behún, M. and Krajníková, K. (2019). Impact of enterprise information systems on selected key performance indicators in construction project management: An empirical study. *Wireless Networks*, , pp. 1-8.

Meso, P and Jain, R. (2006). Agile Software Development: Adaptive Systems Principles and Best Practices. *Information Systems Management*

Mete, J. (2021). A Brief Study on Descriptive Research: Its Nature and Application in Social Science. *International Journal of Research and Analysis in Humanities*, 1(1).

Miles, M. B, Huberman, A. M and Saldana, J. (2014). *Qualitative Data Analysis: A Methods Sourcebook.* 3rd ed. Thousand Oaks, CA, Sage.

Miller, B. (2015). *The Purpose of Project Management and Setting Objectives*. Retrieved from: https://www.projectsmart.co.uk.

Miller, J. B, Garvin, M. J, Ibbs, C. W and Mahoney, S. E. (2000). Toward a New Paradigm: Simultaneous Use of Multiple Project Delivery Methods. *J. Manag. Eng.* 16(3), pp. 58– 67.

Millhiser, W. P and Szmerekovsky, J. G. (2012). Teaching Critical Chain Project Management: The Academic Debate and Illustrative Examples. *INFORMS Transactions on Education 12(2):67-77*

Mills, A. J, Durepos, G and Wiebe, E. (2022). *SAGE Research Methods Encyclopaedia of Case Study Research Coding: Open Coding.* SAGE Research Methods.

Milosevic, D and Patanakul, P. (2005). Standardized Project Management May Increase Development Projects Success. *International Journal of Project Management*. 3(3):181-192. DOI:10.1016/j.ijproman.2004.11.002

Mingers, J and Standing, C. (2016). A Framework for Validating IS Research Based on a Pluralist Account of Truth and Correctness. *Journal of the Association for Information Systems*, DOI:10.17705/1jais.00594

Miozzo, M., Dewick, P. (2002) Building Competitive Advantage: Innovation and Corporate Governance in European construction. *Research Policy*, 31(6).

Mir, F. A., & Pinnington, A. H. (2014). Exploring the value of project management: Linking project management performance and project success. *International Journal of Project Management*, 32(2), 202–217

Mirza, N. A, Akhtar-Danesh, N, Noesgaard, C, Martin, L and Staples, E. (2014). A concept analysis of abductive reasoning. *Journal of advanced nursing*, *70*(9), pp.1980-1994.

Mishra, D, Mishra. A. (2011). Complex Software Project Development: Agile Methods Adoption. *Journal of Software Maintenance and Evolution: Research and Practice,* 23(8)

Mitchell, J., Boettcher-Sheard, N., Duque, C., and Lashewicz, B. (2018). Who do we think we are? Disrupting notions of quality in qualitative research. *Qualitative Health Research*, 28(4).

Mitropoulos, P., and Cupido, G. (2009). "The role of production and teamwork practices in construction safety: A cognitive model and an empirical case study. *Journal of Safety Research*, 40(4), 265-275.

Mitropoulos, P., Tatum, C.B. (1999) Technology adoption decisions in construction organizations. *Journal of Construction Engineering and Management*, 125(5).

Mittal, V, Anderson, E, W, Sayrak, A and Tadikamalla, P. R. (2005). Dual Emphasis and the Long-Term Financial Impact of Customer Satisfaction. *Marketing Science*, 24 (4)

Miu, M., 2015. *Events in Scrum.* Retrieved from: https://medium.com

Mkansi, M and Acheampong, E. A. (2012). Research philosophy debates and classifications: students' dilemma. *Electronic journal of business research methods*, *10*(2), pp132-140.

Moe, N, Dingsøyr, T and Dybå, T. (2008). Understanding Self-Organizing Teams in Agile Software Development. *19th Australian Conference on Software Engineering (aswec 2008)*, 76-85.

Moerer-Urdahl, T and Creswell, J. W. (2004). Using Transcendental Phenomenology to Explore the "Ripple Effect" in a Leadership Mentoring Program. *International Journal of Qualitative Methods*

Mohanty, P. (2011). Project Management Evolution Timeline. Esoteric Nuggets. http://esotericnuggets.blogspot.com/

Mohammad, A.H. and Alwada'n, T. (2013). Agile software methodologies: strength and weakness. *International Journal of Engineering Science and Technology*, *5*(3), p.455.

Mohammed, K. N., and Chambrelin, K. S. (2020). An analytical approach in usage of agile methodologies in construction industries–A case study. *Materials Today: Proceedings*, *33*, 475-479.

Mokhtariani, M, Sebt, M. H and Davoudpour, H. (2017). Characteristics of the Construction Industry from the Marketing Viewpoint: Challenges and Solutions. *Civil Engineering Journal*

Molenaar, K, Sobin, N, Gransberg, D, McCuen, T. L, Korkmaz, S and Horman, M. (2009). *Sustainable, High-Performance Projects and Project Delivery Methods*. The Charles Pankow Foundation and The Design-Build Institute of America

Molwus, J. J., 2014. *Stakeholder Management in Construction Projects: A Life Cycle Based Framework.* Ethos. Retrieved from: https://ethos.bl.uk

Moncaster, A and Dillon, M. (2018). *How gender equality can help fix the construction industry*. The Conversation.

Moon, K and Blackman, D. (2017). *A guide to ontology, epistemology, and philosophical perspectives for interdisciplinary researchers*. Integration and Implementation Insights.

Moon, K., and Blackman, D. (2014). *A Guide to Understanding Social Science Research for Natural Scientists. Conservation Biology*, 28: 1167-1177. Online: http://onlinelibrary.wiley.com/doi/10.1111/cobi.12326/full

Morfaw, J. (2014). *Fundamentals of project sustainability*. Paper presented at PMI® Global Congress 2014—North America, Phoenix, AZ. Newtown Square, PA: Project Management Institute.

Morgan, B., 2016. *Why lean fails so often*. Association for Manufacturing Excellence Retrieved from: https://www.ame.org/target/articles/2016/why-lean-fails-so-often

Morgan, D, L. (2014a). *Integrating Qualitative and Quantitative Methods: A Pragmatic Approach*. Thousand Oaks: Sage.

Morgan, D, L., 2007. Paradigms Lost and Pragmatism Regained. Methodological Implications of Combining Qualitative and Quantitative Methods. *Journal of Mixed Methods Research*

Morgan, D. L., 2013. Pragmatism as a Paradigm for Social Research. *Qualitative Inquiry*, 20(10)

Moriel, R. (2017). *Feasibility in Applying Agile Project Management Methodologies To Building Design and Construction Industry*. Retrieved from http://digitalcommons.harrisburgu.edu/pmgt_dandt/22

Morris, P.W.G and Hough, H.G. (1987). The anatomy of Major Projects: A Study of the Reality of Project Management. *International Nuclear Information System*

Morris, P.W.G. (1994). *Managing Project Management Knowledge for*

Organizational Effectiveness. Retrieved from: http://citeseerx.ist.psu.edu

Morris, P.W.G. (2013). *Reconstructing Project Management*. Wiley Blackwell, Hoboken NJ.

Morris, R. A. (2008). Stop the Insanity of Failing Projects. *Industrial Management*

Morse, J, M and Niehaus, L. (2009). *Mixed Method Design: Principles and Procedures.* Routledge. London

Morse, J. M. (2016). *Mixed Method Design: Principles and Procedures*. Routledge

Moser, P. K. (2015). *Epistemology*. Loyola University Chicago. Retrieved from: https://www.researchgate.net

Mosey, D. (2009). *Saving the best for last: Wolstenholme Report*. Retrieved from: https://www.building.co.uk

Mosey, D. (2021). *Constructing the Gold Standard: An Independent Review of Public Sector Construction Frameworks.* Centre of Construction Law, King's College London

Mosey, D. (2014). *Project Procurement and Delivery Guidance: Using Two Stage Open Book and Supply Chain Collaboration*. (pp. 1-62). King's College London.

Mossman, A. (2009). "There really is another way, if only he could stop … for a moment and think of it"—Why isn't the UK construction industry going lean with gusto?. *Lean Construction Journal* 2009 pp 24 – 36

Mottawa I A., Price A D F., and Sher W., (1998) *The introduction and management of innovative construction processes and products*. 14th Annual ARCOM Conference. University of Reading. 2 672-682

Mottram, C and McDermott, P. (2002). The Implications and Impact of the 'Rethinking Construction' Agenda (Particularly Partnering) on the UK Construction Industry. Retrieved from: https://www.irbnet.de/

Moullin, J. C, Sabater-Hernández, D, Fernandez-Llimos, F and Benrimoj, S. I. (2015). A systematic review of implementation frameworks of innovations in healthcare and resulting generic implementation framework. *Health Research Policy and Systems*. 13(16).

Mubarak, S. A., 2015. Construction Project Scheduling and Control (3rd Edition). *John Wiley & Sons, Incorporated, Somerset*

Muhammed, T. A., 2015. Delays in Construction Projects. *Research Gate*. Retrieved from: https://www.researchgate.net/publication/306032747

Mukherji, P and Albon, D. (2015). *Research Methods in Early Childhood. An Introductory Guide*. 2nd ed. London: Sage Publications.

Mullin, P, Thurairajah, N and Williams, A. (2019). *Using Skills Gap Analysis in Construction Management to Stimulate a Demand led Model of Curriculum*. Conference Paper.

Munassar, N. M and Govardhan, A. (2010). A Comparison Between Five Models of Software Engineering. *IJCSI International Journal of Computer Science Issues*, Vol. 7

Munns, A. K and Bjeirmi, B. F., 1996. The Role of Project Management in Achieving Project Success. *International Journal of Project Management.* 14(2): pp. 81-87

Murphy, B, Bird, C, Zimmermann, T, Williams, L, Nagappan, N and Begel, A. (2013). *Have Agile Techniques been the Silver Bullet for Software Development at Microsoft?*, ACM / IEEE International Symposium on Empirical Software Engineering and Measurement, 2013, pp. 75-84, doi: 10.1109/ESEM.2013.21.

Murphy, M. E, Perera, S and Heaney, G. (2015). Innovation management model: a tool for sustained implementation of product innovation into construction projects. *Construction Management and Economics,* 33(3).

Murray, A., 2011. PRINCE2® in One Thousand Words. *White Paper* Retrieved from: https://www.trainingbytesize.com

Murray, M. (2018). *Narrative Data*. In U. Flick (ed.) (2018) Sage Handbook of Qualitative Data Collection. London: Sage. Pp. 264-279

Musarat, M. A, Alaloul, W, S and Liew, M. S. (2021). Impact of inflation rate on construction projects budget: A review. *Ain Shams Engineering Journal*.

Myers M. D and Avison, D. (2002). *Qualitative Research in Information Systems: A Reader.* Sage

Naik, N and Jenkins, P. (2020). A Web Based Method for Managing PRINCE2® Projects Using Trello®. *International Symposium on Systems Engineering (ISSE)*, Edinburgh, United Kingdom, 2019, pp. 1-3.

Nakayama, M, Hustad, E and Sutcliffe, N. (2021). *Agility and system documentation in large-scale enterprise system projects: a knowledge management perspective*. CENTERIS - International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies 2020

Nam, C. H., and C. B. Tatum. (1997). Leaders and champions for construction innovation. *Constr. Manage. Econ*. 15 (3).

Nam, C.H., Tatum, C.B. (1989) Toward understanding of product innovation process in construction. *Journal of Construction Engineering and Management*, 115(4).

Nandhakumar, J and Avison, J. (1999). The Fiction of Methodological Development: A Field Study of Information Systems Development. *Information Technology & People*, vol. 12, pp. 176-191.

Naoum, S, Lock, K and Fong, D., 2010. Is Fragmentation of The UK Construction Industry? The Main Barrier to Innovation? The Architects' Views? Retrieved from: https://www.researchgate.net/publication/270802558

Naoum, S. G, Harris, J, Rizzuto, J and Egbu, C. (2020). Gender in the Construction Industry: Literature Review and Comparative Survey of Men's and Women's Perceptions in UK Construction Consultancies. Gender in the Construction Industry: Literature Review and Comparative Survey of Men's and Women's Perceptions in UK Construction Consultancies. *Journal of Management in Engineering*, 36(2).

Nasim, A, Seyed, E. H, Abdul, H. B and Nazirah, Z. A. (2019). *Management Criteria for Green Building in Malaysia; Relative Important Index.* In: Energy Sources, Part A: Recovery, Utilization, and Environmental Effects, DOI: 10.1080/15567036.2019.1568634

National Association for Women in Construction. (2018). *Statistics of Women in Construction.* Retrieved from: https://www.nawic.org/statistics

National Association of Women in Construction. (2020). *Statistics of women in construction*. Retrieved from: https://www.nawic.org/nawic/Statistics.asp

National Health Service, (2003). *PRINCE2 Case Study*. The APM Group Limited, Bucks, UK.

National Institute for Children's Health Quality. (2022). *5 Reasons Why Evaluation Matters to Your Project.* Insights.

Navarro-Astor, E., Román-Onsalo, M., & Infante-Perea, M. (2017). Women's career development in the construction industry across 15 years: Main barriers. *Journal of Engineering Design and Technology*, 15(2), 199–221. https://doi.org/10.1108/JEDT-07-2016-0046

Nawi, M. N, M, Baluch, N and Bahauddin, A. Y. (2014). Impact of Fragmentation Issue in Construction Industry: An Overview. *MATEC Web of Conferences*. Retrieved from: https://www.matec-conferences.org/

Nawi, M.N.M., Lee, A. and Nor, K.M. (2011). Barriers to the implementation of Industrialiased Building System (IBS) in Malaysia. *The Built and Human Environment Review*.

Neamat, S and Yitmen, I. (2017). Factors Affecting the Innovation and Competitiveness in Kurdistan Region of Iraq Construction Industry. *International Journal of Advanced Engineering Research and Science (IJAERS)*, 4(2).

Neely A, Adams C and Kennerley, M. (2002). *The Performance Prism*. *The Scorecard for Measuring and Managing Business Success.* Pearson Education.

Neely, A, Gregory, M and Platts, K. (1995). Performance measurement system design - a literature review and research agenda. *Int. J. of Operations and Production Mgmt*. 15 80–116.

Neely, A. (1999). The performance measurement revolution: Why now and what next? *International Journal of Operations & Production Management*, 19(2)

Neely, A., and Austin, R., 2000. *Measuring operations performance: past, present, and future*. Neely, A. (Ed.), Performance Measurement: Past, Present and Future. *Centre for Business Performance, Cranfield*

Neely, A., Mills, J., Platts, K., Gregory, M. and Richards, H. (1996). 'Performance measurement system design: Should process based approaches be adopted?', *Int. J. Production Economics*, 46-47, 423-431.

Nelson, R. (2003) Obituary [for Keith Pavitt]. *Research Policy*, 32(10).

Nelson, R. R., 2007. It Project Management: Infamous Failures, Classic Mistakes, and Best Practices. *MIS Quarterly Executive*, 6(2),

Nerur, S, Mahapatra, R and Mangalaraj, G. (2005). Challenges of migrating to agile methodologies. *Commun. ACM*, 48(5), pp. 72–78, May 2005, doi: 10.1145/1060710.1060712.

Neubert, M. J. Hunter, E. M. and Tolentino, R. C. (2016). A servant leader and their stakeholders: when does organizational structure enhance a leader's influence?. *The Leadership Quarterly,* 27(6), pp. 896–910, 2016.

Newbold, R. C. (1998). *Project Management in Fast Lane*, *Applying the Theory of Constraints.* St. Lucie Press

Newkirk, J. (2002). Introduction to Agile Processes and Extreme Programming. ICSE Retrieved from: http://faculty.salisbury.edu

Newman, C, Edwards, D, Martek, I, Lai, J, Thwala, W. D and Rillie, I. (2020). Industry 4.0 deployment in the construction industry: a bibliometric literature review and UK-based case study. *Smart and Sustainable Built Environment*.

Newspapers.com. (2021). Lord Simon of Wythenshawe: A Long Career in Public Service. Retrieved from: https://www.newspapers.com/

Newton, P. (2015). *Project Management Processes: Project Skills*. Retrieved from: http://www.free-management-ebooks.com

Nguyen, H. M. and Mohamed, S. (2011). Leadership behaviors, organizational culture and knowledge management practices: An empirical investigation, *Journal of Management Development,* 30(2), 206 – 221.

Nguyen, L.H. and Watanabe, T. (2017). The impact of project organisation culture on the performance of construction projects. *Sustainability,* 9(5), pp. 1-21.

Nguyen, N. M, Killen, C. P, Kock, A and Gemünden, H. G. (2018). The Use of Effectuation in Projects: The Influence of Business Case Control, Portfolio Monitoring Intensity and Project Innovativeness. *International Journal of Project Management*, 36(8).

Nguyen, T. and Chileshe, N. (2015). Revisiting the construction project failure factors in Vietnam. *Built Environment Project and Asset Management*, 5(4).

Nguyen, T. S and Mohamed, S. (2020). *Interactive Effects of Agile Response-to-Change and Project Complexity on Project Performance*. Griffith University Retrieved from: https://www.researchgate.net/

Nicholson, R., 1999, Egan – Rethinking Construction. Paper presented at the Construction Productivity Network Seminar. *Royal Institution of British Architects*, Birmingham.

Nicolette, D. (2022). A Case For Short Iterations. Retrieved from: https://www.infoq.com/

Niglas, K. (2001) *Paradigms and methodology in educational research*. Paper presented at the European Conference on Educational Research.

Niranjan, V and Nisha, M. M. (2018). A Study on Quality Management System and Customer Satisfaction in Construction Companies with Special Reference to Coimbatore. *International Research Journal of Engineering and Technology (IRJET)*. 5(11).

Nishanthini, A and Nimalathasan, B. (2013). Determinants of profitability: A case study of listed manufacturing companies in Sri Lanka. *Merit Research Journal of Art, Social Science and Humanities*, 1(1).

Nissa, N. K. (2021). *A Quick Introduction: Agile Software Development Methodology.* Retrieved from: https://nzlul.medium.com/

Njuangang, S. (2014). *Raising the Profile of Facilities Management (FM) In Healthcare - Managing Performance of Infection Control*. ethos. University of Central Lancashire.

Noktehdan, M, Shahbazpour, M, Zare, M. R and Wilkinson, S. (2019). Innovation Management and Construction Phases in Infrastructure Projects. *J. Constr. Eng. Manage*, 145(2).

Noktehdan, M., M. Shahbazpour, and S. Wilkinson. 2015. “Driving innovative thinking in the New Zealand construction industry.” Buildings 5 (2).

Norberg, C., and Johansson, M. (2021). “Women and “ideal” women”: The representation of women in the construction industry. *Gender Issues, 38*, 1-24.

Nordmeyer, B., 2019. What Are the Pros & Cons of PERT Charts? *Chron.* Retrieved from: https://smallbusiness.chron.com

Northing ham Trent University. (2022). *What is the importance of a Project Manager in construction*? Retrieved from: https://online.ntu.ac.uk/

Nudurupati, S. S, Bititci, U. S, Kumar, V and Chan, F. T. S. (2011). State of the art literature review on performance measurement. *Computers and Industrial Engineering*.

Nudurupati, S., Arshad, T. and Turner, T. (2007) 'Performance measurement in the construction industry: An action case investigating manufacturing methodologies', Computers in Industry, 58, 667-676.

