Social Synthesis: A psycho-social perspective of the construction project team

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Abstract

This paper presents a framework resulting from systematic investigation within the field of social psychology, from which to derive new narratives, concepts, and relationships for collaborative design in architecture, engineering, and construction (AEC). A systematic literature review generated a series of themes that had potential for relevance to interdisciplinary built environment project teams. These were then explored, drawing on qualitative research conducted using focus groups drawn from three AEC organisations and observation of a live case-study industry project. The social psychology anchor themes of (1) motivation and reward; (2) risk attitudes; and (3) social climate were then recontextualised using the qualitative data, to derive construction-specific social and psychological factors that influence the collaborative design process.

The resultant psycho-social framework applies psychology theory to describe a multiplicity in the role agency of project team members, as actors in industry, discipline, company, and individual contexts. Role agency and domain-specific themes are combined within the collective to influence normative and adaptive responses within the team interaction space, where collective systems of meaning are synthesised and design outcomes produced.

Design and decision making in the architecture, engineering and construction (AEC) industry sector, has largely been reported as a multidisciplinary, multi-faceted process, where interdisciplinary, inter-organisational, and interpersonal links are challenged by knowledge gaps, increasing project complexities, and dysfunctional relationships (Murray & Langford, 2003; Elmualim & Gilder, 2014; Farmer, 2016). Project team environments can be turbulent and uncertain (Groak, 1992; den Otter & Prins, 2002), with collaborative tasks taking place within temporary, culturally heterogeneous teams in distributed locations (Gann & Salter, 2000; Loosemore & Chin, 2000; Reichstein et al., 2005; Barrett & Sexton, 2006; Austin et al., 2007; Morrell, 2015).

The techno-operational lens of the construction industry

The AEC sector has responded to these inherent challenges with characteristic techno-operational response, with scant attention paid to behavioural approaches (Koskela et al., 2002; Baiden et al., 2003; Barrett & Sexton, 2006; Emmitt & Gorse, 2007; Shelbourn et al., 2007; Forgues & Koskela, 2009; Kululanga, 2009; Sunding & Ekholm, 2015). Whilst social relationships are frequently discussed and accepted as pertinent to building design team performance, literature has tended to overlook the qualitative aspects and effects of social behaviour which influence and direct the performance of collaborative teams (Salter & Torbett, 2003).

Technological advance and tools of design democratisation, such as BIM, are perceived as enablers of design collaboration (Abrishami et al., 2014; Garber, 2014; Adamu et al., 2015). Yet synchronous social exchange remains a critical aspect of design problem solving, knowledge sharing, value transfer and collective creativity (Salter & Gann, 2003; Sebastian, 2004; Emmitt & Gorse, 2007; den Otter & Emmitt, 2007; den Otter & Emmitt, 2008; Goldschmidt & Eshel, 2009; Glock, 2009; Lloyd, 2009; Luck, 2009; Kocaturk, 2013).

Purpose of the study

Whilst there exists a legacy of work that examines psycho-social elements of the architectural design process (Medway & Clark, 2003; Luck & McDonnell, 2006; Pryke 2012; McDonnell & Lloyd, 2014; D'Souza and Dastmalchi, 2016; Paletz et al., 2017) its in-project, pan-construction application is limited. The direct aim of this study was, therefore, to expand and deepen understanding of the psycho-social dynamics of the collaborative team in the AEC sector. This exploratory study sought to identify key concepts already present in the discipline of social psychology, and supplant and recontextualise these within construction.

To this end, a qualitative study was conducted. Findings are summarised and presented as a diagrammatic and descriptive framework. The framework introduces and re-understands relevant social psychology concepts and narratives within the specific and unique culture of the construction industry. As a first pass at understanding the social psychology of the AEC project team, the framework may now be used:

a. By researchers, as a signpost to future domain-specific research agenda in relation to collaborative design;

b. By practitioners, to indicate industry-specific concerns for AEC project delivery;

c. By educators and training providers, to inform more subject-specific curriculum areas which may be used to inform AEC professional education.

Research design

First, a systematic, exploratory study of constructs within the social psychology domain was conducted, peer-reviewed, and published in a

previous paper (Barrett et al. 2013). The study included only literature that was listed by Scopus as being within the social psychology domain. This allowed the study to focus upon psycho-social narratives from their 'pure' source, thus remaining uncomplicated by parallel domain literature, such as project management, which may conflate psycho-social narratives with associated findings from other disciplines.