Nunnally J and Bernstein L. (1994). *Psychometric Theory*. New York: McGraw-Hill Higher, INC; 1994.

Nwabueze, U., and Mileski, J. (2018). Achieving competitive advantage through effective communication in a global environment. *Journal of International Studies*, *11*(1).

Oakland, J. S and Marosszeky, M. (2017). *Total Construction Management: Lean Quality in Construction Project Delivery*. Routledge, London.

Oberlender, G. D., 2014. *Project Management for Engineering and Construction*, 3rd ed. Access Engineering

O'Brien, M and Al-Soufi, A. (1994). A survey of Data Communications in the UK Construction Industry. *Journal of Construction Management and Economics*

Ochieng, E, Price, A and Moore, D. (2013). *Management of Global Construction Projects.* Palgrave, Macmillan.

OECD (Organisation for Economic Co-operation and Development). (2005). *Oslo manual: Guidelines for collecting and interpreting innovation data.* Paris: OECD.

OECD (Organisation for Economic Co-operation and Development). (2008). *Construction Industry.* Retrieved from: https://www.oecd.org

OECD Manual. (2001). *Measuring Productivity - Measurement of Aggregate and Industry-Level Productivity Growth.* Retrieved from: http://www.oecd.org/

Oesterreich, T.D. and Teuteberg, F. (2016). Understanding the implications of digitisation and automation in the context of Industry 4.0: a triangulation approach and elements of a research agenda for the construction industry. *Computers in Industry*, Vol. 83, pp. 121-139.

Office for National Statistics. (2015). *What is the productivity puzzle*? Retrieved from: https://www.ons.gov.uk/

Office for National Statistics. (2018). *Construction output in Great Britain: November 2018.* Retrieved from: https://www.ons.gov.uk

Office for National Statistics. (2020). *Construction output in Great Britain: April 2020.* Retrieved from: https://www.ons.gov.uk/

Office for National Statistics. (2021). *How has UK construction performed over the pandemic?* Retrieved from: https://blog.ons.gov.uk/

Office of Migrant Education. (2001). *Comprehensive Needs Assessment*. Archived Information

Royse, D and Badger, K. (2015). Needs Assessment Planning: Starting Where You Are. *Australian Social Work*, 68(3), 364–374.

Office of Nuclear Energy. (2021). *Fission and Fusion: What is the Difference*? Energy.Gov

Office, T. S. (2017). *Managing successful projects with PRINCE2*. The Stationery Office.

Ofori G, and Moonseo P. (2006) Stimulating Construction Innovation in Singapore through the National System of Innovation. *Journal of Construction Engineering and Management.* 132(10).

Ofori, G., 2015. Nature of the Construction Industry, Its Needs and Its Development: A Review of Four Decades of Research. *Journal of Construction in Developing Countries*

Ogunlana S. O. (2008). Factors and Procedures in Large Construction Projects in Vietnam. *Engineering, Construction and Architectural Management*, 11(6).

Okoroiwu, H. U and Akwiwu, E. C. (2019). Choice of Parametric and Non-Parametric Statistical Procedures in Clinical and Biomedical Research. *Sokoto Journal of Medical Laboratory Science,* 4(2).

Olaniran, H. F. (2015). On the role of communication in construction projects in Nigeria. *Journal of Environmental Science and Technology*, *2*(5), 048-054.

Olanrewaju, A. L and Abdul-Aziz, A. R. (2015*). Building Maintenance Processes and Practices. The Case of a Fast-Developing Country*. Springer

Olanrewaju, A. L, Tan, S. Y and Kwan, L. F. (2017). Roles of communication on performance of the construction sector. *Procedia Engineering*. Creative Construction Conference 2017, CCC 2017.

Olawale, A. Y. (2010). *Cost and time control practice of construction projects in the UK: The pursuit of effective management control*. University of the West of England.

Olawale, Y and Sun, M. (2015). Construction Project Control in the UK: Current Practice, Existing Problems and Recommendations for Future Improvement. *International Journal of Project Management*, 33(3) 623-637

Olawale, Y., and Sun, M. (2013). PCIM: Project control and inhibiting-factors management model. Journal of management in engineering, 29(1), 60-70.

O'Leary, Z., 2004. *The Essential Guide to Doing Research*. London: Sage.

Oliveira, H. (2021). *Get to know the Convergence Framework, a way to organize your actions as an Agilist*. Retrieved from: https://building.nubank.com.

Olle, T. W, Sol, H. G and Verrijn-Stuart, A. 1982. *Information Systems Design Methodologies: A Comparative Review*. Amsterdam: North-Holland.

Olsson N. 2006. Management of flexibility in projects. Int J Project Manag. 24(1):66–74.

Olsson, N. O., Sørensen, A. Ø., and Leikvam, G. (2015). On the need for iterative real estate project models–Applying agile methods in real estate developments. *Procedia Economics and Finance*, *21*, 524-531.

Olteanu, C. G. (2018). IT agile transformation. *Academy of Economic Studies. Economy Informatics*, *18*(1), 23-31.

Omar, H., Mahdjoubi, L., and Kheder, G. (2018). Towards an automated photogrammetry-based approach for monitoring and controlling construction site activities. *Computers in Industry*, 98, 172-182.

Omondi, O. J, Diang'a, S, Gwaya, A and Onyanyo, R. (2017). Effects of Procurement Processes on Successful Completion of Construction Projects in Uasin Gishu County. *IOSR Journal of Business and Management (IOSR-JBM)*, 19(12).

Opie, C and Brown, D. (2019). *Getting Started in Your Educational Research: Design, Data Production and Analysis*. Sage Publication

Opoku, A and Fortune, C. (2013). Implementation of Sustainable Practices in UK Construction Organizations: Drivers and Challenges. *The International Journal of Sustainability Policy and Practice*, 8(1).

Opoku, A, Ahmed, V and Cruickshank, H. (2015). Leadership style of sustainability professionals in the UK construction industry. *Built Environment Project and Asset Management.* 5(2).

Opoku, D. J, Agyekum, K and Ayarkwa, J. (2019): Drivers of environmental sustainability of construction projects: a thematic analysis of verbatim comments from built environment consultants, *International Journal of Construction Management*.

Oppong, G. D., Chan, A. P. and Dansoh, A. (2017). A review of stakeholder management performance attributes in construction projects. *International Journal of Project Management*, 35(6), pp. 1037-1051.

O'Reilly, G. (2018). 5 Critical Success Factors for Project Management Improvement Retrieved from: https://www.brightwork.com

Oribhabor, C. N and Anyanwu, C. A. (2019). Research Sampling and Sample Size Determination: A practical Application. *Federal University Dutsin-Ma Journal of Educational Research (Fudjer),* 2 (1): 47-56.

Ortloff, D, Popp, J, Schmidt, T and Mielke, M. (2009). *A customer-driven approach to product engineering of micro and nano devices—Requirement analysis*. Proceedings of the 13th International Conference on the Commercialization of Micro and Nano Systems, Copenhagen.

Osipova, E., and Eriksson, P. E. (2013). Balancing control and flexibility in joint risk management: Lessons learned from two construction projects. *International Journal of Project Management,* 31(3), 391-399.

Ostertagová, E, r Ostertag, O and Kováč, J. (2014). Methodology and Application of the Kruskal-Wallis Test. *Applied Mechanics and Materials* pp 115-120

Osuala, E. C. (2007). *Introduction to research methodology* (3rd ed.). Onitsha: African – First Publishers Ltd.

Owen, J. (2018). Construction Sector Deal: big on aspiration, but can it deliver? *Building.* Retrieved from: www.building.co.uk

Owen, R, Koskela, L, Henrich, G and Codinhoto, R., 2006. Is agile project management applicable to construction? Retrieved from: http://usir.salford.ac.uk/9369/1/2006

Owen, R. L and Koskela, L., 2006a. *Agile Construction Project Management*. 6th International Postgraduate Research Conference in the Built and Human Environment, 6/7 April 2006 Delft, Netherlands. Research Institute for the Built and Human Environment, University of Salford.

Owolabi, J. D, Faleye, D, Eshofonie, E. E, Tunji-Olayeni, P. F and Afolabi, A. O. (2019). Barriers and Drivers of Innovation in the Nigerian Construction Industry. *International Journal of Mechanical Engineering and Technology.* 10(2).

Owolabi, J. D; Amusan, L. M; Oloke, C. O; Olusanya, O; Tunji, O. P; Owolabi, D; Peter, J and Omuh, I., 2014. Causes and Effect of Delay on Project Construction Delivery Time. *International Journal of Education and Research*.

Owusu-Manu, D, Ghansah, F. A, Boateng, F, Asumadu, G and Edwards, D. J. (2019). *The Strategic Benefits of Innovation Adoption in Construction Consultancy Firms: The Role of Quantity Surveyors*. Proceedings for the 6th International Conference on Development and Investment in Infrastructure – Strategies for Africa.

Oxford Dictionary (2020). *Definition of Productivity*. Retrieved from: https://www.lexico.com

Oxford Dictionary of National Biography. *Emmerson, Sir Harold Corti (1896–1984).* Retrieved from: https://www.oxforddnb.com/

Oyedele, O. A., 2016. Impacts of construction industry on socio-economic development of Nigeria. ResearchGate. Retrieved from: https://www.researchgate.net

Oyegoke, A.S., Khalfan, M.M.A., McDermott, P and Dickinson, M., 2008. Managing Risk and Uncertainty in an Agile Construction Environment: Application of Agile Building Specialist Model. *Int. J. Agile Systems and Management, Vol. 3, Nos. 3/4, pp.248–262*

Özkan, D and Mishra, A. (2019). Agile Project Management Tools: A Brief Comparative View. *Cybernetics and Information Technologies*, 19(4).

Ozkan, F, Ozkan, O and Gunduz, M., 2012. Causal Relationship Between Construction Investment Policy and Economic Growth in Turkey. *Technological Forecasting & Social Change*

Ozorhon, B and Oral, K. (2017). Drivers of Innovation in Construction Projects. *J. Constr. Eng. Manage*. 143(4).

Ozorhon, B., Abbott, C., Aouad, G. and Powell, J. (2010). *Innovation in Construction: A Project Life Cycle Approach*. SCRI Research Report, SCRI, UK., pp. 13-14.

Ozorhon, B., Cardak, F., and Caglayan, S. (2022). Investigating the Agile Hybrid Approach in Construction. *Journal of Management in Engineering*, *38*(4), 04022022.

P.M. Institute (Ed.). (2017). *Agile Practice Guide*. Project Management Institute.

Pace, M. (2019). A Correlational Study on Project Management Methodology and Project Success. *Journal of Engineering, Project, and Production Management*; Pingtung,9(2): 56-65. DOI:10.2478/jeppm-2019-0007

Packendorff, J. (1995). Inquiring into temporary organization: New directions for project management research. Scandinavian Management Journal, 11(4), 319–333.

Padalkar, M; Gopinath, S and Kumar, A. (2016). Using Agile in Construction Projects: It's more than a methodology. Conference proceedings. Retrieved from: https://www.researchgate.net

Padilla-Díaz, M. (2015). Phenomenology in Educational Qualitative Research: Philosophy as Science or Philosophical Science? *International Journal of Educational Excellence*

Pahuja, S. (2014). Relation of Agility and Modularity. Retrieved from: https://www.infoq.com/

Palaganas, E. C, Sanchez, M. C, Molintas, V. P and Caricativo, R. D (2017). Reflexivity in Qualitative Research: A Journey of Learning. *Qualitative Report*, 22(2), pp. 426–438.

Palmer-Trew, S and Taylor, P. (2019). *Project Management: It's All Bollocks! The Complete Exposure of the World Of, and the Value Of, Project Management*. Routledge.

Pan, W, Gibb, A. G and Dainty, A. R., 2007. Perspectives of UK Housebuilders on the use of Offsite Modern Methods of Construction. *Construction Management and Economics, 25(2), 183-194*

Pandey, P and Pandey, M. M., 2015. Research Methodology: Tools and Techniques. *Bridge Center*. Retrieved from: http://www.euacademic.org

Pandit, B, Albert, A, Patil, Y and Al-Bayati, A. J. (2019). Fostering Safety Communication among Construction Workers: Role of Safety Climate and Crew-Level Cohesion. *Int J Environ Res Public Health.* 16(1).

Pandya, S., Yadav, A., Dalsaniya, N. and Mandir, V., 2014. Conceptual Study of Agile Software Development. *International Journal of Computer Science & Communication*.

Papachristos, G., Jain, J., Burman, E., Zimmerman, N., Mumovic, D., Davies, M. (2020). Low carbon building performance: A multi-method approach of project management operations and building energy use applied in a UK public office building. *Journal of Energy and Buildings.* 2019(1).

Papadakis, E and Tsironis, L. (2018). Hybrid methods and practices associated with agile methods, method tailoring and delivery of projects in a non-software context. *Procedia Computer Science*, 138(8).

Pareliya, M, Patel, S and Pandit, D. (2018). *Implementing Agile Project Management (Scrum) Approach in the Development of Building Projects*. CEPT University of Technology.

Parente, S. (2015). Bridging the Gap: Traditional to Agile Project Management. *PM World Journal*, 4(9).

Park, D, Bahrudin, F. I and Han, J. (2020). Circular Reasoning for the Evolution of Research Through a Strategic Construction of Research Methodologies. *International Journal of Quantitative and Qualitative Research Methods*, 8(3).

Parry, G. C and Turner, C. E. (2006) Application of lean visual process management tools, Production Planning & Control, *Production Planning & Control*, 17(1), 77-86, DOI: 10.1080/09537280500414991

Parul, and Singh, J. (2016). Models and Characteristics in Agile processes. International *Journal of Computer Science Trends and Technology (IJCST),* 4(5).

Parumasur, S. B, Govender, P. (2013). The importance of teamwork, continuous top management support and training in bringing about TQM. *Journal of Economics and Behavioral Studies*, 5(9), 639-651.

Parvaneh, F., & El-Sayegh, S. M. (2016). Project selection using the combined approach of AHP and LP. *Journal of Financial Management of Property and Construction*.

Parziale, J. 92017). *5 Phases of An Agile Project Management Framework*. LinkedIn.

Passey, D. (2020). Theories, theoretical and conceptual frameworks, models, and constructs: Limiting research outcomes through misconceptions and misunderstandings. *Studies in Technology Enhanced Learning*, 1(1).

Paterek, P. (2016). Effective Knowledge Management in Agile Project Teams - Impact and Enablers. *PM World Journal*, 5(5).

Patil, D. T and Patil, A. (2020). Effectiveness of Complexity Science in Managing Complexity in Construction Projects. *Journal of Critical Reviews*, 7(7).

Patino, C. M., and Ferreira, J. C. (2018). Internal and external validity: can you apply research study results to your patients. *Jornal brasileiro de pneumologia : publicacao oficial da Sociedade Brasileira de Pneumologia e Tisilogia*, *44*(3), 183. https://doi.org/10.1590/S1806-37562018000000164.

Paulk, M.C., 2001. Extreme Programming from a CMM Perspective. IEEE software Retrieved from: https://www.researchgate.net

Pawar, R. P and Mahajan, K. N. (2017). Benefits and Issues in Managing Project by PRINCE2 Methodology. *International Journal of Advanced Research in Computer Science and Software Engineering*, 7(3).

Pearce, C. L., and Sims, H. P. (2002). Vertical versus shared leadership as predictors of the effectiveness of change management teams: An examination of aversive, directive, transactional, transformational, and empowering leader behaviours. *Group dynamics: Theory, research, and practice*, 6(2).

Pedersen, N and Wright. (2013). *Truth and Pluralism*. Oxford University Press

Peirce, C. S. (1931). *Collected Papers*, Harvard U.P., Cambridge

Pejman G. P. S and Heap-Yih, C. (2020). Pathways for the Improvement of Construction Productivity: A Perspective on the Adoption of Advanced Techniques. *Advances in Civil Engineering*, vol. 2020, pp. 17.

Pengfei, N, Kamiya, M, Bo, L, Xiaonan, L and Qihang, L. (2020). Technological Innovation: A Primary Driver to Promote Global Urban Common Prosperity. *China Economist,* 15(3).

Perrenoud, A. J., Bigelow, B. F. and Perkins, E. M. (2020). Advancing women in construction: Gender differences in attraction and retention factors with managers in the electrical construction industry. *Journal of Management in Engineering*, *36*(5), p.04020043.

Perrier, N, Benbrahim, S and Pellerin, R. (2018). *The core processes of project control: A network analysis.* International Conference on ENTERprise Information Systems / ProjMAN - International Conference on Project MANagement / HCist - International Conference on Health and Social Care Information Systems and Technologies.

Peter, J, Daphne, C and Hillier, D. (2018). Materiality and external assurance in corporate sustainability reporting: an exploratory case study of the UK construction industry. World *Review of Entrepreneurship, Management and Sustainable Development*, 14(4).

Peterman, R., 2016. Project Management Phases: Exploring Phase #3 – Execution. Retrieved from: https://project-management.com

Petroutsatou, K. (2019): A proposal of project management practices in public institutions through a comparative analyses of critical path method and critical chain. *International Journal of Construction Management*. 1(1).

Pham, L., 2018. Qualitative Approach to Research: *A Review of Advantages and disadvantages of Three Paradigms: Positivism, Interpretivism and Critical Inquiry.* The University of Adelaide

Philpott, A. (2019). Staying the Court Enforcement of a UK Construction Adjudication on the Grounds of Fraud, Where There Are Company Voluntary Arrangements or Where There Is Insolvency. *International In-House Counsel Journal,* 12(49).

Picciotto, R. (2019). Towards a 'New Project Management' movement? An international development perspective. *International Journal of Project Management*.

Piderit, S. K. (2000). Rethinking resistance and recognizing ambivalence: A multidimensional view of attitudes toward an organizational change. Academy of Management Review, 25(4), 783–794

Pierce, D. R. J., 2013. Project Scheduling and Management for Construction. *R. S. Means Company, Incorporated, Kingston.* Retrieved from: https://ebookcentral.proquest.com

Pincemaille, C. (2008). PRINCE2: A Methodology of Project Management. Cork Institute of Technology. Retrieved from: https://www.pincemaille.net/

Pink, S, Horst, H, Postill, J, Hjorth, L, Lewis, T and Tacchi, J. (2016). *Digital ethnography: Principles and practices*. Sage Publications

Pinto, J, K and Prescott, J, E. (2015). Variations of Critical Success Factors Over the Stages in the Project Life Cycle. *Journal of management.* 14(1):5-18 DOI:10.1177/014920638801400102

Pinto, J. K and Prescott, S. D. (1988). Critical Success Factors Across the Project Life Cycle. *Research Gate.* Retrieved from: https://www.pmi.org

Pinto, J. K., 1998. *The Elements of Project Success*. In Cleland, D. I. (Ed.), Field Guide to Project Management (pp. 13–21). New York: Van Nostrand Reinhold

Pinto, J. K., 2002. Project Management 2002. *Research-Technology Management* Retrieved from: https://www.tandfonline.com

Pippard, J. L and Bjorklund, R. W. (2003). Identifying Essential Techniques for Social Work Community Practice. *Journal of Community Practice*

PMBOK Guide 2017. *A Guide to Project Management Body of Knowledge,* 6th ed. Newtown Square, PA.

PMI White Paper Report (2010). The Value of Project Management.

PMI, (2000). *A Guide to the Project Management Body of Knowledge*. Retrieved from: https://www.pmi.org/

PMI. (2017). *Agile Practice Guide*, New Edition. Newton Square, Pennsylvania: Project Management Institute.

PMI. (2023). *What is Project Management?* https://www.pmi.org/

PMIS Consulting Limited. (2018). *The Pros and Cons of Agile and Waterfall*. Retrieved from: https://www.pmis-consulting.com/agile-versus-waterfall/

PMIS. (2020). 10 reasons why PRINCE2 is not even close to 'best practice'. Retrieved from: https://www.pmis-consulting.com/

Poli R. (2010). *Ontology: The Categorical Stance. In: Poli R, Seibt J, editors. Theory and Application of Ontology: Philosophical Perspectives*. New York: Springer; p. 1–22

Pollack, J., Helm, J. and Adler, D. (2018) What is the Iron Triangle, and how has it changed? *International Journal of Managing Projects in Business*, 11(2),

Pope-Ruark, R. (2015). Introducing Agile Project Management Strategies in Technical and Professional Communication Courses. *J. Bus. Tech. Commun*. 29(1), pp. 112–133.

Popli, R and Chauhan, N., 2011. Scrum: An Agile Framework. *International Journal of Information Technology and Knowledge Management*

Potter, E. M., Egbelakin, T., Phipps, R., and Balaei, B. (2018). Emotional intelligence and transformational leadership behaviours of construction project managers. *Journal of Financial Management of Property and Construction*. 23(1), 73-89.

Prabhakar, G. P., 2008. Projects and their Management: A literature Review. *International Journal of Business and Management*, 3 (8).

Pratt, S. (2002). *Native Pragmatism: Rethinking the Roots of American Philosophy*. Indiana University Press: Indianapolis.

PRINCE2, (2017). The 7 Principles, Themes and Processes of PRINCE2. Retrieved from: https://www.prince2.com/blog/the-7-principles-themes-and-processes-of-prince2/

PRINCE2, (2018). PRINCE2 - A Structured Project Management Methodology Retrieved from: https://www.prince2.com/uk/prince2-methodology

Privacy Sense. (2022). *The Difference Between the Private and Public Sector*. Available at: http://www.privacysense.net/difference-between-private-public-sector/

Project Management Institute. (2004). A Guide to the Project Management Body of Knowledge. Retrieved from: https://www.saiglobal.com

Project Management Institute. (2019). Scrum. Effective Project Management Consultancy. Retrieved from: http://www.effectivepmc.com/blog/scrum

Project Management Institute. (2008). *A Guide to the Project Management Body of Knowledge (PMBOK Guide).* 4th ed. Project Management Institute.

Project Management Institute. (2013). *A Guide to the Project Management Body of Knowledge (PMBOK Guide).* 5th ed. Pennsylvania: Project Management Institute, Inc.

Project Management Solutions. (2011). Strategies for Project Recovery. A PM Solutions Research Report. Retrieved from: https://www.pmsolutions.com

Project, M. J. (2013). *Agile Project Management: Essentials from the Project Management Journal*. John Wiley & Sons, Incorporated, Hoboken

Proverbs, D. G; Holt, G. D and Cheok, H. Y. (2000). *Construction Industry Problems: The Views of UK Construction Directors.* Research Gate. Retrieved from: https://www.researchgate.net/publication/268369323

Quang, H. N., Khuong, M. N., and Le, N. H. (2015). The effects of leaders' emotional 1331 intelligence on employee engagement in Vietnamese Construction Companies–A case 1332 of Hoa Binh Corporation. *Journal of Economics, Business and Management*, 3(8),

Qumer, A and Henderson-Sellers, B. (2007). An Evaluation of the Degree of Agility in Six Agile method and its Applicability for Method Engineering. *Information and Software Technology*

Qumer, A., Henderson-Sellers, B. (2006). *Comparative evaluation of XP and Scrum using the 4D analytical tool (4-DAT)*. Paper Presented at European and Mediterranean Conference on Information Systems (EMCIS), Costa Blanca, Spain

Qureshi, R. J, Alassafi, M. O and Shahzad, H. M. (2019). Lean Agile Integration for the Development of Large Size Projects. *I.J. Modern Education and Computer Science*, 5(24-33)

Radujković, M and Sjekavica, M. (2017). Project Management Success Factors. *Creative Construction Conference 2017*. Retrieved from: https://ac.els-cdn.com

Radujković, M., Vukomanović, M. and Dunović, I. (2010). Application of key performance indicators in South-Eastern European construction. *Journal of Civil Engineering and Management*, 16(4).

Rafidah, R. R, Majid, M. Z, Sahamir, S. R and Ismail, A. A. (2018). Relative Importance Index of Sustainable Design and Construction Activities Criteria for Green Highway. *Chemical engineering transactions,* 63, DOI: 10.3303/CET1863026

Ragel, L. J. B, Subia, G. S, Mina, J. C and Campos, R. B. (2021). Limitations Of Pert/Cpm In Construction Management Planning: Inputs To Mathematics In Architecture Education. *Turkish Journal of Computer and Mathematics Education*, 12(10).

Rahi, S., 2017. Research Design and Methods: A Systematic Review of Research Paradigms, Sampling Issues and Instruments Development. *International Journal of Economics & Management Sciences*

Rahman, H. A, Chen, W and Hui, J. Y. (2017). Impacts of Design Changes on Construction Project Performance: Insights From a Literature Review. *Journal of Quantity Surveying & Construction Business*. 7(1).

Rahman, A and Alzubi, Y. (2015). Exploring Key Contractor Factors Influencing Client Satisfaction Level in Dealing with Construction Project: an Empirical Study in Jordan. *International Journal of Academic Research in Business and Social Sciences,* 5(12).

Rahman, I. A., and Gamil, Y. (2019, August). Assessment of cause-and-effect factors of poor communication in construction industry. In *IOP Conference Series: Materials Science and Engineering* (Vol. 601, No. 1, p. 012014). IOP Publishing.

Rahman, M. S and Adnan, T. M. (2020). Risk management and risk management performance measurement in the construction projects of Finland. *Journal of Project Management.* 5(167–178).

Rahmani, F and Leifels, K. (2018). Abductive Grounded Theory: a worked example of a study in construction management. *Construction Management and Economics*, 36(10).

Rajgor, M, Paresh, C, Dhruv, P, Chirag, P and Dhrmesh, B. (2016). RII & IMPI: Effective Techniques for Finding Delay In Construction Project. *International Research Journal of Engineering and Technology (IRJET),* 3(1).

Ralph, N, Birks, M and Chapman, Y., 2015. The Methodological Dynamism of Grounded Theory. *International Journal of Qualitative Methods*

Ramadan, N. (2020). *Which agile methodology is the most used? Which advantages does it have in your experience*? Retrieved from: www.researchgate.net

Ramdani, B., Chevers, D., and Williams, D.A. (2013). SMEs' adoption of enterprise applications: a technology-organisation-environment model. *Journal of small business and enterprise development*, 20 (4), 735–753.

Ramesh, B., Mohan, K. and Cao, L. (2012). Ambidexterity in Agile Distributed Development: An Empirical Investigation. *Information System Research*, 23(2).

Rana, J, Brahmbhatt, K and Pitroda, J. R. (2021). Agile Application in Construction Industry. *International Journal of Engineering Sciences and Research Technology*, 10(3).

Rand, G. K. (2000). Critical Chain: The Theory of Constraints Applied to Project Management. *International Journal of Project Management*

Ransom, N. (2019). The Execution Phase of Project Management. Study.com. Retrieved from: https://study.com

Rao, K. N, Naidu, G. K, Chakka, P and India, V. A. P. (2011). A Study of the Agile Software Development Methods, Applicability and Implications in Industry. *International Journal of Software Engineering and its Applications*, 5(2)

Rao, K. N., Naidu, G. K., & Chakka, P. (2011). A study of the Agile software development methods, applicability and implications in industry. *International Journal of Software Engineering and its applications*, *5*(2), 35-45.

Rasit, Z. A. and Isa, C. R. (2014). *The influence of comprehensive performance measurement system (CPMS) towards managers' role ambiguity.* International Conference on Accounting Studies 2014, ICAS 2014, 18-19 August 2014, Kuala Lumpur, Malaysia.

Rasnacis, A and Berzisa, S., 2016. Method for Adaptation and Implementation of Agile Project Management Methodology. *ICTE*

Rastogi, A. (2018). Project Management: How to collect requirements for your project effectively? GreyCampus. Retrieved from: https://www.greycampus.com/

Ravitch, S. M and Carl, N. M. (2016). *Qualitative Research: Bridging the Conceptual, Theoretical and Methodological*. Los Angeles, U.S.A.: SAGE Publications, Inc

Ravitch, S. M and Riggan, M. (2017). R*easons and Rigor. How Conceptual Framework Guide Research,* 2nd ed. Thousand Oaks, CA, Sage.

Rayat C. S. (2018). *Measures of Dispersion.* In: Statistical Methods in Medical Research. Springer, Singapore. https://doi.org/10.1007/978-981-13-0827-7_7

Raz, T., Barnes, R. and Dvir, D. (2003). A Critical Look at Critical Chain Project Management. *Project Management Journal*. 34, 24-32

Raziq, M. M, Borini, F. M, Malik, O. F, Ahmad, M and Shabaz, M. (2018). Leadership Styles, Goal Clarity and Project Success. *Leadership and Organization Development Journal*, 39(2).

Reddy, B. S and Kothapalli, S. (2020). The Comparative Study of Software Change Management in Agile and Traditional Methodologies. *Mukt Shabd Journal*, 9(8).

Reeves, S, Kuper, A and Hodges, B. D., 2008. Qualitative Research Methodologies: Ethnography. *BMJ.* doi: https://doi.org/10.1136/bmj.a1020

Regmi, S, Twayana, R and Upadhayay, B. (2019). *Importance of Project Control and Its Possible Issues, Challenges and Opportunities*. Department of Geomatics Engineering, Kathmandu University.

Rehman, A. A, and Alharthi, K. (2016). An Introduction to Research Paradigms. *International Journal of Educational Investigations*, 3(8).

Reichstein, T., Salter, A. J., and Gann, D. M. (2008). Break on through: Sources and determinants of product and process innovation among UK construction firms. *Ind. Innovation, 15(6).*

Remeny, D., Williams, B., Money, A., & Swartz, E. (1998). *Doing Research in Business and Management - An Introduction to Process and Method*. London: SAGE Publications.

Remon, F. A, and Hafez, S. M. (2013). Applying lean thinking in construction and performance improvement. *Alexandria Engineering Journal*, 52(4).

Rescher, N., 2000. *Realistic Pragmatism*. Albany: SUNY Press. Books

Revicki D. (2014) *Internal Consistency Reliability*. In: Michalos A.C. (eds) Encyclopaedia of Quality of Life and Well-Being Research. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-0753-5_1494

Rhodes, C. (2018). Construction Industry: Statistics and Policy. *House of Commons Library*. Retrieved from: https://www.parliament.uk

Rhodes, C. (2019). Construction Industry: Statistics and Policy. *House of Commons Library*. Retrieved from: http://www.parliament.uk/commons-library

Riazi, S. R. M, Zainuddin, M. F, Nawi, M. N. M; Musa, S and Lee, A. (2020). A critical review of fragmentation issues in the construction industry. *Talent Development & Excellence,* 12(2).

Ribeiro, F. L and Fernandes, M. T., 2010. Exploring agile methods in construction small and medium enterprises: a case study. *Journal of Enterprise Information Management*

Richard, L., 2009. Urban Construction Project Management. *Access Engineering*

Richardson, G. L. (2010). *Project Management Theory and Practice*. Taylor and Francis, Boca Raton, Florida

Rico, D, Sayani, H and Sone, S. (2009). The Business Value of Agile Software Methods: Maximizing ROI with Just-in-Time Processes and Documentation. *J. Ross Publishing, Ft. Lauderdale* Available from: ProQuest Ebook Central

Rigby, K, Sutherland, J and Takeuchi, H. (2016). *Embracing Agile*. Harvard Business Review.

Ritchie, J., Lewis, J., Nicholls, C. M and Ormston, R. (2014). *Qualitative Research Practice: A Guide for Social Science Students and Researchers*. 2nd ed. London: Sage

Ritzer, G. (Ed.). (2012). *The Wiley-Blackwell encyclopedia of globalization*. Wiley-Blackwell.

Rivera, M. L., Mora-Serrano, J., Valero, I., and Oñate, E. (2021). Methodological-technological framework for Construction 4.0. *Archives of computational methods in engineering, 28*(2), 689-711.

Robert G. Cooper and Anita Friis Sommer (2018) Agile–StageGate for Manufacturers, *Research-Technology Management*, 61:2, 17-26, DOI: 10.1080/08956308.2018.1421380

Robert Wood Johnson Foundation (RWJF). 2008. The Interpretivist Paradigm: Assumptions and Beliefs of the Interpretivist Paradigm. Retrieved from: http://www.qualres.org

Robert, B. (ed). (2000). *Rorty and his Critics*. Oxford: Blackwell Publishing

Robinson, D. (2020). PRINCE2 Project Management- Business Case. Retrieved from: https://p2.tech-academy.co.uk/business-case

Robinson, H and Richards, R. (2009). Critical Chain Project Management: Motivation & Overview. *IEEEAC paper*. Retrieved from: https://stottlerhenke.com

Robson, C and Mcartan, K. (2016). *Real World Research*, 4th ed. Chichester, UK: Willey.

Robu, M, Sadeghpour, F and Jergeas, G. (2019). Best Practices Impacting Construction Project Schedule. *CSCE Annual Conference*. Retrieved from:: http://www.csceproceedings.ca

Rockart, J. F. (1979). *Chief Executives Define Their Own Data Needs*. Harvard Business Review.

Rohracher H. (2011). Managing the technological transition to sustainable construction of buildings: A socio-technical perspective. *Technol Anal Strateg Manag*. 13 (1).

Roller, M. R. (2019). A Quality Approach to Qualitative Content Analysis: Similarities and Differences Compared to Other Qualitative Methods. *FQS* 20(3), Art. 31

Romanelli, M. (2018). The Nature of Projects: Understanding the Definition of a Project and the Need for Structured Project Management. Retrieved from: : https://www.stakeholdermap.com/project-management/the-nature-ofprojects.html

Ronald, D. D. (1961). *Management Information Crisis*. Harvard Business Review

Ronald, S. K. (2013). Project Risk Management. *Conference Proceedings from: Atlanta International University*.

Roschke, P. N. (1994). Validation of knowledge-based system with multiple bridge rail experts. *J. Transp. Eng.*, 120(5), 787–806

Rosing, M. V, Schee, H. V and Scheer, A. W. (2015). *The Complete Business Process Handbook: Body of Knowledge from Process Modelling to BPM*. Vol 1, Morgan Kaufmann, London.

Ross, S. M and Morrison, G. R., 2014. Experimental Research Methods. Research Gate. Retrieved from: https://www.researchgate.net

Rostami, R and Thomson, C. (2017). *Sustainable Development of the UK Construction Industry for Future Development*. 2nd International Conference on Civil Engineering, Architecture and Crisis Management.

Rowe, S. F. (2020). *Project Management for Small Projects*. 3rd ed. Berrett-Koehler Publishers

Rowley, J. (2002). *Using Case Studies in Research*. Management Research News Retrieved from: https://s3.amazonaws.com

Rozenes, S. (2011). The Impact of Project Management Methodologies on Project Performance. *International Journal of Information Technology Project Management*, 2(2).

Ruk, S. A., Khan, M. F., Khan, S. G., & Zia, S. M. (2019). A survey on adopting agile software development: issues & its impact on software quality. In *2019 IEEE 6th International Conference on Engineering Technologies and Applied Sciences (ICETAS)* (pp. 1-5). IEEE.

Ruland, C. M, Bakken, S, and Røislien J. (2007). Reliability and validity issues related to interactive tailored patient assessments: a case study. *J Med Internet Res*. 9(3). doi: 10.2196/jmir.9.3.e22.

Ryd, N. (2014). Construction Clients Challenges - Emphasizing Early Stages. 27th IPMA World Congress. 1 Chalmers University of Technology, Dept. of Architecture, SE-412 96 Göteborg, SWEDEN. doi: 10.1016/j.sbspro.2014.03.017

Saad, M, Ullah, Z, Iqbal, S, Hussain, M and Salman, M. (2019). *A study on the impact of leadership styles on employee motivation in construction projects of Lahore*. 10th International Civil Engineering Conference (ICEC-2019): "Technological Transformation of Civil Engineering" February 23-24, 2019, Karachi, Pakistan.

Sacks, R., Brilakis, I., Pikas, E., Xie, H., and Girolami, M. (2020). Construction with digital twin information systems. *Data-Centric Engineering*, 1, E14. doi:10.1017/dce.2020.16

Sacks, R., Treckmann, M., & Rozenfeld, O. (2009). Visualization of Workflow to Support Lean Construction. *Journal of Construction Engineering and Management*, 135(12).

Saddington, P., 2012. *The Agile Pocket Guide: A Quick Start to Making Your Business Agile Using Scrum and Beyond*. John Wiley & Sons, Incorporated, Somerset.

Sahin, M. D., and Öztürk, G. (2019). Mixed Method Research: Theoretical Foundations, Designs and Its Use in Educational Research. *International Journal of Contemporary Educational Research*, *6*(2), 301-310.

Saiti, A., and Stefou, T. (2020). *Hierarchical organizational structure and leadership*. In Oxford Research Encyclopedia of Education.

Sakikhales, M. H and Stravoravdis, S. (2017). *Using Agile Project Management and BIM for Improved Building Performance.* In Dastbaz, M, Gorse, C and Moncaster, A. Building Information Modelling, Building Performance, Design and Smart Construction. Springer.

Salah, K, Z. (2021). Identification of crucial performance measurement factors affecting construction projects in Iraq during the implementation phase, *Cogent Engineering*, 8(1).

Salameh, H., 2014. What, When, Why, and How? A Comparison between Agile Project Management and Traditional Project Management Methods. *International Journal of Business and Management Review*. 2(5).

Saldaña, J. (2015). *The coding manual for qualitative researchers*. Thousand Oaks, CA: Sage.

Salem, O; Solomon, J; Genaidy, A and Luegring, M. (2005). Site Implementation and Assessment of Lean Construction Techniques. *Lean Construction Journal*

Salem, O; Solomon, J; Genaidy, A and Minkarah, I. (2006). Lean Construction: From Theory to Implementation. *Journal of Management in Engineering*

Salkind, N. J. (2010). *Encyclopedia of research design* (Vols. 1-0). Thousand Oaks, CA: SAGE Publications, doi: 10.4135/9781412961288

Salma, P. (2015). The Research Paradigm – Methodology, Epistemology and Ontology – Explained in Simple Language. Retrieved from: http://salmapatel.co.uk

Salter, A., and Torbett, R. (2003). Innovation and performance in engineering design. *Constr. Manage. Econ*., 21(6).

Samarghandi, H, Tabatabaei, S. M. M, Taabayan, P, Hashemi, A. M, Willoughby K. (2016). Studying the reasons for delay and cost overrun in construction projects: the case of Iran. *Journal of Construction in Developing Countries*, 21(1), 51–84, 2016

Samset, K. (2003). *Features of a Project.* Retrieved from: https://www.ntnu.no

Sanda, Y. N, Anigbogu, N. A, Izam, Y. D and Nuhu, L. Y. (2021). Designing Case Study Research in Construction Management. *Journal of Surveying, Construction and Property (JSCP)*, 12(1).