This review identified a series of constructs, which had the potential to be relevant to the 'social order' (Matthews, 2009) of built environment teams, particularly in relation to collective creative thinking and collaboratively produced innovation. These constructs were ordered thematically. From this thematic ordering, three overarching themes could be discerned. These overarching themes were (1) Motivation & reward; (2) Risk attitudes; and (3) Social climate.

These three emerging themes informed a second stage of research. This second stage sought to verify the themes' relevance to AEC, and to re-contextualise them within the AEC domain. This verification and re-contextualisation process was carried out via qualitative scrutiny, using a thematic analysis methodology. Data was collected via subjective, self-report in a series of multidisciplinary focus groups and by direct, semi-participatory observation in the naturalistic setting of a case-study project team environment.

Sampling strategy

Focus group participants all worked for three companies, whose senior level contacts had responded to an earlier survey of design team experiences. Whilst company names are omitted from this paper to protect commercial privacy in accordance with approved ethical procedures, the offices visited included a large multidisciplinary company in the south west of England, and two medium sized, also multidisciplinary practices in the north west of England. Each organisation was involved in projects of all scales across their

regions and nationally. In each case, focus group sessions were attended by participants across all levels of the company hierarchy, and were in a variety of project roles.

The case-study project was selected in a similar way. Case-study team members came from a variety of AEC disciplines, confirmed by an initial questionnaire that canvassed disciplinary affiliation.

The construction industry is vast. Its boundaries are indistinct. AEC design team practitioners represent a mere proportion of its workforce. That said, 40,000 members belong to the Royal Institution of British Architects alone (RIBA 2016). Hence, the researchers were acutely aware that the samples could never be described as representative. However, their perceived typicality of AEC practitioners qualified them for inclusion.

The participants were also, to a degree, self-selecting, evidenced by their involvement in the earlier study of design team behaviour. However, the current study is exploratory in nature and intention. Its purpose was not to generate findings that could be generalised across the industry, but to determine concepts and narratives that the research community could investigate further. Furthermore, it was difficult to secure practitioner involvement for commercial reasons, or due to sensitivities in discussing issues which may be perceived as flaws in their practice. Hence, given the study's exploratory nature and the highlighted domain need for that exploration, the samples used were considered appropriate for this study.

Data collection via self-report: Focus groups

The focus groups involved a total of 74 participants across three AEC companies, each specialising in the design of buildings from either an engineering, architectural, or project management/financial perspective.

Data collection via observation: Case-study

The case-study involved a distributed, multidisciplinary, multi-organisational, temporary team, whose brief was to design a mixed use masterplan according to BIM Level 2 project procedure and guidelines. The project was executed according to RIBA Plan of Work stages 0-4. A total of 19 design team members were recorded during observations, but not all of these members interacted regularly or frequently. Team interaction was observed via three media channels, comprising traditional face to face meetings; telephone conference call; and a member-only online discussion website (Slack).

Thematic analysis method

The observation and focus group transcripts provided datasets that were analysed using thematic analysis. This method was selected for its prevalence in the field of social psychology and its capacity to support discovery, analysis, and reporting of repeated patterns of meaning with the dataset (Braun & Clarke, 2006). The method was also used for its appropriateness for searching out broad themes, rather than focusing on fine detail as for similar methods such as Conversation Analysis (Howitt, 2010).

The following steps were followed in performing the thematic analysis:

1. Transcription and immersion
   Active re-reading of transcripts and re-listening to audio video files, noting repeated patterns or ideas within the research frame.

2. Initial theme-driven coding
   Deductive testing of pre-existing social psychology theory, analysing data within the three themes of motivation and reward, risk attitudes, and social climate, as parent units of analysis and confirmation as anchor themes.

3. Data assignment
   Semantic and interpretative assignment of data to anchor themes.

4. AEC-specific data-driven coding
   Data abstraction and heuristic analysis within the anchor themes, exploring emerging patterns of AEC-specific meaning-in-action (Silverman, 2011), *which had significance for the research question.*

5. Review and definition of domain-specific themes
   Scrutiny and reflexive refinement for internal homogeneity and external heterogeneity.