Sanni-Anibire, M. O., Mohamad Zin, R., & Olatunji, S. O. (2020). Causes of delay in the global construction industry: a meta-analytical review. *International Journal of Construction Management*, 1-13.

Santiago, J and Magallon, D. (2009). *Critical Path Method.* (Cee 320 – Vdc Seminar) Retrieved from: https://web.stanford.edu

Sanvid, V, Grobler, F, Parfitt, K, Guvenis, M and Coyle, M. (1990). Critical Success Factors for Construction Projects. *Journal of Construction Engineering and Management*

Saraf, D. (2013). Study of Factors Affecting Performance of Construction Project. *International Journal of Science and Research (IJSR)*, 6(14).

Sarangee, K., Schmidt, J. B., Srinath, P. B., and Wallace, A. (2022). Agile transformation in dynamic, high-technology markets: Drivers, inhibitors, and execution. *Industrial Marketing Management*, *102*, 24-34.

Sargent, R. G. (1991). *Simulation model verification and validation*. Proc., 1991 Winter Simulation Conf., W. D. Kelton, G. M. Clark, andB. L. Nelson, eds., IEEE, Piscataway, N.J., 37–47

Sarhan, J.G., Xia, B., Fawzia, S. and Karim, A. (2017). Lean construction implementation in the Saudi Arabian construction industry. *Construction Economics and Building*, 17(1), pp. 46- 69.

Sarhan, S and Fox, A. (2013). Performance measurement in the UK construction industry and its role in supporting the application of lean construction concepts. *Australasian Journal of Construction Economics and Building,* 13 (1).

Sarhan, S, Pasquire, C, King, A and Manu, E., 2018. Institutional Waste within the UK Construction Procurement Context: A Conceptual Framework. *The Engineering Project Organization Journal*

Sauce, B and Matzel, L. D. (2017). *Inductive Reasoning*. Springer International Publishing AG

Saunders, L. W., McCoy, A. P., Kleiner, B. M., Lingard, H., Cooke, T., Mills, T., Blismas, N. and Wakefield, R. (2016). International Benchmarking for Performance Improvement in Construction Safety and Health. Benchmarking: *An International Journal*, 23(4), pp. 916- 936.

Saunders, J. (2008). What the customer really needed. J House Consulting. Retrieved from: https://www.jhouseconsulting.com/

Saunders, M, Lewis, P and Thornhill, A. (2012). *Research Methods for Business Students*, Pearson Education Limited: Essex.

Saunders, M, Lewis, P and Thornhill, A., 2007. *Research Methods for Business Students*. (6th ed.) London: Pearson.

Saunders, M, Lewis, P and Thornhill, A., 2009. *Research Methods for Business Students, 5th ed.* Harlow, Pearson Education

Saunders, M, Lewis, P and Thornhill, A., 2019. *Research Methods for Business Students*. 8th Ed. Sage.

Saunders, M. N. (2011) *Research methods for business students*, 5/e: Pearson Education India.

Savas, S. (2019). *The Role of Leagility in Human Resources Management of Construction Industry. In: Academic Studies in Engineering, Architecture, Planning and Design Sciences*. 1st ed. Ivpe Publications.

Savolainen, J., Kähkönen, K., Niemi, O., Poutanen, J. and Varis, E. (2015). Stirring the construction project management with co-creation and continuous improvement. *Procedia Economics and Finance*, 21(15).

Sawhney, A., Riley, M., Irizarry, J., and Riley, M. (2020). Construction 4.0. *Edited by A. Sawhney, Michael Riley, and J. Irizarry. Routledge. doi*, *10*, 9780429398100.

Sayyed, Y, Hatamleh, M. T and Alaya, A. (2023). Investigating the influence of procurement management in construction projects on the innovation level and the overall project performance in developing countries. *International Journal* *of Construction Management*, 23(3). doi.org/10.1080/15623599.2021.1889088

Saynisch, M. (2010). Beyond frontiers of traditional project management: An approach to evolutionary, self–organizational principles and the complexity theory — Results of the research program. *Project Management Journal,* 41(2).

Schall, M. S. (1983). 'A Communication-Rules Approach to Organizational Culture', *Administrative Science Quarterly*, 28(4), pp. 557–581

Schaufelberger, J. E and Holm, L. (2017). *Management of Construction Projects: A Constructor's Perspective.* Routledge, London, ProQuest eBook Central.

Schoderbek, P. P. (1965). A study of the Applications of PERT. *Academy of Management Journal*

Schutz, A. (1967). *The Phenomenology of the Social World* (translated by G. Walsh and F. Lehnert) Evanston: Northwestern University Press.

Schwaber, K and Sutherland, J. (2017). The Scrum Guide™. The Definitive Guide to Scrum: The Rules of the Game. Retrieved from: https://scrumguides.org

Schwaber, K. (1994). SCRUM Development Process. *Advanced Development Methods* Retrieved from: http://www.torak.com

Schwaber, K., Sutherland, J. (2011). The Definite Guide to Scrum: The Rules of the Game. Retrieved from: http://www.scrum.org

Schwalbe, K. (2015). *An Introduction to Project, Program, and Portfolio Management. An Introduction to Project Management*, 5th ed. (pp. 1-36). Minneapolis, Minnesota: Schwalbe Publishing.

Schwartz, A. (2021). Coding in Qualitative Research. https://ofe.ecu.edu/

Scot Ambler and Associates, 2010. Surveys Exploring the Current State of Information Technology Practices. Retrieved from: http://www.ambysoft.com/surveys/

Schlesinger *et al*, (1979). Terminology for model credibility. Simulation 32 (3): 103-104

Scotland, J. (2012). Exploring the Philosophical Underpinnings of Research: Relating Ontology and Epistemology to the Methodology and Methods of the Scientific, Interpretive, and Critical Research Paradigms. *English Language Teaching,* 5(9).

Scrum Manager. (2019). Scrum Manager: Core Subject Area I. Retrieved from: https://www.scrummanager.net

Scrum Institute. (2019). Scrum Burndown Chart. Retrieved from: https://www.scrum-institute.org

Scholl, J. (2016). Project Management Best Practices for Projects that Introduce Innovative Processes. University of Oregon. Retrieved from: https://scholarsbank.uoregon.edu/

Schumpeter, J. A. (1961). *Vol. 55 of the theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle*. London: Transaction Publishers.

Schutt, R.K. (2011). *Investigating the social world: The process and practice of research.* Thousand Oaks, CA: Pine Forge Press

Schwaber, K and Sutherland, J. (2013). The Definitive Guide to Scrum: The Rules of the Game. Retrieved from: http://www.scrumguides.org/docs/scrumguide/v1/scrum-guide-us.pdf.

Scott, M. S. (2007). Determining sample size: How to ensure you get the correct sample size. Qualtrics, 4 (3): 12-23.

Seadon, J and Tookey, J. E. (2018). Drivers for Construction Productivity. *Engineering, Construction and Architectural Management*, 26(6).

Seaden, G and Manseau, A. (2001). Public Policy and Construction Innovation. *Building Research & Information*, 29(3).

Scotland, J., 2012. Exploring the Philosophical Underpinnings of Research: Relating Ontology and Epistemology to the Methodology and Methods of the Scientific, Interpretive, and Critical Research Paradigms. *English Language Teaching;* 5(9)

Sears, S. K; Sears, G. A; Clough, R. H; Rounds, J. L and Segner, R. O. (2015). *Construction Project Management.* John Wiley & Sons, Incorporated, New York

Seeram, E. (2019). An overview of correlational research. *Radiologic technology*, 91(2), 176-179.

Seidu, R.D., Young, B.E., James, D., Robinson, H. and O'Toole, J. (2019). Mind the Gap: Skills Shortage within the UK Construction Industry. *International Conference on Innovation, Technology, Enterprise and Entrepreneurship icitee 2019.* AI-Ekir, Kingdom of Bahrain 24 - 25 Nov 2019

Senior, B.A., 2009. Critical Path Method Implementation Drawbacks: A Discussion Using Action Theory. Colorado State University, Retrieved from: http://ascpro.ascweb.org

Sennett, P. (2022). *Agile vs. traditional project management*. University of Rochester. https://www.rochester.edu/

Senouci A, Alsarraj A, Gunduz M, Eldin N. 2017. Analysis of change orders in Qatari construction projects. International *Journal of Construction Management*. 17(4):280–292

Serrador, P, and Pinto, J. K., 2015. Does Agile work? — A Quantitative Analysis of Agile Project Success. *International Journal of Project Management 33*

Sertyesilisik, B., 2017. A preliminary Study on the Regenerative Construction Project Management Concept for Enhancing Sustainability Performance of the Construction Industry. *International Journal of Construction Management*

Setor, T., and Joseph, D. (2019). *When agile means staying: The relationship between agile development usage and individual IT professional outcomes*. In *Proceedings of the 2019 on Computers and People Research Conference* (pp. 168-175).

Sexton, M., and Lu, S. (2009). *Innovation in small professional practices in the built environment*. Chichester: Wiley Blackwell.

Sexton, M., and P. Barrett. (2003). A literature synthesis of innovation in small construction firms: Insights, ambiguities and questions. *Constr. Manage. Econ.* 21 (6).

Seymour, D and Rooke, J. (1995). The Culture of the Industry and the Culture of Research, *Construction Management and Economics*, 13(6)

Seymour, T and Hussein, S. (2014). The History of Project Management. *International Journal of Management & Information Systems*. 18(4).

Shabbir, S. (2018). What is the Difference Between Approach and Methodology? Quora. Retrieved from: https://www.quora.com

Shah, P., Pitroda, J. and Shah, M. (2020). Gender Inequality in Construction Industry: A Review. *UGC Care Journal,* 40(60)

Shah, S. R and Al-Bargi, A., 2013. Research Paradigms: Researchers' Worldviews, Theoretical Frameworks and Study Designs. *Arab World English Journal*

Shah, S. R. A. Khan, A. Z. and Khalil, M. S. (2011). Project Management Practices in e-government Projects: A Case Study of Electronic Government Directorate (EGD) in Pakistan. *International Journal of Business and Social Science*, 2(7).

Shahbazpour, M. (2010). *Strategic manufacturing system and process innovation: A framework for small and medium sized enterprises*. Ph.D. dissertation, Dept. of Mechanical Engineering, Univ. of Auckland.

Shahin, A, and Jamshidian, M. (2006). Critical Success Factors in Project Management: a Comprehensive Review. *Proceedings of 1st International Project Management Conference, pp. 1–14*

Shahir, H. Y, Daneshpajouh, S and Ramsin, R. (2008). "Improvement Strategies for Agile Processes: A SWOT Analysis Approach," *2008 Sixth International Conference on Software Engineering Research, Management and Applications*, pp. 221-228, doi: 10.1109/SERA.2008.33.

Shammas-Toma, M., Seymour, D. and Clark, L. (1998) Obstacles to implementing total quality management in the UK construction industry. *Construction Management and Economics*, 16, 177–92.

Shand, J. (2003). *Fundamentals of Philosophy*, Routledge, London.

Shankarmani, R, Pawar, R, Mantha, S. S and Babu, V. (2012). Agile Methodology Adoption: Benefits and Constraints. *International Journal of Computer Applications*, 58(15).

Shankarmani, R, Pawar, R, Mantha, S. S and Babu, V. (2012). Agile Methodology Adoption: Benefits and Constraints. *International Journal of Computer Applications*, 58(15).

Shao, Z, Feng, Y and HU, Q. (2017). Impact of top management leadership styles on ERP assimilation and the role of organizational learning. *Information and Management*, 54(7).

Shah, F. H, Bhatti, O. S and Ahmed, S. (2023). Project Management Practices in Construction Projects and Their Roles in Achieving Sustainability—A Comprehensive Review. *Eng. Proc.* 2023, 44, 2. https://doi.org/10.3390/engproc2023044002

Sharma, L. (2016). Waterfall Model. Retrieved from: http://toolsqa.com/software-testing/waterfall-model/

Sharma, S, Sarkar, D and Gupta, D. (2012). Agile Processes and Methodologies: A Conceptual Study. *International Journal on Computer Science and Engineering*, 4(5).

Sharma, S, Sarkar, D and Gupta, D. (2012). Agile processes and methodologies: A conceptual study. *International journal on computer science and Engineering*, 4(5), 892.

Sharma, S. (2019). *Descriptive Statistics and Factorial Design*. Horizons University, Paris

Sheffield, J and Lemétayer, J. (2013). Factors associated with the software development agility of successful projects, *International Journal of Project Management*, (31) 2, pp. 459–472

Sheffield, J. and Lemétayer, J. (2013). Factors Associated with the Software Development Agility of Successful Projects. *International Journal of Project Management*, 31(3).

Shen, L and Lin, Y. (2014). Strategies in using building information modelling (BIM) to solve problems in project management of Chinese construction enterprises. Appl Mech Mater 504:2700–2705. https://doi.org/10.4028/www.scientifc.net/AMM.501-504.2700

Shenhar, A. J and Dvir, D. (2007). *Reinventing project management: The diamond approach to successful growth and innovation*. Boston, MA: Harvard Business Press.

Shenhar, A. J. and Dvir, D. (2007a). Project Management Research: The Challenge and Opportunity. *Project Management Journal*, 38(2).

Shenhar, A. J., and Dvir, D. (2007). Project management research: The challenge and opportunity. *Project Management Journal*, 38(2), 93–99.

Shepherd, M., and Atkinson, R. (2011). Project Management Bodies of Knowledge; Conjectures and Refutations. *The Electronic Journal of Business Research Methods*, 9(2), 152-158.

Sherman, F. (2019). Limitations of Critical Path Method. *Bizfluent.* Retrieved from: https://bizfluent.com

Sherratt, F. (2019). Managing “a little bit unsafe”: complexity, construction safety and situational self-organising. *Engineering, Construction and Architectural Management (ECAM)*

Sheuly, S. (2013). *A Systematic Literature Review on Agile Project Management*. Lappeenranta University of Technology.

Shivakumar S.K. (2018). *Digital Project Management Best Practices. In: Complete Guide to Digital Project Management.* Apress, Berkeley, CA.

Shonk, K. (2020). *What is Negotiation? Learn the Building Blocks of Indispensable Negotiation Business Skills*. Program of Negotiation, Harvard Law School.

Shou, Y, Sellbom, M and Chen, H. (2021). Fundamentals of Measurement in Clinical Psychology. Reference Module in Neuroscience and Biobehavioural Psychology, *Elsevier*

Shou,Y and Yeo, K. T. (2000). Estimation of Project Buffers in Critical Chain Project Management. *ICMIT 2000:162–7*

Shuai, L and Li, H. (2013). Problems and effective countermeasures in construction safety management. *Appl Mech Mater* 439:1702–1705. https://doi.org/10.4028/www.scientific.net/ AMM.438-439.1702

Shubh and Gandhi, P. (2012). *SWOT Analysis of Agile Methodologies*. Proceedings of the Intl. Conf. on Advances in Computer Science and Electronics Engineering.

Sibiya, M; Aigbavboa, C and Thwala, W. (2016). *Construction Projects' Key Performance Indicators: A case of the South Africa Construction Industry*. International Conference on Construction and Real Estate Management.

Sid, A. (2018). Advantages and Disadvantages of Traditional and Lean Method Retrieved from: http://www.academia.edu

Siedlecki, Sandra L. (2020). Understanding Descriptive Research Designs and Methods, *Clinical Nurse Specialist*, 34(1). p 8-12 doi: 10.1097/NUR.0000000000000493.

Siegelaub, J. M. (2020). *How PRINCE2 Can Complement the PMBOK Guide and Your PMP*. APMG-International

Sikka, S., Dawood, N., Marasini, R. and Dean, J. (2006). *Identification and development of key performance indicators to establish the value of 4D planning.* ARCOM Doctoral Workshop on Emerging Technologies in Construction, School of the Built Environment, University of Salford: 10 November 2006.

Sil, R. (2009). Simplifying Pragmatism: From Social Theory to Problem-driven Eclecticism. *International Studies Review*, 11, 648-652

Silitonga, E. S and Widodo, D. S. (2017). Organizational Performance Analysis: Organizational Commitment, Competence and Organizational Culture (Study On Bekasi City Government). *International Journal of Recent Scientific Research*, 8(4), pp. 16732-16740.

Silva, F. B, Bianchi, M. J and Amaral, D. C. (2019). Evaluating Combined Project Management Models: Strategies for Agile and Plan-Driven Integration. *Product: Management & Development*, 17(1).

Singh, H., 2016. Traditional vs. Agile Project Management. Harnessing the Synergy of the Blend. *Sigma PM Consulting* Retrieved from: https://pmisv.org

Singh, K., Saeed, M. and Bertsch, A., (2012). Key Factors Influencing Employee Responses Towards Change: A Test in the Telecom Industry in India. *Journal of Management Policy and Practice*, 13(3), pp. 66-81.

Sinha, D and Sinha, S. (2014). Managing in a VUCA World: Possibilities and Pitfalls. *Journal of Technology Management for Growing Economies*, 11(1).

Sinha, R, Shameem, M and Kumar, C. (2020). SWOT: Strength, Weaknesses, Opportunities, and Threats for Scaling Agile Methods in Global Software Development. *ISEC 2020: Proceedings of the 13th Innovations in Software Engineering Conference on Formerly known as India Software Engineering Conference February 2020 Article No.: 3Pages 1–10https://doi.org/10.1145/3385032.3385037*

Skarpenes, O., and Nilsen, A.-C. E. (2015). Regional gender inequality in the Norwegian culture of equality. *Gender Issues*, 32, 39–56.

Skorstad, E.J. and Ramsdal, H. (2016), *Flexible Organizations and the New Working Life: A European Perspective*, Vol. 22, Routledge Taylor & Francis Group, New York, NY.

Slaughter E S. (1993) Builders as Sources of Construction Innovation. *Journal of Construction Engineering and Management.* 119(3).

Slaughter, E. S. (1998). Models of construction innovation. *J. Constr. Eng. Manage*. 124 (3).

Smartsheet Inc. (2019). Comprehensive Guide to the Agile Manifesto. Retrieved from: https://www.smartsheet.com

Smartsheet Inc. (2019). Demystifying the 5 Phases of Project Management. Retrieved from: https://www.smartsheet.com

Smeekes, I, Borgman, H and Heier, H. (2018). A Wheelbarrow Full of Frogs: Understanding Portfolio Management for Agile Projects. *Proceedings of the 51st Hawaii International Conference on System Sciences*.

Smith, B. (2003). *Ontology.* In L. Floridi (ed.). Blackwell Guide to the Philosophy of Computing and Information, Oxford: Blackwell

Smith, D, Ahmed, V and Saboor, B. (2020). *BREXIT: Assessing the Impact on the UK Construction Industry & Mitigating Identified Risks*. Proceedings of the International Conference on Industrial Engineering and Operations Management Dubai, UAE, March 10-12, 2020

Smith, L. (2003). Overview of Project Management. *The Journal of Défense Software Engineering*

Smollan, R. K. (2011), "The multi-dimensional nature of resistance to change", *Journal of Management & Organization*, 17(6), pp. 828-849.

Smyth, H., and Morris, W. (2007). An epistemological evaluation of research into projects and their management: Methodological issues. *International Journal of Project Management*, 25(4), 423-436.

Söderlund, J. (2023). 17. Project-based organizations: an overview of an emerging field of research. *Research Handbook on Complex Project Organizing*, 172.

Soetanto, R. and Proverbs, D. G. (2002). Modelling the satisfaction of contractors: the impact of client performance. *Engineering, Construction and Architectural Management*, 9(5/6), pp. 453-465.

Sohail, F., Zia, S., Qureshi, R., Naseem, M. and Haider, H. (2021) "Impact of Agile Methodology on Software Development Life Cycle", *Pakistan Journal of Engineering and Technology*, 4(2), pp. 153-158. doi: 10.51846/vol4iss2pp153-158.

Sohi, A. J. Hertogh, M, Bosch-Rekveldt, M and Blom, R. (2016). Does Lean & Agile Project Management Help Coping with Project Complexity? *Procedia - Soc. Behav. Sci.*, vol. 226, pp. 252–259.

Soiferman, L. K. (2010). Compare and Contrast Inductive and Deductive Research Approaches. University of Manitoba. Retrieved from: https://files.eric.ed.gov

Solinski, A and Petersen, K. (2016). Prioritizing agile benefits and limitations in relation to practice usage. *Software Qual J*, 24(447–482). DOI 10.1007/s11219-014-9253-3

Somekh, B and Lewin, C. (2005). *Research Methods in Social Sciences*. London: Sage.

Sommerville, I. (2011). Software Engineering: Ninth Edition. Retrieved fromhttps://edisciplinas.usp.br

Somerville, J. (2021). *A Brief History of Project Management*. Innovative Management Solutions, Inc. https://ims-web.com/

Sony, M. (2018). Industry 4.0 and lean management: a proposed integration model and research propositions. *Production & Manufacturing Research*, *6*(1), 416-432.

Sony, M. and Naik, S. (2019). Key ingredients for evaluating Industry 4.0 readiness for organizations: a literature review. *Benchmarking: An International Journal*.

Sousa, S. D and Aspinwall, E. (2010). Development of a Performance Measurement Framework for SMEs. *Total Quality Management & Business Excellence*, 21 475-501

Souza, D. V. S. D. 2015. *A Conceptual Framework and Best Practices for Designing and Improving Construction Supply Chains*. PhD diss., University of Salford

Souza, J. and Alves, J. (2018). Lean-integrated management system: a model for sustainability improvement. *Journal of Cleaner Production*, 172(1).

Spalek, S. (2016). *Traditional Vs. Modern Project Management Methods. Theory and Practice.* 21st International Scientific Conference Economics and Management

Sparrow, P. (2018). Waterfall Model of SDLC. Retrieved from: https://www.ianswer4u.com

Sparrow, P. (2019). Waterfall Model: Advantages and Disadvantages of Waterfall Model. Retrieved from: https://www.ianswer4u.com

Spitzm€uller, C., D. M. Glenn, M. M. Sutton, C. D. Barr, and S. G. Rogelberg. 2007. Survey non-respondents as bad soldiers: Examining the relationship between organizational citizenship and survey response behaviour. International *Journal of Selection and Assessment,* 15(4):449–59. doi:10.1111/j.1468-2389.2007.00403.x

Špundak, M. (2014). *Mixed Agile/Traditional Project Management Methodology – Reality or Illusion?* Proceeding from the 27th IPMA World Congress. Retrieved from: https://www.researchgate.net

Srimathi S, Dinesh S and Sethuraman R. (2017). A Review on Critical Success Factors in Construction Project. *International Journal of Scientific Research in Science, Engineering and Technology*

Srivastava, A, Bhardwaj, S and Saraswat, S. (2017). SCRUM Model for Agile Methodology. Proceedings from *International Conference on Computing, Communication and Automation (ICCCA2017).*

Stadler, M., Vallon, R., Pazderka, M., & Grechenig, T. (2019). Agile distributed software development in nine central European teams: Challenges, benefits, and recommendations. *International Journal of Computer Science & Information Technology* (IJCSIT) Vol, 11.

Stare, A. (2013). Agile Project Management – A Future Approach to the Management of Projects? *Dynamic Relationships Management Journal*

State of Agile Coaching Report. (2021). *An Analysis of the Emerging Profession Of Agile Coaching*. Vol 2. Business Agility Institute, Scrum Alliance, and ICAgile.

State of Agile Report. (2022). *15th State of Agile Report: Agile adoption accelerates across the enterprise*. Digital.ai.

Stattina, P and Loeb, S. (2014). To Measure Is to Know. If You Cannot Measure It, You Cannot Improve It: Statistical Modelling Cannot Compensate for Unmeasured Bias. *European Urology*, 65(1), 701–703.

Stavru, S. (2014). A critical examination of recent industrial surveys on agile method usage. *J. Syst. Softw*. 94, pp. 87–97, doi: 10.1016/j.jss.2014.03.041.

Stavru, S. (2014). A Critical Examination of Recent Industrial Surveys on Agile Method Usage. *Journal of Systems and Software*, 94(2014)

Stavru, S., 2014. A critical examination of recent industrial surveys on agile method usage. *J. Syst. Softw*. 94, 87–97.

Steinfor, P and Walker, D., 2007. *Critical Success Factors in Project Management Globally and How They May Be Applied to Aid Projects*. Proceedings of the PMOZ Achieving Excellence- 4th Annual Project Management Australia Conference

Stellman, A., and Greene, J. (2014). *Learning agile*. Sebastopol, CA: O'Reilly Media,

Steyn, H. (2001). An Investigation into the Fundamentals of Critical Chain Project Scheduling. *International Journal of Project Management*

Stober, T and Hansmann, U., 2010. Agile Software Development. *Springer-Verlag Berlin Heidelberg.* Retrieved from: https://www.springer.com

Stormi, K. T, Laine, T and Korhonen, T. (2019). Agile performance measurement system development: an answer to the need for adaptability? *Journal of Accounting & Organizational Change.* 15(2).

Straçusser, G. (2015). *Agile Project Management Concepts Applied to Construction and Other Non-IT Fields*. Paper presented at PMI® Global Congress 2015—North America, Orlando, FL. Newtown Square, PA: Project Management Institute

Stretton, A. (2016). Customers' needs and project requirements: Series on increasing project management contributions to helping achieve broader ends. *PM World Journal*, 5(3).

Streule, T, Miserini, N, Bartlomé, O, Klippel, M and De Soto, B. G. (2016). Implementation of Scrum in the Construction Industry. *Procedia engineering, 164, 269–276.*

Subramaniam, C., Ismail, S., Arof, K. Z. M., Hazwani, N., and Saleh, A. L. (2020). Causative Failure Factors of Communications Management in Mixed-Use Development Projects in Malaysia. *Journal of critical reviews*, *7*(5).

Succi, G., Marchesi, M., Williams, L., and Wells, J. D. (2002). *Extreme programming perspectives*. Addison-Wesley Longman Publishing Co., Inc..

Sull, D. (2009). Competing through organizational agility. *McKinsey Q*. Retrieved from: http://www.mckinsey.com

Sullivan A, Harris FC. (1986). Delays on large construction projects. *International Journal of Operation & Production Management*, 6(1):25–33.

Sun M, Fleming A, Senaratne S, Motawa I, Yeoh ML. 2006. A change management toolkit for construction projects. *Arch Eng Design Manag*. 2(4):261–271.

Sun, W, Fang, C and Chen, Y. (2022). *Code Search based on Context-aware Code Translation.* In 44th International Conference on Software Engineering (ICSE '22), May 21–29, 2022, Pittsburgh, P A, USA. ACM, New York, NY, USA, 13 pages. https://doi.org/10.1145/3510003.3510140

Supriadi, L. S. R, Wisesatama, B and Latief, Y. (2018). Development of Work Breakdown Structure (WBS) Dictionary for Road Construction Works. *IOP Conference Series: Earth and Environmental Science*

Suresh, S., Renukappa, S., and Stride, M. (2020). *The impact of Covid-19 on the UK construction industry*. University of Wolverhampton.

Sutherland, J. (2014). *SCRUM: The art of doing twice the work in half the time*. Crown Business: New York.

Sutherland, J. W. (1975). *Systems: Analysis, Administration and Architecture*. New York: Van Nostrand.

Sutt, J, Sutt, J and Sutt, J. (2011). Manual of Construction Project Management: For Owners and Clients. *John Wiley & Sons, Incorporated, Hoboken*

Sutton, J and Austin, Z. (2015). Qualitative Research: Data Collection, Analysis, and Management. Retrieved from: https://www.ncbi.nlm.nih.gov

Swan, D. and Kyng, E. (2004), *An Introduction to Key Performance Indicators*, Centre for Construction Innovation, Northwest.

Swersky, D. (2018). The SDLC: 7 Phases, Popular Models, Benefits & More [Online] Retrieved from: https://raygun.com/blog/software-development-life-cycle/

Szymański, P. (2017). Risk management in construction projects. *Procedia Engineering,* 208, 174- 182.

Szymanski, S. (2006). What is the Construction Industry? An Economic Fact Book. *The Harry Van Arsdale Jr. Center for Labor Studies Empire State College/SUNY.* Retrieved from: https://www.esc.edu

Tabassi A. and Abu Bakar, AH. (2011). Towards assessing the leadership style and quality transformational leadership: The case of construction firms of Iran. *Journal of Technology Management,* 5(3), 245-258.

Tabassi, A. A., Ramli, M., Bakar, A. H. A., and Pakir, A. H. K. (2014). Transformational leadership and teamwork improvement: The case of construction firms. *Journal of Management Development,* 33(10), 1019-1034.

Taher, S. E and El-Korany, T. M., 2016. Critical Chain Project Management- A Critique. Retrieved from: https://www.researchgate.net

Taherdoost, M. (2016). Validity and Reliability of the Research Instrument; How to Test the Validation of a Questionnaire/Survey in a Research. *International Journal of Academic Research in Management (IJARM)* 5(3).

Takeuchi, H and Nonaka, I. (1986). *The New New Product Development Game*. *Harvard Business Review*

Takim, R. (2005). *A framework for successful construction project performance*. Unpublished PhD thesis. Glasgow Caledonian University.

Takim, R. and Akintoye, A. (2002). *Performance indicators for successful construction project performance.* 18th Annual ARCOM Conference, University of Northumbria: 2-4 September 2002, 545-555.

Talebi, S. (2014). *Rethinking the project development process through use of BIM*. 2nd BIM International Conference on Challenges to Overcome

Tarne, B. (2007). *Don't throw the baby out with the bathwater: how to combine and use both agile and traditional project management approaches*. Paper presented at PMI® Global Congress 2007—North America, Atlanta, GA. Newtown Square, PA: Project Management Institute.

Taromirad, M and Ramsin, R. (2008). *CEFAM: Comprehensive Evaluation Framework for Agile Methodologies*. 32nd Annual IEEE Software Engineering Workshop.

Tarwani, S and Chug, A. (2016). Agile Methodologies in Software Maintenance: A Systematic Review. *Informatica* 40 (2016) 415–426.

Tashakkori, A and Teddlie, C. (2003). *Handbook of Mixed Methods in Social & Behavioural Research.* SAGE Publications

Tashakkori, A and Teddlie, C. (2010). *Handbook of Mixed Methods in Social and Behavioural Research.* Sage Publications

Tashakkori, A. and Teddlie, C. (1998). *Mixed Methodology: Combing Qualitative and Quantitative Approaches.* London: Sage

Tasseel, N. (2021). Sailing – *The Ultimate Metaphor*. The Storytellers. Retrieved from: https://thestorytellers.com/

Tatum, C. B. 1987. Process of innovation in construction firm. *J. Constr. Eng. Manage.* 113 (4).

Tatum, C. B. 1989. "Organizing to increase innovation in construction firms. *J. Constr. Eng. Manage.* 115 (4).

Tavakol, M, and Dennick R. (2011). Making sense of Cronbach's alpha. *Int J Med Educ*. 27(2).

Tawiah, P. A., and Russell, A. D. (2008). Assessing infrastructure project innovation potential as a function of procurement mode." *J. Manage. Eng*. 24 (3)

Taylor, J. (2011). Factors Influencing the Use of Performance Information for Decision Making in Australian State Agencies. *Public Administration*, 89(4), 1316–1334.

Taymor, E, n.d. Agile Handbook. *Philosophie.* Retrieved from: http://agilehandbook.com/agile-handbook.pdf

Tendedez, H, Ferrario, M and Whittle, J. (2018). *Software Development and CSCW: Standardization and Flexibility in Large-Scale Agile Development*. In Proceedings of the ACM on Human-Computer Interaction, Vol. 2, CSCW, Article 171 (November 2018). ACM, New York, NY. 22 pages. https://doi.org/10.1145/3274440

Tennis. J. T. (2008). Epistemology, Theory, and Methodology in Knowledge Organization: Toward a Classification, Metatheory, and Research Framework. In Knowledge Organization. Retrieved from: http://faculty.washington.edu

Tenso, T, Norta, A. H, Rootsi, H, Taveter, K and Vorontsova, I. (2017). *Enhancing Requirements Engineering in Agile Methodologies by Agent-Oriented Goal Models: Two Empirical Case Studies*. IEEE 25th International Requirements Engineering Conference Workshops (REW), 2017, pp. 268-275.

Tereso A., Leão C. P and Ribeiro T. (2019) *Project Management Practices at Portuguese Startups.* In: Rocha Á., Adeli H., Reis L., Costanzo S. (eds) New Knowledge in Information Systems and Technologies. WorldCIST'19 2019. Advances in Intelligent Systems and Computing, vol 930. Springer, Cham.

Tezel, A. (2016). Implementing Lean Construction: The Major Pitfalls. Retrieved from: http://leanconstructionblog.com

Tezel, A., Papadonikolaki, E., Yitmen, I., and Hilletofth, P. (2020). Preparing construction supply chains for blockchain technology: An investigation of its potential and future directions. *Frontiers of Engineering Management*, *7*(4), 547-563.

Thariani, R. and Kloppenborg, T. J. (2001). *Information systems and construction project management – similarities and differences*. Paper presented at Project Management Institute Annual Seminars & Symposium, Nashville, TN. Newtown Square, PA: Project Management Institute.

The American Institute of Architects (AIA). (2004). *The Associated General Contractors of America (AGC), "Primer on Project Project Delivery.* The American Institute of Architects and The Associated General Contractors of America.

The Banwell Report. (1964). The Placing and Management of Contracts for Building and Civil Engineering Work *Willey Online Library*

The Constructor. (2018). Construction Project Life Cycle – Phases in Life Cycle of a Construction Project. Retrieved from: https://theconstructor.org

The Contracts Engineer. (2017). 4 Stages of Construction Project Design. Retrieved from: https://thecontractsengineer.com

The Egan Report. (1998). Rethinking Construction *Willey Online Library.* Retrieved from: https://onlinelibrary.wiley.com

The Emmerson Report. (1962). Survey of Problems Before the Construction Industry: A Report Prepared by Sir Harold Emmerson. *Willey Online Library.* Retrieved from: https://onlinelibrary.wiley.com

The KPI Working Group. (2000) 'KPI Report for the Minister for Construction'. Retrieved from: www.bis.gov.uk/files/file16441.

The Latham Report. (1994). Constructing the Team. Retrieved from: http://constructingexcellence.org.uk

The Office of Research Integrity. (2021). *Responsible Conduct in Data Management*. Retrieved from: https://ori.hhs.gov/

The PM² Methodology Guide. (2016). Project Management Methodology. Retrieved from: http://www.fos-unm.si [

The Simon Report. (1944). Placing and Management of Building Contracts: The Simon Committee Report. *Willey Online Library.* Retrieved from: https://onlinelibrary.wiley.com

The Standish Group. (2012). The Standish Group Report: CHAOS MANIFESTO Retrieved from: https://cs.calvin.edu

The Standish Group. (2014). The Standish Group Report: CHAOS. Retrieved from: https://www.projectsmart.co.uk

The Stationery Office. (2011). PRINCE2® in One Thousand Words. *White Paper* Retrieved from: https://www.trainingbytesize.com

The Stationery Office. (2012). by Buttrick, R. PRINCE2® and the National and International Standards. Retrieved from: www.viableprojects.eu

Theophilus, A and Micheal, A. (2021). *Assessing project management practices in avoiding project delays*. College of Art and Built Environment, KNUST.

Thesing, T., Feldmann, C., and Burchardt, M. (2021). Agile versus waterfall project management: decision model for selecting the appropriate approach to a project. *Procedia Computer Science*, *181*, 746-756.

Thi, C. H and Swierczek, W, F. (2010). Critical success factors in project management: implication from Vietnam. ResearchGate. Retrieved from: https://www.researchgate.net

Thomas, J., and Mullaly, M. (2008). *Researching the value of project management*. Newtown Square, PA: Project Management Institute. Turner, R. (2014). Handbook of project-based management (4th ed.). New York, NY: McGraw-Hill Education.

Thomas, P. Y. (2010). Towards developing a web-based blended learning environment at the University of Botswana. Retrieved from: http://uir.unisa.ac.za

Thomas, R., Sargent, L., and Hardy, C. (2011). Managing organizational change: Negotiating meaning and power-resistance relations. *Organization Science*, 22(1), 22–41.

Thomassen, M. (2011). BIM and Collaboration in AEC Industry. Aalborg University, Denmark. Retrieved from: [http://projekter.aau.dk

Thyssen, M. H, Emmitt, S, Bonke, S and Kirk-Christoffersen, A. (2010). Facilitating Client Value Creation in the Conceptual Design Phase of Construction Projects: A Workshop Approach. *Architectural Engineering and Design Management*. Retrieved from: https://files.transtutors.com

Ticehurst, G. (2009). *Business research methods: A managerial approach*. NSW Australia: Addison Wesley Longman

Tidd, J., J. Bessant, and K. Pavitt. (2005). *Managing innovation: Integrating technological, managerial organizational change.* New York: Wiley.

Toegel, G., and Jonsen, K. (2016). *Shared Leadership in a Global Context: Challenges of Transferring Control to Team Members*. Advances in Global Leadership, Emerald Group Publishing Limited.

Tokar, S. (2018). *6 Types of Project Management Methodologies to Boost Success*. Southern New Hampshire University.

Toljaga-Nikolic, D, Todorovic, M, Dobrota, M and Obradovic, T. (2020). Project Management and Sustainability: Playing Trick or Treat with the Planet. *Sustainability*

Toole T M. (1998) Uncertainty and Home Builders' Adoption of Technological Innovations. *Journal of Construction Engineering and Management*. 124(4)

Toole, T. M., M. Hallowell, and P. Chinowsky. 2013. A tool for enhancing innovation in construction organizations. *Eng. Project Organ. J.* 3 (1).

Toor, S. U. R. (2011). Differentiating leadership from management: An empirical investigation of leaders and managers. *Leadership and Management in Engineering*, 11(4), 310-320.

Touran, A, Gransberg, D. D, Molenaar, K, R and Ghavamifar, K. (2011). Selection of project delivery method in transit: Drivers and objectives. *J. Manag. Eng*., 27(1), pp. 21–27.

Transforming Design and Construction. (2017). *A Framework for Change*. Retrieved from: http://leanconstruction.org

Trevethan R. (2017). Deconstructing and Assessing Knowledge and Awareness in Public Health Research. *Frontiers in public health*, *5*, 194. https://doi.org/10.3389/fpubh.2017.00194

Trietsch, D. (2005). Why a Critical Path by Any Other Name Would Smell Less Sweet? Towards A Holistic Approach to PERT/CPM. *Project Management Journal*

Trinh, M. T and Feng, Y. (2020). Impact of Project Complexity on Construction Safety Performance: Moderating Role of Resilient Safety Culture. *Journal of Construction, Engineering and Management.* 146(2).