Findings of the thematic analysis

A synopsis of the AEC domain specific findings of the thematic analysis is presented below, within the overarching psycho-social anchor themes of (1) Motivation and reward; (2) Risk attitudes; and (3) Social climate. A full list of domain specific themes and subthemes are presented in Table 1.

(1) Motivation and reward

High levels of intrinsic motivation were expressed by participants. However, whilst intrinsic motivation was widely expressed in relation to design tasks, it was also acknowledged that motivation was influenced by social relationships, which combine both social and task-based factors. Peer recognition and peer learning were noted to be significant dual-focus factors that enhanced intrinsic towards contribution to collaborative tasks, beyond minimum requirements.

However, intrinsic motivators could conflict. A tensional relationship existed between practitioners' abilities to contribute to delivery of collective output, and the need to individually generate profit for their company.

It was noted that a lack of time combined with workload pressures could inhibit individuals' abilities to think creatively and contribute effectively to collective design tasks, constituting a frequent extrinsic barrier to collaborative

design work. However, an additional extrinsic barrier appeared to be atypical and unique to this interprofessional context. This related to the demoralising capacity of implied hierarchies in the project team, with some members relegated to subservient roles. This was particularly found in relation to engineers working subserviently to architect clients, or for specialist roles who were considered peripheral to the core team. Where more equitable interdisciplinary roles were embraced, this was reported and observed as a significant motivational factor for collaborative learning and consequent collective, creative action.

Extrinsic barriers within the case study design team were also experienced in relation to the complexity and interpretative variability of project-relevant industry standards, protocols, and guidance. This was a factor which was outside their control, but prompted conflict and demotivation apropos their collective expectations for design outcomes.

Participants widely expressed that their motivation for high levels of engagement in group tasks was frequently derived from non-financial sources. Non-financial sources were observed to include positive feedback and recognition that they might receive for innovative work. In fact, when financial gains were sought, this created a source of conflict between those who were driven by pro-self (profit-led/career enhancing) rewards and those who maintained a pro-team or pro-industry (better product/new knowledge) motivation. However, where pro-industry innovation was conceived, this was sometimes in the interests of pro-self, financial gain. This hints at a social dynamic in design teams, which is fuelled by 'competitive altruism' where individuals operate with apparent pro-social motivation, but covertly gain individual benefits as the 'greater good' may pay dividends indirectly back to its instigator (Hardy & Van Vugt 2006; Roberts 1998). These findings have clear implications for project team procurement strategies.

Discussions regarding collective purpose, motivation, and potential reward tended to occur more during face to face meetings, where dominant members would debate and reinforce project objectives to the wider team. This

importance of face to face interaction for collective motivation is consistent with the findings of Amabile et al. (1996) and Nijstad et al. (2010). It also highlights the role of both member dominance and interaction media format for determining and reinforcing collective motivation.

Focus group participants identified that cultures and expectations within the respective companies of team members were additional drivers of effective collaboration. Where incidences of excellence were achieved by the project team, then positive feedback and recognition for this work became a critical success factor in sustaining motivation throughout the project life cycle, as well as into future projects. As a result, it may be posited that if excellence and innovation are real aspirations, then it is imperative that continuous loops of feedback and reward be established between team members and their peers, employers, stakeholders, disciplinary institutions and industry funding organisations.

In addition to organisational, disciplinary and industry motivational factors, the propensity for engagement in collaborative tasks is additionally influenced by individual preferences, which participants suggested may be, in some part, generational, as collaboration is a more recent aspect of professional education and culture. Whilst newer generations of professionals suggested that they felt more comfortable in collaborative relationships, so they also felt more comfortable with the technological solutions intended to facilitate them. It was generally felt by participants that this was a paradoxical scenario, where newer generations of professionals default to using these technologies e.g. email, online forums, and BIM, at the expense of more traditional and creatively productive face to face interaction and analogue drawing. Participants of all generations were in unanimous agreement that face to face interaction was the most effective medium of communication, when collaborative creativity is the intention.

(2) Risk attitudes

Participants expressed that, to facilitate better creativity in collaborative design, a level-setting of collective propensity for risk taking should be

established during the early vision-setting of the project, though this rarely occurs. Neither was a conversation of this nature recorded during the case-study observation. However, it was observed that, where collective risk tolerance was discussed, this was more likely to be communicated during face to face interaction, where social cues were more available (Friedman & Förster, 2001; Madjar et al., 2011). Consistent with the discussion in relation to the motivation and reward anchor theme, this suggests that media format is a significant factor, when teams seek to distribute a collective perception of risk norms.