Tripp, J. F. (2012). *The Impacts of Agile Development Methodology Use on Project Success: A Contingency View*. Michigan State University.

Trivedi, C. (2020). Ontology and epistemology: An explainer. Retrieved from: https://conceptshacked.com/

Trochim, W. M. K., 2006. Research Methods Knowledge Base. Retrieved from: https://www.socialresearchmethods.net

Tuffaha, F. M, Assaf, S, Zaben, Y. Z and Hadidi, L. A. (2020). A framework for the performance assessment of construction contractors in Saudi Arabia. *Journal of Built Environment Project and Asset Management*.

Tukel, O. I. and Rom, W. (2006). *Analysis of Resource Buffer Management in Critical Chain Scheduling.* Paper presented at PMI® Research Conference: New Directions in Project Management, Montréal, Québec, Canada. Newtown Square, PA: Project Management Institute

Tuli, F. (2010). *The Basis of Distinction Between Qualitative and Quantitative Research in Social Science: Reflection on Ontological, Epistemological and Methodological Perspectives.* Ambo University. Retrieved from: http://citeseerx.ist.psu.edu

Tulsian, M. (2014). Profitability Analysis (A comparative study of SAIL & TATA Steel). *IOSR Journal of Economics and Finance*, 3(2).

Tumbas, P and Matković, P. (2006). Agile vs Traditional Methodologies in Developing Information Systems. *Management Information Systems*

Turin, D. A. (1969). *The Construction Industry: Its Economic Significance and Its Role in Development*. London: University College, Environmental Research Group.

Turk, D, France, R and Rumpe, B. (2005). Assumptions Underlying Agile Software Development Processes. *Journal of Database Management, Idea Group Inc*., pp. 62-87

Turk, D., France, R., and Rumpe, B. (2014). Limitations of Agile Software Processes. *ArXiv*, abs/1409.6600.

Turner & Townsend (2019). *International construction market survey (2019).* Retrieved from: http://www.infrastructure-intelligence.com/

Turner, J. R and Muller, R. (2003). On the Nature of the Project as a Temporary Organization. *International Journal of Project Management*

Turner, J. R. (1999). *The Handbook of Project-Based Management*, 2nd Ed. Retrieved from: http://ceit.aut.ac.ir

U.S. Department of Energy. (2003). Work Breakdown Structure. Retrieved from: http://www4.rcf.bnl.gov

UCLA: Statistical Consulting Group. (2021). What Does Cronbach's Alpha Mean? Retrieved from: https://stats.oarc.ucla.edu

Udom, K. (2012). *New procurement methods coming to a project near you*. Available at: www.thenbs. com/knowledge/new-procurement-methods-coming-to-a-project-near-you

Uikey, N and Suman, U. (2012). *An Empirical Study to Design an Effective Agile Project Management Framework.* University, Indore, India.

UK Construction Online. (2018). The Construction Industry in 2019 – Cash will be King. Retrieved from: https://www.ukconstructionmedia.co.uk

UK Industry Performance Report. (2002). Retrieved from: https://www.glenigan.com

UK Industry Performance Report. (2003). Retrieved from: https://www.glenigan.com

UK Industry Performance Report. (2016) Retrieved from: https://www.glenigan.com/

UK Industry Performance Report. (2021). Retrieved from: https://www.glenigan.com

Ullah, K., Lill, I., and Witt, E. (2019). *An overview of BIM adoption in the construction industry: Benefits and barriers.* In 10th Nordic Conference on Construction Economics and Organization. Emerald Publishing Limited.

Unegbu, C. O, Yawas, D. S. and Dan-Asabe, B. (2020). An Investigation of the Relationship Between Project Performance Measures and Project Management Practices of Construction Projects for the Construction Industry In Nigeria. *Journal of King Saud University*. 20

Ungureanu, A and Ungureanu, A. (2014). Methodologies Used in Project Management. *ResearchGate*.

University of Cambridge. (2018). *Engineering Diversity: How gender equality can help fix the construction industry*. Retrieved from: https://www-engineeringdiversity.eng.cam.ac.uk/

University of Portsmouth. (2012). Advantages and Disadvantages of Analysing Written Documents for the Purposes of Research. Retrieved from: http://compass.port.ac.uk

University of South Florida. (2020). *The Research Process*. University of South Florida Libraries. https://guides.lib.usf.edu/

University of Southern California. (2021). *Research Guide. Organizing Your Social Sciences Research Paper*. USC Libraries.

University of Southern California. (2021). *Research Guides: Organizing Your Social Sciences Research Paper*. Retrieved from: https://libguides.usc.edu/

Usman, M, Soomro, T. R and Brohi, M. N. (2014). Embedding Project Management into XP, SCRUM and RUP. *European Scientific Journal*, 10(15).

Usmani, F. (2018). Critical Chain Method (CCM) in Project Management. *PM Study Circle*. Retrieved from: https://pmstudycircle.com

Vaes, S and Huyse, H. (2016). *The Role of the Private Sector in Development Cooperation: Three Case Studies In South Africa*. HIVA - Research Institute for Work and Society.

Van Casteren, W. (2017). The Waterfall Model and the Agile Methodologies: A comparison by project characteristics – short. ResearchGate. Retrieved from: https://www.researchgate.net/

Van der Ryst, G. J. (2019). Management Strategies and Organisational Structures for Project Management (Thesis). Johannesburg: University of Johannesburg Retrieved from: http://hdl.handle.net/102000/0002

Van der Panne, G, van Beers, C and Kleinknecht, A. (2003). Success and failure of innovation. *Int J Innov Manage*. 7(3):309–338

Vaníčková, R. (2017). Application of PRINCE2 Project Management Methodology. *Studia commercialia Bratislavensia*, 10(38).

van Riper, C. J., K. E. Wallen, A. C. Landon, M. A. Petriello, G. T. Kyle, and J. Absher. (2016). Modelling the trust-risk relationship in a wildland recreation setting: A social exchange perspective. *Journal of Outdoor Recreation and Tourism*, 13:23–33. doi:10.1016/j.jort.2016.03.001

Varajao, J, Colomo-Palacios, R. and Silva, H. (2017), "ISO 21500:2012 and PMBoK 5 processes in information systems project Management", *Computer Standards and Interfaces*, 50(2).

Varghese, A., and Xavier, A. S. (2019). *Influence of Cycle Time on the Productivity of Transit Mixers.* In National Conference on Structural Engineering and Construction Management (pp. 703-712). Springer, Cham.

Varpio, L and Macleod, A. (2020). Philosophy of Science Series: Harnessing the Multidisciplinary Edge Effect By Exploring Paradigms, Ontologies, Epistemologies, Axiologies, and Methodologies. *Academic Medicine*, 95(5).

Vasista, T. G and Abone, A. (2018). Benefits, Barriers and Applications of Information Communication Technology in Construction Industry: A Contemporary Study. *International Journal of Engineering & Technology*. 7 (3.27).

Vaskimo, J. (2011). *IPMA World Congress 2011 on October 12, 2011, in Brisbane, Queensland,* International Project Management Association, Amsterdam, The Netherlands (2011)

Vazquez-Bustelo, D and Avella, L. (2006). Agile Manufacturing: Industrial Case Studies in Spain. *Technovation*, 26(10), Pp. 1147-61.

Veditz, L. A., 1993. The Channel Tunnel - A Case Study. Executive Research Project Retrieved from: https://apps.dtic.mil

Vennström, A. (2008). The Construction Client as a Change Agent - Contextual Support and Obstacles. Luleå University of Technology

Ventresca, M. J and Mohr, J. W. (2001). *Archival Research Methods*. Blackwell

VersionOne. (2017). 11th Annual State of Agile Report. Retrieved from: https://www.agile247.pl/

VersionOne. (2020). 14th Annual State of Agile Report. Retrieved from: https://www.collab.net/

Veshosky, D. (1998) Managing innovation information in engineering and construction firms. *Journal of Management in Engineering*, 14(1).

Vilagut G. (2014). *Test-Retest Reliability*. In: Michalos A.C. (eds) Encyclopedia of Quality of Life and Well-Being Research. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-0753-5_3001

Villanova University, (2020). *Project Management: The Use of Agile Project Management is Increasing.* [Retrieved from: https://www.villanovau.com/

Villanova University, (2021). What is the Iron Triangle of Project Management? Retrieved from: https://www.villanovau.com/

Villazón, C. C; Pinilla, L. S and Olaso, J. R. O. (2020). Identification of Key Performance Indicators in Project-Based Organisations through the Lean Approach. *Journal of Sustainability.* 12(5977).

Vinekar, V., Slinkman, C.W. and Nerur, S. (2006). Can Agile and Traditional Systems Development Approaches Coexist? An Ambidextrous View. *Information Systems Management*, 23(3).

Voordijk, H. (2009), "Construction management and economics: the epistemology of a multidisciplinary design science", *Construction Management and Economics*, 27(8), pp. 713-720.

Vrijhoef, R and Koskela, L. (2005). A Critical Review of Construction as a Project-Based Industry: Identifying Paths Towards a Project Independent Approach to Construction. Retrieved from: https://pdfs.semanticscholar.org

Vrijhoef, R. and Koskela, L. (2000) The four roles of supply chain management in construction. *European Journal of Purchasing & Supply Management*, 6, 169–78).

Wahyuni, D. (2012). The research design maze: understanding paradigms, cases, methods and methodologies. *Journal of applied management accounting research,* 10, 69–80

Walker, D. H. T. and Lloyd-Walker, B. (2014). *Understanding relationship-based procurement in the construction sector: summary of research findings*. Paper presented at Project Management Institute Research and Education Conference, Phoenix, AZ. Newtown Square, PA: Project Management Institute.

Walker, A. (1996). *Project Management in Construction*. 3rd Ed., Blackwell science.

Walker, A. (2015). *Project Management in Construction.* 6th ed. Wiley Blackwell.

Walker, I. (2010). *Research Methods and Statistics*. Palgrave Macmillan

Walliman, N. (2017). *Research Methods: The Basics*. 2nd Edition. Routledge, London

Walsh, E, Holton, J. A, Bailyn, L, Fernandez, W, Levina, N and Glaser, B., 2015.

What Grounded Theory Is: A Critically Reflective Conversation Among Scholars. *Organizational Research Methods.* Sage

Walker, D. H. T and Lloyd-Walker, B. M. (2015). *Collaborative project procurement arrangements*. Newtown Square, PA: Project Management Institute. Academia: Summaries of New Research for the Reflective Practitioner

Walsh, I. (2014). A Strategic Path to Study IT Use Through Users' IT Culture and IT Needs: A Mixed-Method Grounded Theory. *Journal of Strategic Information Systems*

Walter, M. (2006). *Social Science Methods: An Australian Perspective*. Oxford, New York: Oxford University Press.

Wang, J. J, Sasanipoor, N. and Wang, M.M. (2018), "How PMBOK standard and relationship quality influence IT outsourcing project success: an investigation of the mediated moderation effects", *Journal of Global Information Technology Management*, 21(4), pp. 282-300.

Wanner, R. (2021). How to Control Agile Projects – Monitoring and Control. Retrieved from: https://rolandwanner.com/

Ward, A. D. (2016). *Development of a contextualised understanding of the diffusion of innovation among quantity surveyors in the UK construction industry*. Nottingham Trent University. Retrieved from: http://irep.ntu.ac.uk/

Watkins, M. W. (2018). Exploratory Factor Analysis: A Guide to Best Practice. *Journal of Black Psychology*, 44(3), 219–246.

Watt, A. (2014). Project Management. Retrieved from: https://opentextbc.ca/projectmanagement/front-matter/about-the-book

Wazir, M. R, Wazir, M. I and Ahmed, S. (2019). Critical Evaluation of Project Management Foundations. *City University Research Journal*, 9(2).

Wedawatta, G, Ingirige, B and Amaratunga, D., 2011. Case Study as a Research Strategy: Investigating Extreme Weather Resilience of Construction SMEs in the UK. University of Salford. Retrieved from: http://usir.salford.ac.uk

Weick, K. E. (2005). Organizing and failures of imagination. *International Public Management Journal*, 8, 425–438.

Wells, H, Dalcher, D and Smyth, H. (2015). *The adoption of agile management practices in a traditional project environment*: An IT/IS Case Study. 48th Hawaii International Conference on System Sciences.

Wells, H. (2012). How effective are project management methodologies? An explorative evaluation of their benefits in practice. *Project management journal*, *43*(6), 43-58.

Western Michigan University. (2019). Design Phase. Facilities Management. Retrieved from: [https://wmich.edu/facilities/design-phase

Wetherill, M, Rezgui, Y, Lima, C and Zarli, A. (2002). Knowledge Management for The Construction Industry: The E-COGNOS Project. *ITcon* Vol. 8 (2002).

White, D., and Fortune, J. (2002). Current practice in project management—An empirical study. *International Journal of Project Management,* 20(1), 1–11

Whitmore, D., Papadonikolaki, E., Krystallis, I., and Locatelli, G. (2020). Are megaprojects ready for the Fourth Industrial Revolution?. *Proceedings of the Institution of Civil Engineers-Management, Procurement and Law*, *174*(2), 49-58.

Wideman, M. (2006). Project management methodologies. Retrieved from: http://www.maxwideman.com/issacons/iac1013a/index.htm.

Wiesche, M, Jurisch, M. C, Yetton, P. W and Krcmar, H., 2017. Grounded Theory Methodology in Information Systems Research. *MIS quarterly,* 41(3)*, pp. 685-701*

Wijesinghe, S. (2018). *How to Improve the UK Construction Industry Performance*. The School of Built Environment. University of Salford.

Wild, A. (2001). *The Phillips report on building: 1950*. In: Akintoye, A (Ed.), 17th Annual ARCOM Conference, 5-7 September 2001, University of Salford. Association of Researchers in Construction Management, Vol. 1, 609-17.

Williams, M., and Moser, T. (2019). The art of coding and thematic exploration in qualitative research. *International Management Review*, *15*(1), 45-55.

Williams, T.M. (1999). The Need for New Paradigms for Complex Projects. *International Journal of Project Management*, 17(5).

Winch, G. M. (2006). Towards a theory of construction as production by projects. *Building Research & Information,* 34(2), 164-174.

Winch, G. M. (1998). Zephyrs of creative destruction: Understanding the management of innovation in construction. *Building Research & Information*, 26(4).

Winch, G. M. (2009). *Managing Construction Projects*. John Wiley & Sons, Incorporated, Somerset.

Winch, G. M. (2013). Escalation in Major Projects: Lessons from the Channel Fixed Link. *International Journal of Project Management*.

Withers, I. (2017). Construction faces tough 2018 as forecast downgraded. *The Telegraph.* Retrieved from: https://www.telegraph.co.uk

Wolfe, R.A. (1994). Organizational innovation: Review, critique and suggested research directions. *Journal of management studies,* 31(3).

Wolff, S. (2012). Scrum Goes Formal: Agile Methods for Safety-Critical Systems. Retrieved from: http://delivery.acm.org

Wolfswinkel, J. F, Furtmueller, E and Wilderom, C. P. M. (2013). Using Grounded Theory as a Method for Rigorously Reviewing Literature. *European Journal of Information Systems*

Wolstenholme, A. (2009). Never Waste a Good Crisis: A Review of Progress since Rethinking Construction and Thoughts for Our Future. Retrieved from: http://constructingexcellence.org.uk [Accessed 30 Jun. 20]

Wolstenholme, A; Austin, S; Bairstow, M; Blumenthal, A; Lorimer, J; McGuckin, S. (2009). *Never Waste a Good Crisis: A Review of Progress Since Rethinking*

Construction and Thoughts for our Future. Loughborough University. Report. https://hdl.handle.net/2134/6040

Woodhead, R., Stephenson, P., and Morrey, D. (2018). Digital construction: From point solutions to IoT ecosystem. *Automation in Construction, 93,* 35-46.

Wright, T. (2016). *Gender and sexuality in male-dominated occupations: Women Working in Construction and Transport.* UK: Palgrave Macmillan.

Wright, T. and Conley, H. (2020). Advancing gender equality in the construction sector through public procurement: Making effective use of responsive regulation', *Economic and Industrial Democracy*, 41(4), pp. 975–996. doi: 10.1177/0143831X17745979.

Wu, C., Wang, F., Zou, P.X. and Fang, D. 2016. How safety leadership works among owners, contractors and subcontractors in construction projects. *International Journal of Project Management,* 34(5), pp. 789-805.

Wysocki, R. K and McGary, R. (2007). Effective Project Management - Traditional, Adaptive, Extreme. *Information Systems Control Journal,*

Wysocki, R. K and McGary, R. (2009). *Effective Project Management - Traditional, Adaptive, Extreme. Fifth Edition*. Wiley Publishing, Inc

Wysocki, R. K and McGary, R. (2011). *Effective Project Management - Traditional, Adaptive, Extreme. Fifth Edition.* Wiley Publishing, Inc

Wysocki, R.K. (2011), *Executives Guide to Project Management*, Wiley, Hoboken, NJ.

Xia, B and Chan, A. P. (2012). Measuring complexity for building projects: a Delphi study. *Engineering, Construction and Architectural Management*

Xiang, C and Yue, W. (2009). Program Evaluation and Review Technique Based on Moment Generating Function and its Application in Software Engineering. World Congress on Software Engineering. Retrieved from: https://ieeexplore.ieee.org

Xue, X, Zhang, R, Yang, R and Dai, J. (2014). Innovation in Construction: A Critical Review and Future Research. *International Journal of Innovation Science*, 6(2).

Yang, C, Q and Miller, B. P. (1988). *Critical Path Analysis for the Execution of Parallel and Distributed Programs.* The 8th International Conference on Distributed. Retrieved from: https://www.computer.org

Yang, H., Yeung, J. F. Y. Y., Chan, A. P. C. C., Chiang, Y. H and Chan, D. W. M. C. (2010). A Critical Review of Performance Measurement in Construction. *Journal of Facilities Management*, 8(4), 269–284.

Yang, H., Yeung, J., Chan, A., Chiang, Y. and Chan, D. (2010). A critical review of performance measurement in construction. *Journal of Facilities Management,* 8(4).

Yang, L. R, Huang, C. F, Wu, K. S. (2011). The Association Among Project Manager's Leadership Style, Teamwork and Project Success. *International Journal of Project Management*, 29(3).

Yap, J. B. H, Chow, I. N and Shavarebi, K. (2019). Criticality of Construction Industry Problems in Developing Countries: Analysing Malaysian Projects. *Journal of Management in Engineering*, 35(5).

Yasin M. M, Gomes, C. F and Miller, P. E. (2009). Characteristics of Portuguese Public-Sector Project Managers: Toward Closing the Effectiveness Gap. *Project Management Journal*, 40(3).

Yeganeh, A. A, Azizi, M, Falsaf, R. (2019). Root causes of design construction interface problems in Iranian design-build projects. *J Constr Eng Manag* 145(12):1–14. https://doi.org/10.1061/ (ASCE)CO.1943-7862.0001727

Yeo, K. T. (2002). Critical Failure Factors in Information System Projects. International *Journal of Project Management*

Yin, R. K., 2003. *Case Study Research: Design and Methods*. Newbury Park: Sage Publications.