The case-study team conceived project risk in the traditional project terms of cost, time, and quality, but also identified the loss of intellectual ownership of innovative outcomes and negative industry feedback as an additional and significant risk. As mitigation of this latter risk type, this design team removed content from the developing design and withheld information from their client, despite implicit potential improvements to the built outcome.

This behaviour of the case-study team aligned with perceptions of the focus group participants. They painted a picture of a risk averse industry, where creativity and innovation can be stifled due to a hesitation to own and disseminate a 'risky' or novel idea. Focus group participants tended to feel that higher risk-takers were not usual in design teams and this was also found in the case-study project team. This culture of risk aversion was found to influence project teams to eliminate potentially innovative alternatives, and, instead, to repeat tried and tested solutions, consistent with the findings of Friedman and Förster (2001). Participants noted that if potentially innovative solutions were found, the industry's risk averse culture limited the team's propensity for sharing them, thus provoking a disjunctive relationship between a team's potential for high risk strategies and their professional ethos of practice toward industry improvement.

(3) Social climate

Analysis found that practitioners tended to feel that they belonged to cohesive design teams, and that this was conducive to collective creative thinking in the

design process, and resultant innovative outcomes. However, whilst participants experienced cohesiveness in relation to their task, this experience was considered to be much less prevalent in relation to project team social relationships. Whilst the study examines a professional, rather than a personal, group environment, this finding remains of particular concern as it is the socially driven interaction that strengthens group ties, which are linked to improved innovative performance (Hülsheger et al., 2009; Miron et al., 2004; Zhou et al., 2009). Additionally, participants reported that where they were members of a team with a high degree of social cohesiveness, their own intrinsic motivation to engage in collaborative creative tasks was also higher. The study also found that interdisciplinary learning (insights and knowledge gained from interaction with other disciplines) could act as social stimulation towards social cohesiveness, having a positive effect, not only on team motivation to collaborate well, but also on group cohesiveness overall. This is consistent with findings relating to a number of studies of creativity and innovation in multidisciplinary teams (Luck, 2013; Christensen and Ball, 2016; Stompff et al., 2016).

The complexity of a building project requires a multiplicity of core and specialist roles. Where projects required large numbers of team members, it was found that fragmentation became an inevitable solution to the management of the large number of interactions required. This approach supported the internal cohesiveness of the resultant subgroups, but this fragmentation was also found to instigate rivalries and goal dissonance across the project. This dissonance commonly fostered definition of ingroups and outgroups, which, in the case-study, relegated the 'design team' as a separate entity to the main 'project team.' This separated designers from the overall project context, activities, and dominant project vision.

The case-study circumstance of the separated design team may support a hypothesis that a 'creative outgroup' can occur in some design teams, responding to the human instinct to define ingroups and outgroups (Tajfel, 1978; Tajfel & Turner, 1979; Tajfel, 1981). The concept of the existence of a creative outgroup within project teams was affirmed by architectural focus

group participants. However, other disciplines also perceived that they were also relegated to an outgroup due to their traditional subservience to the architectural discipline. Hence, whilst the presence of ingroups and outgroups in the project team were broadly confirmed, their definition, at this stage, may be determined by a variety of possible factors, such as disciplinary, commercial, and demographic characteristics.

Despite this, a positive finding of the study was that, in contrast to received wisdom across the construction sector, conflict tended *not* to be a key feature of design team interaction. In fact, participants were more likely to experience a positive team climate. In the case-study team, where conflict was observed, this was, in the main, generated by factors external to the design team, such as the complexity of the project-related guidance and compliance requirements, and external challenge to a team's brief or identity.

Findings also confirmed predictions from the social psychology literature relating to psychological safety (West, 1990). Participants recognised its importance for maximising contribution of new ideas (Edmondson & Mogelof, 2006; Gibson & Gibbs, 2006; Baruah & Paulus, 2011). However, these participants also reported experiences which suggested that participative safety was not always implemented in practice, and this was confirmed in the case-study observations. Following deeper analysis of this contradiction, it was found that whilst project teams tended to collectively value creativity and innovation, their leaders require further support in providing conducive environments to their attainment. Interactions with clients, project leaders, and the longevity of team relationships were reported to be significant in this regard, as these were frequently reported to induce social anxieties, which inhibited idea contribution, reflecting the findings of Camacho and Paulus (1995). Although face to face interaction was perceived to foster group cohesiveness, the studies found that psychological safety could be hindered by the traditional cultural norms of meeting protocols, which exerted a hierarchical dominance amongst the project team. Where such hierarchical dominance occurs, it may then create a team environment that is not experienced as a safe place for risk-taking (Amabile, 1988; Burnside, 1990;

Nystrom, 1990; Edmondson, 1999; Chatman & Flynn, 2001). Thus, an environment may be created, which is not supportive of equitable creative contribution.