Yllen Johansson M. (2012). *Agile project management in the construction industry: An inquiry of the opportunities in construction projects*. Sweden: KTH Royal Institute of Technology Stockholm.

Young, B. E, Seidu, R. D, Ponsford, S, Robinson, H and Adamu, Z. (2021). Cost Changes in UK Design and Build Projects. *Journal of Emerging Trends in Economics and Management Sciences (JETEMS)*, 12(1):49-57

Yusof, N.B., Shafei M.W.M., Ilias S. and Anidin, N.Z., (2010). Factors Influencing Firms Readiness Towards Innovation in House Building Industry; A Multi-dimensional construct. *International Journal of Organizational Innovation*, 2(3).

Yusuf, Y.Y, Sarhadi, M. and Gunasekaran, A. (1999). Agile Manufacturing: The Drivers, Concepts and Attributes. *International Journal of Production Economics*, 62, pp. 33-43.

Zahrizan, Z., Ali, M., Haron, T., & Marshall-Ponting, A. (2014). Exploring the Barriers and Driving Factors in Implementing Building Information Modelling (BIM) in the Malaysian Construction Industry: *A Preliminary Study*, 75(1), 1– 10.

Zairi, M. 1994. “Innovation or innovativeness? Results of a benchmarking study.” *Total Qual. Manage*. 5 (3).

Zakrzewska, M., Piwowar-Sulej, K., Jarosz, S., Sagan, A., and Sołtysik, M. (2022). The linkage between Agile project management and sustainable development: A theoretical and empirical view. *Sustainable Development, 30*(5), 855-869.

Zaman, U., Nawaz, S., Tariq, S., and Humayoun, A. A. (2019). Linking transformational leadership and “multi-dimensions” of project success: Moderating effects of project flexibility and project visibility using PLS-SEM. *International Journal of Managing Projects in Business*.

Zamim, S. K. (2021). Identification of crucial performance measurement factors affecting construction projects in Iraq during the implementation phase, *Cogent Engineering*, 8(1).

Zasa, F. P., Patrucco, A., & Pellizzoni, E. (2020). Managing the Hybrid Organization: How Can Agile and Traditional Project Management Coexist? *Research-Technology Management*, *64*(1), 54-63.

Zavadskas, E, Vilutienė, T, Turskis, Z and Šaparauskas, J. (2014). Multi-criteria analysis of Projects' performance in construction. *Archives of Civil and Mechanical Engineering*, 14 114-121

Zavyalova, E, Sokolov, D and Lisovskaya, A. (2019). Agile vs Traditional Project Management Approaches: Comparing Human Resource Management Architectures. *International Journal of Organizational Analysis*.

Zawdie, G. (2012). *Construction Innovation through Change Management.* In Akintoye, A, Goulding, J. and Girma, Z. (eds.) Construction Innovation and Process Improvement. Oxford: John Wiley & Sons.

Zender, Y. O., and de Soto, B. G. (2020). Use of Scrum in the rehabilitation of a commercial building in Peru. *Construction Innovation*, *21*(2), 145-163.

Zhai, L., Xin, Y., & Cheng, C. (2009). Understanding the value of project management from a stakeholder's perspective: Case study of mega-project management. *Project Management Journal*, 40(1), 99–109.

Zhang F, Zuo J and Zillante G. (2013). Identification and Evaluation of the Key Social Competencies for Chinese Construction Project Managers. *International Journal of Project Management,* 31(5).

Zhang Y, Wang J, Hu F, Wang Y. 2017. Comparison of evaluation standards for green building in China, Britain, United States. *Renew Sustain Energy Rev*. 68 (1).

Zhang, J, Jia, S and Diaz, E. (2018). Dynamic monitoring and control of a critical chain project based on phase buffer allocation. *Journal of the Operational Research Society*, 69(12).

Zhang, Yan & Wildemuth, Barbara M. (2009). *Qualitative analysis of content*. In Barbara M. Wildemuth (Ed.), Applications of social research methods to questions in information and library science (pp.318-329). Westport, CT: Libraries Unlimited.

Zhao X, Hwang, B. G, Lee, H. N. (2016). Identifying Critical Leadership Styles of Project Managers for Green Building Projects. *International Journal of Construction Management*, 16(2).

Zhao, W, Wang, W and Lu, X. (2011). Auto-Layout Algorithm of Project Network Diagram. *Workshop on Digital Media and Digital Content Management* Retrieved from: https://ieeexplore.ieee.org

Zhao, Z. Y; You, W. Y and Zuo, J. (2010). Application of Innovative Critical Chain Method for Project Planning and Control under Resource Constraints and Uncertainty. *Journal of Construction Engineering and Management*

Zhong, B., Wu, H., Li, H., Sepasgozar, S., Luo, H., and He, L. (2019). A scientometric analysis and critical review of construction related ontology research. *Automation in Construction, 101*, 17-31.

Zhong, Q.; Tang, H.; Chen, C. A. (2022). Framework for Selecting Construction Project Delivery Method Using Design Structure Matrix. *Buildings,* 12(443). https://doi.org/10.3390/ buildings12040443

Zhou, Z, Yang, M. G and Shen, L. (2016). Overview and Analysis of Ontology Studies Supporting Development of the Construction Industry. *Journal of Computing and Civil. Engineering,* 30(6)

Zhou, Z., Goh, Y.M. and Li, Q. (2015). Overview and analysis of safety management studies in the construction industry. *Safety Science*, 72(February), pp. 337-350.

Zia, A, Arshad, W and Mahmood, W. (2018). Preference in using Agile Development with Larger Team Size. *International Journal of Advanced Computer Science and Applications*, 9(7).

Zidane, Y. J, Andersen, B, Zidane, Y. J, Andersen, B. (2018). The top 10 universal delay factors in construction projects delay factors. *Int J Manag Proj Bus* 11(3):650–672. https://doi.org/10.1108/ IJMPB-05-2017-0052

Zimmermann R., L. M. D. F. Ferreira, and A. C. Moreira. (2020). An empirical analysis of the relationship between supply chain strategies, product characteristics, environmental uncertainty and performance. *Supply Chain Manag. An Int*. J. 25 (3): 375–391.

Ziółkowski, A and Deręgowski, T. (2014). Hybrid Approach in Project Management – Mixing Capability Maturity Model Integration with Agile Practices. *Social Sciences*, 85(3).

Zozaya-Gorostiza, C. (2012). *Knowledge-based process planning for construction and manufacturing*. Elsevier.

Zubkova A. B., Rusanova L. D. (2019). International Business Management: Agility Journey for High-Tech Companies. *Department of International Business and Finance.*

Zubon, S. H., and Taher, M. K. (2022). A Comparison Between the International Standards PRINCE2 and PMBOK in Project Management. Retrieved from: eudl.eu

Zucker, A. (2017). If Agile is Better, why is Adoption So Low? Project Management Essentials. Retrieved from: https://pmessentials.us/

Zuhairy, M, Tajuddin, M, Iberahim, H and Ismail, N. (2017). *Leadership Styles and Organizational Performance in Construction Industry in Malaysia*. Manipal International University (MIU). Retrieved from: www.researchgate.net

Zulch, B. G. (2014). *Communication: The foundation of project management*. Conference on ENTERprise Information Systems / ProjMAN 2014 - International Conference on Project MANagement / HCIST 2014 - International Conference on Health and Social Care Information Systems and Technologies.

Žužek, T, Gosar, Z, Kušar, J and Berlec, T. (2020). Adopting Agile Project Management Practices in Non-Software SMEs: A Case Study of a Slovenian Medium-Sized Manufacturing Company. *Journal of Sustainability,* 12, 9245.

Zwikael, O and Globerson, S., 2006. From Critical Success Factors to Critical Success Processes. *International Journal of Production Research* [Online] Available at: https://www.tandfonline.com

Zwikael, O. (2019). *Executing a Project.* In: Zwikael, O and Smyrk, J. R. (2019). Project Management. Springer Nature Switzerland.

Zyphur, M. J., & Pierides, D. C. (2020). Making quantitative research work: From positivist dogma to actual social scientific inquiry. *Journal of Business Ethics*, *167*(1), 49-62.

APPENDICES

Appendix A: Ethics Approval

University of Central Lancashire

23 May 2019

Stanley Nguangang / Kelechi Bukola Babatunde

School of Engineering

University of Central Lancashire

Dear Stanley / Kelechi

Re: BAHSS Ethics Committee Application
Unique Reference Number: BAHSS 671

The BAHSS ethics committee has granted approval of your proposal application 'Application of Agile and Traditional Project Management Strategies in the Management of UK Construction Projects'. Approval is granted up to the end of project date.

It is your responsibility to ensure that

- the project is carried out in line with the information provided in the forms you have submitted
- you regularly re-consider the ethical issues that may be raised in generating and analysing your data
- any proposed amendments/changes to the project are raised with, and approved, by Committee
- you notify EthicsInfo@uclan.ac.uk if the end date changes or the project does not start
- serious adverse events that occur from the project are reported to Committee
- a closure report is submitted to complete the ethics governance procedures (Existing paperwork can be used for this purposes e.g., funder's end of grant report; abstract for student award or NRES final report. If none of these are available use e-Ethics Closure Report Proforma).

Yours sincerely

Rick Peterson

Deputy Vice Chair

BAHSS Ethics Committee

* for research degree students this will be the final lapse date

NB - Ethical approval is contingent on any health and safety checklists having been completed and necessary approvals gained as a result.

Appendix B: Participants Information Sheet

uclan
University of Central Lancashire

Application of Agile and Traditional Project Management Strategies in the Management of UK Construction Projects

This document provides you with information about the research, and why you have been invited to participate in the interview. It is important you understand why this research is done and what it will involve. Please read this document carefully before deciding to take part in the research. If you have any questions or concerns, please do not hesitate to contact me via the contact details provided at the end of this document.

Thank you,

Kelechi Bukola Babatunde

What is the purpose of the study?

The construction industry has traditionally been the leading sector of the economy in the United Kingdom and a major growth driver. Annually, it contributes about £90 billion (6.7%) to the UK economy and comprises of over 280 businesses with 10% of total UK employment.

One of the greatest challenges of the construction industry is the management of uncertainties. Construction project managers over the years have engaged in the use of templates, checklists and models that have phases and sub-phases. Globalisation, however, has spurred the need for flexibility in work processes, hence, the need for a new management approach that will improve the overall performance of construction projects.

Agile project management (APM) is a framework for delivering products quickly and efficiently. Agility is defined as the ability to function proactively in a dynamic, unpredictable and changing environment. Studies have proved that APM strategies are three times more effective than the traditional project management approach, because APM is not formulated on the need for anticipation but on the need for continuous adaptation.

There are ongoing studies that aim to improve on the overall efficiency of the UK construction industry. However, these are hampered by the fact that Agile and traditional project management approaches continue to be treated as two separate knowledge domains.

The purpose of this research is to assess the application of Agile and Traditional project management strategies in the management of UK construction projects. This is achieved through the exploration of the perceptions of construction industry practitioners about Agile project management methodology.

Why have I been invited to participate?

The researcher is looking for experienced practitioners in the construction sector such as project managers, construction engineers, site managers, designers and construction workers, who are willing to take part in the interview process. You have been chosen because of your role and experience.

Do I have to take part?

It is your decision whether you wish to participate. It is totally voluntary. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. However, you are free to withdraw within **two weeks** without giving a reason.

What will happen to me if I take part?

If you decide to take part, your participation will involve answering some questions about project management methods via an interview. The interview will be digitally recorded, that is if you are happy with your words being recorded. You do not have to answer all questions during the interview, and you may wish to end the interview or withdraw from the research without given reasons. You may also withdraw your story or words up to **two weeks** after the interview is completed.

What are the possible benefits of taking part?

This is an opportunity for you to help us understand the perception of construction project management practitioners in the UK. Whilst there are no immediate benefits for those people participating in the project, it is hoped that this work will have a beneficial impact in the UK construction sector on how to make construction projects agile and fit for any changes spurred by globalisation.

What are the possible risks of taking part?

Participation in this research is not anticipated to cause you any disadvantages or discomfort. It will require you to give a maximum of one hour of your time. You may also be concerned about being identified through what you say during the interview, however, the researcher will take all necessary steps to make sure you cannot be identified through what you say during the interview.

What happens when the research study stops?

You will not be contacted or required to participate in any further interviews regarding this study.

What will you do with the information I share?

All information that you share during the interview will only be used for this research or any publications or presentations related to the research. The information will not be shared with any other person apart from my PhD supervisors. The only time when information can be shared is if you share information that will make the researcher believe that you may be at risk of harm or that someone else may be at risk of harm. In this case, the researcher will have to pass the information to the relevant agencies.

The answers you give during the interview will be recorded and securely stored on the University's and home computer which is password protected in which case only the researcher will have access to the information. Your name will not be used when storing the information that you provide, and your consent form will not be stored together with the information that you provide, so that even the researcher will not be able to match names to the answers given after the interviews. Your information will be kept in the University computer system for 5 years from the end of the project then it will be destroyed.

If the information that you share is to be used publicly (e.g., in a publications or presentations), anything that may allow people to know it is your word will be removed e.g., your name, place of work, etc.

What will happen to the results of the research study?

The results of the research study will be used in thesis, presentations and publications related to the research study. You can get a copy of the findings at the end of the research if you wish to do so.

What should I do if I want to take part?

You will need to sign and send back the consent form via email or post, indicating your interest to participate in this research. You will then be contracted to agree a time that is convenient for you to be interviewed.

Who is organising and funding the research?

This research is conducted and funded by Kelechi Bukola Babatunde, a PhD candidate, from the school of Engineering at the University of Central Lancashire.

Who has reviewed the study?

This research has been reviewed by the supervisory team and approved by the University Research Ethics Committee of the University of Central Lancashire.

Contact for Further Information

If you have any questions or concerns about the research, please contact the researcher, Kelechi Bukola Babatunde on 07476150008 or kbbabatunde@uclan.ac.uk. If you are not satisfied with the answer given by the researcher, or if you wish to make a complaint about the research, or how you have been treated by the researcher, please contact the researcher's Director of Studies, Dr. Stanley Njuangang on snjuangang1@uclan.ac.uk or the University Officer for Ethics on OfficerforEthics@uclan.ac.uk.

Many thanks for taking time to read this information sheet.

Date: 08 May 2019.

Appendix C: Open-Ended Survey Questions

Interview Questions

Aim: To explore the perceptions of UK construction practitioners on the use of Agile project management methodology.

Background

1. How long have you worked in the construction industry?
2. What is the size of your organisation (in terms of the number of employee or annual turnover)?
3. What aspect of construction are you involved in? E.g., contracting, sub-contracting, etc.
4. What is the size of your project team?

The industry

1. How would you describe the UK construction industry?
2. Do you believe the UK construction industry lags behind other industries? If yes, why do you think so? If not, why not?
3. What are the key difficulties you've experienced in managing a construction project? What is easy?
4. From a project management perspective, in comparison to other industries (especially manufacturing/production and IT) do you think that there is a difference in managing a construction project? Or are there no differences (project is project)?

Tools and methods

1. Which project management tools and methods are available in your organisation? And how many of them are you really using in practice?
2. How do you decide which tools and methods to implement?
3. Do you think there is need for a new project management method to improve the performance of construction projects? Or do you think the current methods and tools are enough?

Agile Project Management (APM)

1. What do you know about Agile project management?
2. Do you think Agile project management is useful for construction? If yes, why? If not, why not?
3. Does your organisation try to implement Agile? If yes, why? If not, why not?

APM Customer Focus

1. Can you describe the vision, strategy, and objectives of your organisation in meeting the needs of the customers?
2. What are your organisation's key strategies and measures for managing project deliverables?
3. How do you manage customers changing requirements throughout the project life cycle?

APM Team/Quality Focus

1. What kind of relationship exist among the project team, the technical team (the developers) and stakeholders throughout a construction project life cycle?

2. How do you disseminate information regarding the project goals and objectives?
3. How do you keep the team (the project team and the field workers) always motivated?
4. How do you measure the performance or progress of an ongoing project?

5. What procedures do you follow to ensure sustainable development is maintained at a constant working pace in your project activities?
6. What measures do you have to ensure technical excellence in your designs and what support does the field team have in clarifying further design queries?

7. How do you identify and simplify the key activities of a project?
8. Briefly explain to me how your project team is organised?
9. What procedure does the team follow to reflect on the project outcome?

Others

1. In your opinion, can the introduction of Agile project management (that adapts to changes) enhance the overall performance of a construction project?
2. Do you think it will be useful to design a framework that integrates the traditional and Agile project management methods? If yes, what sort of components should the framework cover?
3. Finally, do you have any further thoughts or ideas which you would like to share with me?

Appendix D: Survey Questionnaire

The School of Engineering,

University of Central Lancashire,

Fylde Road, Preston.

PR1 2HE.

<u>To whom it may concern</u>:

My name is Kelechi Babatunde, a Ph.D. research student at the University of Central Lancashire (UCLan), Preston. The aim of this research is to investigate ways of improving the performance of UK construction projects with the goal of developing a framework that integrates the traditional and agile project management methodologies. The purpose of integration in this study is to enhance the traditional project management methodologies with best practices from agile methodologies, thus allowing a gradual introduction of agile project management benefits to be realised into the UK construction industry.

As part of this research, I would like you to assist me by completing the following questionnaire. This questionnaire is divided into five sections. ***Section one*** will establish your role and experience in the construction industry. ***Section two*** covers issues leading to poor performance of UK construction projects. ***Section three*** will assess your knowledge of the traditional project management methodologies. ***Section four*** will evaluate the potential contribution of agile project management in managing construction projects and the extent to which agile elements can improve the performance of UK construction projects. ***Section five*** evaluates the barriers that hinders the integration of traditional and agile methodologies for the management of UK construction projects.

This survey will require about 15 to 20 minutes of your time. Your answers will be anonymous and confidential; hence your name is not required. Your participation is strictly voluntary, therefore, return of a completed survey will indicate your consent to participate.

If you have any queries, kindly contact me on kbbabatunde@uclan.ac.uk and I will be happy to respond. You can also contact my Director of Studies, Dr. Godfaurd John on GAJohn@uclan.ac.uk.

Thank you for your time and consideration.

Sincerely,

Kelechi Babatunde

Section 1: Respondents Information

1. What gender do you identify as?

☐ Male

☐ Female

☐ Prefer not to answer.

2. Which sector of the construction industry have you worked (**ONLY tick one answer**)?

☐ Public sector

☐ Private sector

☐ Both

3. Which of these roles best describe your current position (**ONLY tick one answer**)?

☐ Project/Program Manager

☐ Site manager

☐ Contractor

☐ Consultant

☐ Quantity surveyor

☐ Architect

☐ Other (please specify) …………………………….

4. What is your level of experience in the construction industry?

☐ Less than 2 years

☐ 3 – 5 years

☐ 6 – 10 years

☐ 11 -20 years

☐ 21 years and above

5. What is the size of your current organisation in the construction industry?

☐ 10 employees or less

☐ 11 to 49 employees

☐ 50 to 249 employees

☐ 250 to 999 employees

☐ 1000 and above

Section 2: Construction Projects Performance Issues

6. Recent reports from Construction Excellence (2020) revealed that the performance of UK construction projects is poor. What is your level of agreement to this statement?

☐ Strongly agree
☐ Agree
☐ Disagree
☐ Strongly disagree

7. Below are some of the issues associated with poor performance of UK construction projects. Please select your level of agreement to the issues.