Participants frequently encountered difficult or obstructive personalities. However, they did not consider that this was the prime driver of a negative team climate. Instead, a dissonance in team goals and values was reported and observed to be more likely to undermine a supportive climate. Where team members were not harmonious in their expectations for the design process or its outcome, then conflict was more likely to occur. Commonality in project expectations was identified as critical to success, particularly where team members differed in their ambitions for profit-led or product-led goals.

Consistent with discussions of 'groupthink' (Baruah & Paulus, 2011; Janis, 1982; Postmes et al., 2001), participants also expressed that cohesiveness can sometimes direct teams to a consensus that may not be entirely satisfactory, and can be detrimental to project outcomes. This is particularly noted where more dominant group members seek to establish apparent consensus based on group acquiescence. Such acquiescence appears to be entrenched in project team culture, appearing to be fuelled by a strong hierarchical nature amongst disciplines and professional levels, as well as a general reluctance to constructively challenge project leaders, clients and accepted wisdom. This results in dominant members advocating psychological safety for creativity and collaboration, but implementation of this environment of safety becomes frustrated by the industry cultural norm.

The psycho-social framework: Descriptive themes

The qualitative analysis revealed that AEC practitioners experienced a variety of psycho-social factors which influence their collaborative practice and the perceived success of its outcomes. These can be categorised within the social psychology anchor themes of motivation and reward, risk attitudes, and social climate. Within these anchor themes, themes specific to the AEC domain

include: *clients, procurement, practice guidance, professionalism vs. profit, time and workload, innovation drivers, feedback and recognition, professional identity, interdisciplinary knowledge, intra-team behaviour, the social team, the creative outgroup, innovation dissemination, and innovation adoption.*

Further detail is included within the sub-thematic content (Table 1), providing additional AEC-specificity to emerging narratives. This sub-thematic content offers a series of sufficiently fine grained topics, which warrant substantive investigation in future research studies.

MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
AEC THEME: *Client*		
Clarity of client vision; client capabilities as influence on scope for innovation.	Client risk propensity	Ability for companies to develop brief; correlation of member dominance with client proximity; barrier to collaboration – lack of client proximity; clarity of client-team communication of vision; conflict caused by client distance from non-dominant team roles; reticence to challenge client and brief; client distance as barrier to collaboration.
AEC THEME: *Procurement*		
Low fee/budget limits innovation potential; specialists procured through core disciplines, not collaboratively; innovation goals obfuscated by procurement complexity; procurement processes inhibit scope for innovation.		Alliances formed based on experience; dominant members as filter to team membership; longevity of relationships; team design response to project scale and complexity; value of diversity within procured teams; conflict caused by process constraints on appointment.
AEC THEME: *Practice Guidance*		
Process complexity inhibits task definition; lack of prioritisation of compliance to standards; barrier to motivation via over complex an variable standards and protocols; compliance-reality dissonance.		Role clarity determined by clarity of guidance; confusion caused by process complexity; decision validity compromised by lack of clarity in guidance; conflict caused by conflicting guidance; conflicting guidance results in unclear output; market deference as response to variable disciplinary interpretation; dissatisfaction with decisions taken in response to conflicting guidance; conflict caused by dissonance between compliance and reality.
AEC THEME: *Professionalism vs. profit*		
Company profit goal conflicts with innovative performance; company rewards polarised to team rewards.		Corporate profit goal and process innovation goal conflict.

Table 1: AEC-specific themes and sub-thematic content, within the social psychology anchor themes (continued overleaf).

MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
AEC THEME: *Time + Workload*		
Documented progress motivates; lack of time as barrier to motivation; non-contribution by team members as barrier to motivation.		Influence of time and workload on possibilities for face-to-face meeting; conflict under pressure relating to theory vs. delivery; project deadlines induce individual pressure; time pressures inhibit collective information sharing; intra-team co-operation of workload management leads to positive climate; consensus damaging when under pressure; conflict caused by request for changes that will cause delay.
AEC THEME: *Innovation drivers*		
Company culture as project innovation driver; industry innovation driven by critical mass of individuals.	Group risk propensity established to determine vision; risk aversion prompts removal of innovation potential rather than problem solving.	Ability to accommodate change; the importance of constructive challenge; quantitative measures of innovation, not just aesthetic recognition.
AEC THEME: *Innovation dissemination*		
Innovation dissemination determined by time available; contribution to industry improvement as motivating factor; impact of branding to establish intellectual ownership; barrier to motivation when 'word' is not being spread.	Risk of potential profit loss by expansion of stakeholder engagement; risk of conflict with industry agencies; conflict between corporate risk management and innovation dissemination; risks relating to compromised intellectual ownership; commercial privacy conflicts with innovation dissemination.	Industry dissemination as shared team goal; conflict caused by differing commercial/dissemination goals dominant members act as filters to external engagement.
AEC THEME: *Innovation adoption*		
		Lack of knowledge overlap between technical providers and construction disciplines; dominance of individual rather than disciplinary preference in innovation adoption.
AEC THEME: *Feedback + recognition*		
Motivation derived by gaining credit for work done; motivation derived from peer feedback; impact of positive recognition from external funders on team motivation; promotion of stakeholder engagement to enhance external recognition; recognition of industry contribution as extrinsic reward; pro-team promotion vs self-promotion; industry feedback as mechanism to foster team learning.	Consensus used to manage risk of effect of output; negative industry response as influence on decisions; negative industry response as influence on innovation sharing; project output influenced by expected industry response; risk ownership shared to mitigate effects of negative feedback; risk of negative feedback externally to team; reticence to share information outside the team in case of negative feedback; risk of being perceived as non-productive.	Importance of recognition for innovation via publicity; stakeholder engagement as mechanism for minimising industry conflict; positive climate generated by positive external recognition; external individuals keen to be part of the group.
AEC THEME: *Professional identity*		
		Individual preferences towards introversion-extraversion.

Table 1 continued: AEC-specific themes and sub-thematic content, within the social psychology anchor themes (continued overleaf).

MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
AEC THEME: *Interdisciplinary knowledge*		
Clarity of role understanding; engineering subservience to architect; specialist disciplines peripheral to process; timing of appointment as factor in ability to collaborate; willingness to share information promotes learning; priority of project delivery in relation to collective learning and success.	Role specialism as factor in ownership of specialist risk; corporate information protection inhibits information sharing.	Criticism of engineering engagement in team; engineering subservience to architect; interdisciplinary common language aids collaboration; timing of appointment as factor in ability to collaborate; abilities and expectations engendered in education; benefits of direct interaction; team success derived from shared learning experience; disciplinary partitioning across industry; availability of non-construction expertise for construction innovation; reappraisal of team roles as key activity; interdisciplinary sharing towards innovation; disciplinary sector knowledge equates to member specialism; innovation from extra-discipline knowledge; disciplinary skills required for specific problem solving; innovation derived from interdisciplinary processes; positive climate generated by group supported learning.

Table 1 continued: AEC-specific themes and sub-thematic content, within the social psychology anchor themes (continued overleaf).

MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
AEC THEME: *Intra-team behaviour*		
Generational propensity for collaboration; individual comfort in technological solutions for collaboration; individual dedication to collaborative innovation; motivation derived from collective success; member non-contribution as motivation limiting factor; team identity created as brand within industry; team core value to improve industry.	Sharing of risk of failure performed via group narrative; establishing risk norms for risk sharing; influence of corporate information protection on openness and information sharing; risk adoption according to leader confidence; consensus as risk mitigation strategy; corporate information protection limits role clarity.	Ability to contribute ideas limited by company hierarchies; team collaboration norms dependent on company norms; fragmentation to preserve cohesiveness; appropriate selection of communication media; collaboration fostered by co-location of individuals; competence outweighs behaviour; differencing individual goals causes conflict; dominant members establish psychological safety; effort of face to face interaction reaps rewards; false consensus created via dominance member; impact of the 'negative' member; importance of climate of trust; motivation from pro-collaboration team dynamic; mutual support for innovative performance; need for pro-active response to social dynamics; need for respect; norms of meeting organisation and agenda setting; personal characteristics for innovation collaboration; role of 'banter' as social lubricant; role of 'banter' to determine individual identity; shared mental model of the successful outcome; subscribing to cohesiveness gives reward in focus and progress; need for design process facilitator; explicit 'no wrong answer' culture; team identity forged within industry; team core value to improve industry; team pride in innovation venture; communication tech adoption as collaboration facilitator; fragmentation to preserve cohesiveness; reinforcement of team task-focussed behaviour; limited face-to-face meeting to reduce cost to company; subscribing to cohesiveness reaps rewards in focus and progress; reticence to discuss personal life; sharing personal politics establishes norms and cohesion; interpersonal tensions evident via concealed disparagement; collective identity strengthened by shared adversity; clarity of communication aids collaboration; change to team identity disturbs and distracts; call to focus on task rather than individual contribution.
AEC THEME: *The social team*		
Motivation to collaborate – association with inspiring people.		Social interaction outside design team meetings.

Table 1 continued: AEC-specific themes and sub-thematic content, within the social psychology anchor themes.

The psycho-social framework: Diagram of collaboration

The dynamic process of building design synthesis has been summarised and visualised in the framework diagram (Figure 1).

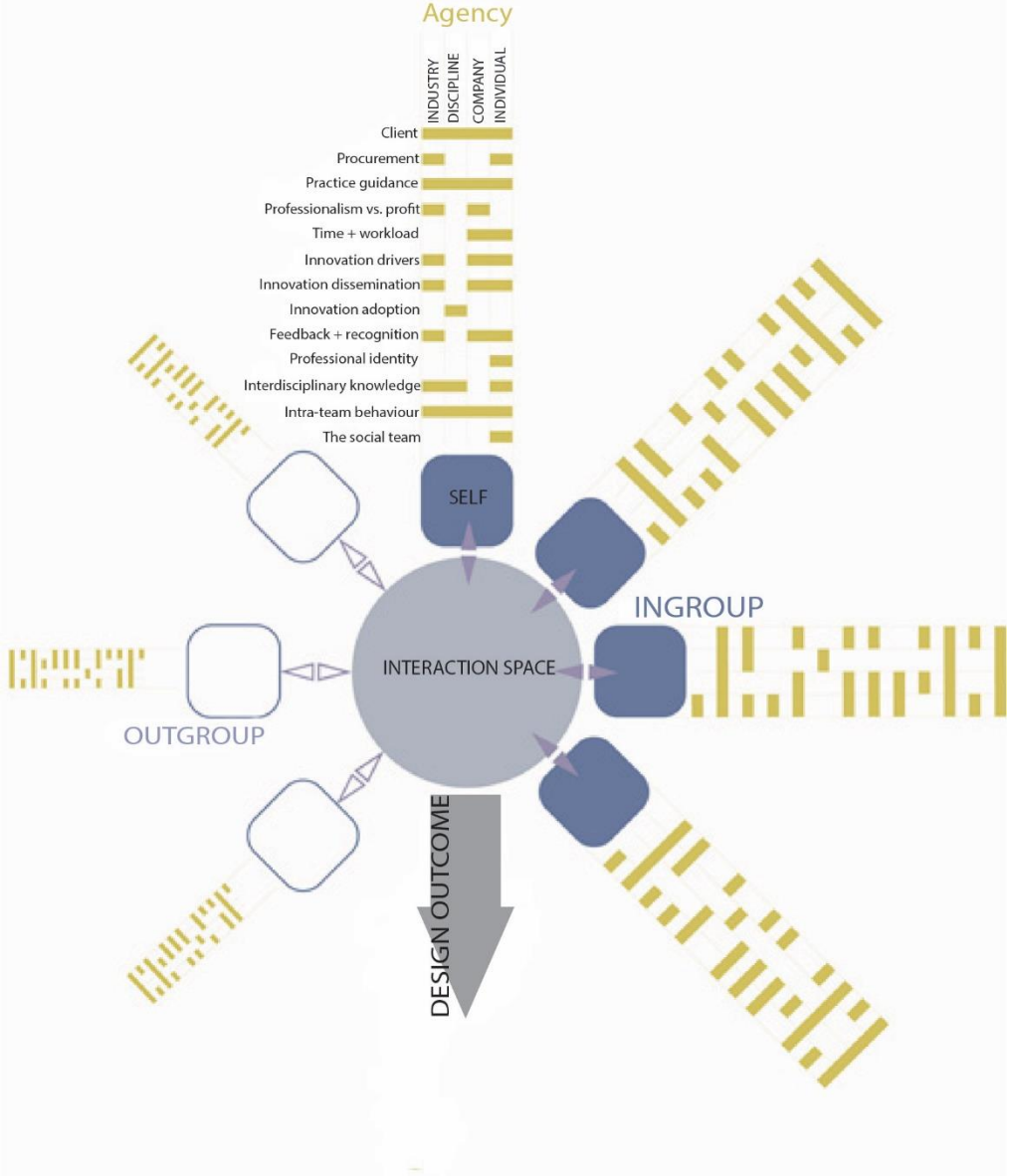

Figure 1: A psycho-social diagram of AEC collaboration.

The components of the framework diagram include:

1. *Interaction space*

   The interaction space amalgamates psychological notions of life space (Lewin, 1935; Lewin 1954) with Gero's design space (Gero & Maher, 1993; Gero et al., 1994; Gero, 1996; Gero, 2007; van Amstel et al., 2016), defining a hypothetical space where normative and adaptive thinking occurs. The interaction space can, thus, be defined as the design environment, which is defined by the project team and is the locus of creative performance, meaning transfer, and co-evolution of the shared mental model of the imagined building (Goldschmidt & Eshel, 2009; Lloyd, 2009; Luck, 2009; McDonnell & Lloyd, 2014).

2. *Self*

   The self is the entity which, in the context of this research, is defined as the individually held self-concept, self-cognition, and schemata, which normatively responds and acts in the interaction space (Deutsch & Gerard, 1955; Markus, 1977; Adarves-Yorno et al., 2007).

3. *Ingroups and outgroups*

   The study found that a description of the project team as a multilateral collective of 'selves,' equivalent in their ability to inform and perform in the interaction space, was insufficient. Individual prominence, dominance, and cohesiveness varied across social interactions in AEC teams. Team heterogeneity had observable impacts on collaborative thinking, determined by characteristics such as hierarchical and disciplinary difference, causing subgroups within the team to emerge. These subgroups are then subject to differential capacities to contribute within the interaction space. The study found that disciplinary stereotyping and prejudicial behaviour appeared to be a particular issue for the AEC sector in relation to differential self-categorisation and affiliation, with indications that creative disciplines may frequently form an outgroup, dissociating norms of creativity from the interaction space.

4. *Agency*

   Findings suggested that the individual AEC design team member operates as an agent of a series of multi-level drivers, which direct their creative contribution in the interaction space of a design project. Four levels of agency were observed to be at work: (1) industry, (2) discipline, (3) company, and (4) individual. As the influence, priorities, and scope of these levels of agency vary between design team members, so do the group dynamics that emerge, in turn influencing the process and direction of design.

5. *AEC Themes*

   Within the four levels of agency, a series of themes emerged as being significant and influential in the collaborative design process. These were: (1) the client; (2) procurement; (3) practice guidance; (4) professionalism versus profit; (5) time and workload; (6) innovation drivers; (7) innovation dissemination; (8) innovation adoption; (9) feedback and recognition; (10) professional identity; (11) interdisciplinary knowledge; (12) intra-team behaviour; (13) the social team, and (14) the creative outgroup. These factors provide headings and directions for project management; industry guidance; curriculum content, and new research foci.

6. *Dynamic exchange of normative response and action*

   This describes the process by which individual preferences, propensities, attitudes, and actions influence, and are influenced, by the normative values of the group, established within the interaction space toward responsive and task-adaptive action.

7. *Design outcome*

   The final component of the framework is described as the innovation outcome. This is the collective output of the team, and is dependent upon the dynamics of the interaction space, which are determined by the normative and task-adaptive responses of its members.

Limitations and future research

As an exploratory study, new topics, narratives, and relationships have been identified, in relation to the social dynamics that influence collaborative thinking in the AEC multidisciplinary team. However, the findings presented here may only be taken as tentative. Construction and psychology researchers are emphatically encouraged to investigate these topics, narratives, and relationships in detail and across contexts, so that generalisable findings can contribute domain specific knowledge of psycho-social factors that are antecedents of innovation, excellence, and success in collaborative process and performance.

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