Issues	Strongly Agree	Agree	Disagree	Strongly Disagree
Fragmented nature of construction industry	☐	☐	☐	☐
Ageing demographic profile	☐	☐	☐	☐
Poor technology adoption	☐	☐	☐	☐
Prolonged planning and negotiation period	☐	☐	☐	☐
Hierarchical leadership and management style	☐	☐	☐	☐
Reliance on traditional methodologies and practices	☐	☐	☐	☐
Shortage of skilled labour/workforce	☐	☐	☐	☐
Inability to keep the project team motivated throughout the project	☐	☐	☐	☐
Minimal/slow rate of innovation in the industry	☐	☐	☐	☐
Health and safety issues	☐	☐	☐	☐
Documentation issues such as access difficulties, modification of documents on site, management of revisions, disorganised images, etc.	☐	☐	☐	☐
Unresponsiveness between and among project team	☐	☐	☐	☐
Lack of collaboration among project stakeholders	☐	☐	☐	☐
Changing requirements during construction phase	☐	☐	☐	☐
Dissatisfaction from clients due to contractual and variation claims	☐	☐	☐	☐
Improperly assessed/defined projects needs	☐	☐	☐	☐
Inefficient co-ordinations and supervisions	☐	☐	☐	☐
Inaccurate forecast/budgets due to inadequate feasibility studies	☐	☐	☐	☐
Poor knowledge management	☐	☐	☐	☐
Sustainability concerns and waste management	☐	☐	☐	☐

Section 3: Traditional Project Management Methodology

Traditional project management is an established methodology where projects are run in a sequential cycle. Projects usually follows a fixed sequence of initiation, planning, execution, monitoring, and closure.

8. How often do you use the traditional project management methodology in managing construction projects?

☐ Always

☐ Often

☐ Seldom

☐ Never

9. How would you rate your knowledge on traditional project management method/methodology?

☐ Extensive

☐ Above Average

☐ Average

☐ Below average

10. How important are the following benefits of the traditional methodology in managing construction projects?

Benefits	Very important	Important	Slightly important	Not important
Clearly defined objectives	☐	☐	☐	☐
Clearly defined deliverables	☐	☐	☐	☐
Focussed on quality	☐	☐	☐	☐
Offers good control of the project's processes	☐	☐	☐	☐
Comprehensive documentation	☐	☐	☐	☐
Single point accountability	☐	☐	☐	☐
Provides guidance and helps in understanding uncertainty for new project managers	☐	☐	☐	☐
Clear division of labour due to its work breakdown structure	☐	☐	☐	☐
Standardization and unified language - the customer knows what to expect	☐	☐	☐	☐
Cost effective (where the project outcomes are predicted accurately)	☐	☐	☐	☐
Smooth work-flow due to its sequential nature	☐	☐	☐	☐

Efficiency, especially for projects developed in complex environments	☐	☐	☐	☐

11. In your opinion, which of the following elements of the traditional project management methodology is (are) its major weakness(s)?

Features	**Strongly agree**	**Agree**	**Disagree**	**Strongly disagree**
Rigid/inflexible structure	☐	☐	☐	☐
Linear organisational structural types	☐	☐	☐	☐
Pre-defined user requirements for the entire project	☐	☐	☐	☐
Fixed life cycle/ developmental model	☐	☐	☐	☐
Process centric with strict implementation procedure	☐	☐	☐	☐
Minimal clients' involvement at the later stages of the project	☐	☐	☐	☐
No synthesis between the project phases OR Gateways between project phases are inflexible	☐	☐	☐	☐
One-way flow of communication	☐	☐	☐	☐
High cost of restart	☐	☐	☐	☐
Heavily reliant on predictability	☐	☐	☐	☐
Heavily reliant on task breakdown	☐	☐	☐	☐
Assumption of task or goal certainty				
The methodology is used alike irrespective of projects size and complexity				
Project plans are hardly updated because of the huge time taken to pre-plan the entire project				
Overlapping roles between the controllers and the controlled				

<u>Section 4: Agile Project Management</u>

Due to the limitations associated with the traditional project management methodologies, the agile project management methodology was developed.

Agile methodology is a way of managing projects based on an incremental, iterative approach. It involves constant collaboration with stakeholders and continuous improvement at every stage of the project.

12. Are you aware of the agile project management methodology?

☐ Yes

☐ No (Skip the next question)

13. How would you rate your knowledge on agile project management?

☐ Extensive

☐ Above Average

☐ Average

☐ Below average

14. What comes to your mind when you think of agile project management? Please tick all that applies.

☐ A methodology applicable only to software development projects.

☐ An approach that enables the project team to provide quick responses to customers queries

☐ A method that requires no project managerial role

☐ A methodology that requires no planning and documentation

☐ An approach that delivers results as quickly as possible

☐ A methodology that uses short development cycles to focus on continuous improvement

☐ A highly iterative and incremental approach, where stakeholders and developers work in collaboration to understand the domain, determine requirements, and prioritize functionalities.

15. Would you like to see any of these agile benefits when managing a construction project? Please tick all that applies.

Benefits	**Definitely**	**Probably**	**Probably not**	**Definitely not**
Value-driven development	☐	☐	☐	☐
Collaboration and transparency	☐	☐	☐	☐
Closer engagement with business owners	☐	☐	☐	☐
Adaptive/flexible planning and continuous improvement	☐	☐	☐	☐
Focus on the specific needs of customers	☐	☐	☐	☐
Incremental release approach focuses expectations and reality	☐	☐	☐	☐
Unlimited flexibility (adaptive changes)	☐	☐	☐	☐
Attention to technical excellence	☐	☐	☐	☐
Short iterative releases/shortened feedback loop	☐	☐	☐	☐

Frequent evaluation and resolution of issues	☐	☐	☐	☐
Delivery speed/time to market	☐	☐	☐	☐
Reduced project waste due to less amount of re-work	☐	☐	☐	☐
Reduced cost since the focus is on business value with every activity	☐	☐	☐	☐
Greater team expertise control and enhanced resource effectiveness	☐	☐	☐	☐
Better team ownership and accountability for project outcomes.	☐	☐	☐	☐
Increased productivity due to heightened morale of the team	☐	☐	☐	☐
Improved team engagement and commitment	☐	☐	☐	☐
Enhanced discipline due to self-organisation of the team	☐	☐	☐	☐
Efficient communication between stakeholders	☐	☐	☐	☐
Reduced documentation	☐	☐	☐	☐
Retrospective learning/reflective practices	☐	☐	☐	☐

Section 5: Integration of Traditional and Agile Project Management Methods/Methodologies

Upon implementation in the construction industry, agile project management methodology offers great potentials. However, several barriers could hinder its adoption and implementation.

16. How important are the following factors in the adoption and integration of agile project management methodology in the construction industry?

	Factors	**Extremely important**	**Important**	**Low in importance**	**Not at all important**
Organisational Factors	General organisation resistance to change	☐	☐	☐	☐
	Rigid organisational structure	☐	☐	☐	☐
	Organizational culture at odd with agile values	☐	☐	☐	☐
	Inadequate management support, sponsorship and participation	☐	☐	☐	☐
	Lack of agile logistical arrangements/budget constraints	☐	☐	☐	☐
	Perceived time to transition to agile	☐	☐	☐	☐

Skills and Technical	Lack of skills/experience with agile methods	☐	☐	☐	☐
	Existing technology and tools does not support agile adoption	☐	☐	☐	☐
	Minimal collaboration and poor knowledge sharing practices	☐	☐	☐	☐
	Insufficient training and education	☐	☐	☐	☐
Process-Related	Inconsistent processes and practices across teams	☐	☐	☐	☐
	Lack of collaboration and ineffective feedback systems	☐	☐	☐	☐
	Lack of agile progress tracking mechanism	☐	☐	☐	☐
Human-Related Factors	Team distributed in different locations	☐	☐	☐	☐
	Non-availability of personnel with the right skills	☐	☐	☐	☐
	Prevalence of traditional development methods	☐	☐	☐	☐
	Fear of and resistance to change	☐	☐	☐	☐
	Lack of confidence and ability to scale	☐	☐	☐	☐
	Team members working on multiple projects	☐	☐	☐	☐

17. Can you suggest other ways we can integrate the traditional and agile project management methodologies for managing construction projects?

……………………………………………………………………………………………
…………………

Thank you for your time.

For a summary of the project results, please contact me on
kbbabatunde@uclan.ac.uk

APPENDIX E: VALIDATION QUESTIONS

Structured and Semi-structured Survey to Evaluate, Refine, and Validate the framework that integrates the TRAditional and AGILE project management methodologies for the management of UK construction projects.

Overall aim of the proposed framework

The integration of traditional and agile methodologies aims to enable a gradual introduction of agile benefits to be realised into the UK construction industry whilst retaining the existing benefits of the TPM methodology.

Participants Demographics

1. Background

☐ Industry

☐ Academia

☐ Both

2. Years of experience in industry

Industry……….

Academia………

3. Highest educational qualification……………………………………………

Evaluation Question:

Having studied the proposed framework for the integration of traditional and agile methodologies (attached). Please rate the following questions regarding the framework on scale of 1 to 4. Indicate your response by ticking the appropriate check box provided and comment as appropriate.

Description of scale: 1 = strongly agree. 2 = agree. 3 = disagree. 4 = strongly disagree.

Based on your experience,

4. To what extent do you agree that the components and phases of the framework is logical and relevant to the UK construction industry?

☐ Strongly agree

☐ Agree

☐ Disagree

☐ Strongly disagree

Please insert comments if any: ………………………….

5. To what extent do you agree the components and phases of the framework is logical and relevant to the UK construction industry?

☐ Strongly agree

☐ Agree

☐ Disagree

☐ Strongly disagree

Please insert comments if any: ………………………….

6. To what extent do you agree that collaborative organisational structure is necessary for the implementation of the framework?

☐ Strongly agree

☐ Agree

☐ Disagree

☐ Strongly disagree

Please insert comments if any: ………………………….

7. To what extent do you agree with the usefulness of the developed framework in its main format?

☐ Strongly agree

☐ Agree

☐ Disagree

☐ Strongly disagree

Please insert comments if any: ………………………….

8. To what extent do you agree with the usefulness of the developed framework in its main format?

☐ Strongly agree

☐ Agree

☐ Disagree

☐ Strongly disagree

Please insert comments if any: ………………………….

9. To implement the developed framework, it is essential to evaluate their current practices, identify the gaps, and define how the improved processes will work.

☐ Strongly agree

☐ Agree

☐ Disagree

☐ Strongly disagree

Please insert comments if any: ………………………….

10. To implement the framework, there needs to be an evaluation of the existing customer interaction processes and the implementation of an appropriate process that will enhance the collaboration of customers throughout the project life cycle.

☐ Strongly agree

☐ Agree

☐ Disagree

☐ Strongly disagree

Please insert comments if any: ………………………….

11. Do you think the phases in the developed framework is easy to understand and follow?

Please give reasons for your comment ………………………….

12. Do you think the proposed framework can impact on the performance of construction project delivery?

Please give reasons for your comment………………………….

13. Do you think the proposed framework could be adopted/adapted in your organisation? Please give reasons for your response ………………….

14. Would you recommend the use of this proposed framework?

Please give reasons for your response …………………………….

15. Please suggest further improvements that can be considered in this proposed framework that integrates the strengths of traditional and agile methodologies for the management of UK construction projects.

……………………………………………………………

APPENDIX F: VALIDATION FINDINGS

Table 10-1: Design and ease of understanding

ID	Responses
P1	Yes, I do. Clear and Concise Phases: The framework is well-defined, logically organised, and clearly explained, it will enable the users to grasp the overall structure and purpose of each phase. Consistent Terminology: If the framework maintains consistency in its terminology and concepts across all phases, it reduces confusion and aids in comprehending the flow of the process. Visual Aids and Diagrams: Visual representations like flowcharts, diagrams, or illustrations can make complex concepts more accessible and facilitate a better understanding of the framework. This works well. Modularity and Reusability: If the framework is designed with modularity and reusability in mind, users can focus on specific phases without having to understand the entire process at once. Previous Familiarity: The ease of understanding might also depend on the user's background and prior experience with similar frameworks or methodologies. Users familiar with related concepts may find it easier to grasp the new framework. I feel users will adapt to this well. Applicability to the Task: If the framework addresses the specific needs and challenges of the task at hand, users are more likely to engage with it and find it easier to follow. This process does this. Feedback and Improvements: Regularly collecting feedback from users and incorporating improvements based on their suggestions can enhance the framework's usability over time.
P2	Yes. Clear diagram and text description
P3	As presented and structured I feel that the phases in the developed framework are relatively easy to understand and very easy to follow
P4	I believe that the developed framework is easy to understand and follow
P5	Not as easy as you might think. You need someone with an experience who have the knowledge to understand the different phases in the developed framework
P5	Yes, but examples of differences in implementation would have been good.
P7	The phases of the framework appear to be well thought out and logically structured, in my opinion. The integration of traditional and agile concepts is explained clearly, and the benefits of this integration are outlined at each phase. The framework's goal of improving flexibility, adaptability, collaboration, and client involvement is effectively articulated. However, the target audience's familiarity with both traditional and agile project management methodologies will determine whether the framework is easy to understand and follow. People who are familiar with both approaches may find it easier to understand and apply the framework's concepts to their projects. Individuals who are unfamiliar with these methodologies, on the other hand, may require additional explanations or training to fully understand and implement the framework.

P8	Yes! Obviously, the phases/stages in the developed framework are well understood based on the presentation of a well constructive research framework. In a well-designed research framework for a successful research project, there must be a starting point and an end point, that is a completion stage(like a tunnel). The developed framework presented indicate an "initiation phase" that's the kick start of the framework, which provides the reader with a clear understanding on the client's goal and topmost priorities within the context. At this phase, the key objectives were fully explored for all parties to ensure a proper understanding of the research framework.
P9	They are clear and detailed to understand.
P10	Absolutely
P11	It will be but people will need to have the process and ideas explained, also the risk part of the project management process will have to be properly and robustly managed. This is currently quite reactive and ad hoc in many instances.
P12	yes at times it is easy to follow and understand

Table 10-2: Impact of the framework on performance

ID	Responses
P1	Yes, I Do - easy to understand and follow for all members of the team.
P2	Yes. it would be interesting to see a pilot of the framework
P3	In my opinion the proposed framework can only have a very positive impact on the performance of construction project deliveries and KPI's
P4	Yes, the is always room for improvement. The construction industry wants to improve constantly and project management principles like the agile methods are a bit cumbersome to implement. A hybrid model might work
P5	yes, Labour shortages and variability in prices, Delay in completion of projects, Cost overruns of projects, Construction project risk management, Uncertain/unscheduled activities, Lack of communication, Planning
P5	Yes, but it needs to be tried. Currently it seems theoretical.
P7	The proposed TRAGILE framework has the potential to significantly improve construction project delivery performance as it aims to balance structure and flexibility by combining the strengths of traditional and agile methodologies. This integration will improve adaptability, client participation, and iterative feedback loops. This should encourage effective execution, risk management, and a culture of continuous improvement while addressing challenges and fostering successful outcomes in construction projects.
P8	off course, it's very obvious that the implementation of the developed framework by any business organisation will utilises all the five stages outlined in the framework.
P9	I would say 50/50 only because there is NEC which bridges those gaps within the industry.
P10	Yes, enabling projects to be delivered within their fundamental scope enhances the project's better results, reaches the goals faster, or reduces expenses.
P11	Yes, if managed and implemented correctly
P12	Yes, it can if it is not collaborated properly

Table 10-3: Do you think the framework can be adopted in your organisation?

ID	Responses
P1	Yes, I do - easy to follow and adaptable to all construction projects.
P2	No. My organisation is not directly involved in construction
P3	I see no reason why the proposed framework could not readily be adopted into our business
P4	No, we are rigid to change
P5	Yes, organization that chooses a framework and immediately begins making adaptations to fit its existing business risks losing the value inherent in the framework: the incredible organizational insight or extensive experience brought by the framework's authors. Also, some adaptations can severely limit the adapting organization's ability to use benchmarking to compare performance in an objective manner.
P6	Yes

P7	Most likely. Since it would offer the organization a compelling strategic advantage.
P8	Yes, the proposed framework may be adopted by business organisation based on the organisation objectives to fit the needs of the organisation objectives.
P9	It is difficult to say as my organisation currently adopt more of a traditional approach with NEC due to the types of contracts awarded.
P10	yes, by cutting short all the time wasted in bureaucratic planning stage
P11	training of personnel is key, time to consider process and risk management fully, rather than last minute
P12	Yes, it can because it has a number of benefits that can help an organisation

Table 10-4: Would you recommend the proposed framework?

ID	Responses
P1	Yes, I would - ease of use is ideal for the team
P2	I would recommend that it be piloted to establish the benefits before being able to recommend it fully.
P3	I would highly recommend the use of this proposed framework for any mid-sized to large scale enterprise
P4	Yes, I would recommend the proposed framework. Work methods that have worked in other industries are introduced into the construction industry often, but they mostly don't work optimally as in other sectors. I believe it is about time we create what works for the industry with its peculiar characteristics and this is a good place to start.
P5	Yes, the purpose of a framework is to assist in the development, providing standard, low-level functionality so that developers can focus efforts on the elements that make the project unique. High-quality, pre-vetted functionality increases software reliability, speeds up programming time, and simplifies testing
P6	Yes
P7	That depends on the project variables. I would recommend this framework because of its integration of the benefits of the traditional and agile approaches allowing for a balanced approach, flexibility, and client satisfaction focus. However, before applying the framework, its suitability must be evaluated based on project complexity, organisational readiness, knowledge, and potential opposition to change.
P8	Yes, this proposed framework will be recommended to any business organisation that wants to enhance its performance.
P9	It would be a good approach to adopt especially on larger schemes.
P10	yes, it would aid proper planning by saving time and cost and making us get it right at first attempt
P11	see comments above, without training it will be impossible
P12	Yes, I would recommend it

Table 10-5: Further suggestions for improvement

ID	Responses
P1	Include an "lessons learnt" element to the process
P2	A feedback loop following closure phase. This is shown on the flow diagram but not in the text description and it may be worth describing how knowledge is preserved and reused for future projects
P3	Further improvements to the proposed framework could be made by seeking feedback from UK construction industry leaders on how best to integrate the strengths of traditional and agile methodologies
P4	I really don't see an improvement, but I would like to state that the lines that separate the design and execution stages are pretty blurry in the industry even with the use of technologies like BIM that are meant to make things easy. How you tailor this hybrid framework to this would be interesting. So think about this.
P5	Collaborate with the customer. Work together daily. Build projects around motivated individuals. Convey information face-to-face Form self-organizing teams. Reflect on how teams can become more effective.
P6	None
P7	Develop a comprehensive change management strategy to address resistance to new methodologies, ensuring smooth adoption and alignment with the organization's culture.
P8	The proposed framework is very okay and a schematic structure of the framework has been provided making it more dynamic within the context of this research.
P9	Bridging the gap between both methodologies will enhance the way projects are delivered, perhaps integrating the NEC contracts requirements will simplify procedures.
P10	since the traditional method works well with a larger team, an approach to properly integrate the hybrid without massive effects of cutting down on human resources or causing redundancy in the organization would be appropriate
P11	none
P12	unfortunately, at this time I have no suggestions