Evolving The Idea:
Designing teams for detailed design

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Abstract

The detailed design phase is critical in maintaining the design concept whilst considering aesthetic ventures in light of time, cost, and buildability prior to implementation. During this phase, design components are connected, solutions are tested and methods of implementation finalised. Design becomes a truly interdisciplinary activity.

In addition, the challenge of sustainability requires built environment professionals to transcend traditional disciplinary boundaries if effective solutions are to be realised. However, there is currently limited research on how the behaviour of teams affects subsequent products and outcomes. This paper aims to contribute to a better understanding of this link.

An experiment was carried out using single discipline and multi-disciplinary teams with differing collective personality characteristics to test whether it is essential to have the right personalities in the design team as well as the correct disciplines. Observation of design workshops provided the necessary data for analysis of how these environments influenced design outcomes. An evolutionary analogy was applied to map and understand the way that ideas behave during each of the four design processes. The teams' performances and design outcomes are then analysed to draw some tentative conclusions about how design teams may be formed and managed during the detailed design phase.

Keywords:
interdisciplinary design, detailed design, team roles, sustainability, teams

1. “GOD IS IN THE DETAILS”

Mies van der Rohe’s now rather hackneyed idiom identifies the detail design phase as one of the most critical if design quality is to be manifested in architecture. Mies is accepted as a master proponent of his phrase, particularly in relation to “junctions between external enclosure and primary structure.” (Groak, 1992 p196). Whilst not wishing to lower Mies from his pedestal within the architectural spirit, his buildings are successful in detailing static elements of building, but we cannot credit him to the same degree with his detailing of non-static elements such as energy flows and environmental performance.

An absence of knowledge can excuse our modernist master. Only as environmental movements were emerging during the mid-twentieth century, does Reyner Banham berate the modernists’ separation of architectural detailing with mechanical and electrical requirements into the “infantile fallacy that architecture is necessarily divisible into function and form, that the mechanical and cultural parts of the art are in essential opposition.” (Banham, 1969 p265). Banham further criticises the profession which has “been happy to hand over all forms of environmental management, except the structural to other specialists...........and they have taught young architects to continue this dereliction of manifest duty.” (*ibid* p267).

2. THE INTER-DISCIPLINARY ENVIRONMENT

Today, the environmental agenda has moved from the fringes of architectural design to an embodied value within it. One would expect, therefore, that the integration of the cultural, structural, mechanical and electrical elements of building has become suitably integrated within the design process.

However, the detailed design process is the atelier for not only solutions to sustainable building, but also of efficiency in construction information flows and construction method. Richard Feilden (2004 p89) notes where rapid building systems and initiatives such as prefabrication and modular construction are employed, there is a lack of attention in how these parts fit together, resulting in buildings constructed as a poorly resolved kit of parts. He emphasises this as the most common reason for environmental failure.

Whilst design innovation in relation to sustainability has surely gathered momentum in recent decades, Peter Rogers (2001, p34) suggests that poor detailing can be attributed to “fragmentation and poor communication.” Ian Ritchie (2001, pp63-75) calls for more inter-disciplinary “synthetic thinking” as a way to achieve Banham’s integration. No longer is the ‘standard detail’ acceptable. To produce components, assemblies and other systems, disciplines need to act as an integrated set of players, communicating effectively in all directions to achieve innovation and success for our sustainable future.

Nevertheless, research remains limited regarding how we manage these disciplinary interfaces between during the crucial detailed design phase. Indeed, in practice, we frequently build teams based on disciplinarity and commercial issues such as availability and fee, but rarely do we consider the interfaces between the personalities involved and how the management of soft skills and psychological factors influence the design outcomes.

This link between the way in which individuals behave within teams with the knowledge and skills that the individual brings to the team may be crucial in shaping designs and should be an important facet in an inquiry into improvements. If the balance of team roles is considered to be of comparable significance to the array of available functional skills, further exploration is needed into how various combinations of team roles and disciplines may influence team performance and output. This study, carried out among employees of a large multi-disciplinary built environment office[1] is an initial test into how different personality and disciplinary combinations influence design outcomes.

3. A STUDY IN DISCIPLINARITY AND PERSONALITIES IN TEAMS

Four combinations of disciplinarity and team role were defined. Teams were designed either as single discipline or multi-disciplinary groups and were either balanced or unbalanced in relation to the combination of preferred team roles. The definition of balance was derived directly from R. Meredith Belbin's team role theory (Belbin 2000; Belbin 2004), a classification of personal preferences in relation to the role of the individual in teams and widely applied to guide and develop management groups. Belbin identified eight team roles, each with their own characteristic behaviours, strengths and allowable weaknesses which contribute to a collective performance. Belbin observed that "with the right combination of people that act of creation seemed effortless" whilst other teams were less prolific in idea generation but were "well able to elicit a few good suggestions an to act on them appropriately"(2000 p30).

The successful teams were likely to benefit from particular key team roles. Such teams were likely to benefit from clear leadership (provided by either a Chair or a Shaper), the ability to finalise proposals (provided by the Completer Finisher), be able to think creatively (through the Innovator or Resource Investigator) and there is likely to be a member present who will intervene to avert potential friction and enable difficult characters in the team to use their skills to positive ends (Team Worker). Whilst no role combination exists that will provide the magic formula for good performance, this kind of informed team design is considered likely to produce positive results. Conversely, Belbin also notes that teams may be unbalanced due to superfluities in some strengths and deficiencies in others. These teams are less likely to perform well.

Similarly, teams were designed with a good balance between individual team role preferences according to Belbin's recommendations or they were deliberately designed to be unbalanced. Individual team role profiles from the overall sample group were ascertained using a card game[2] based on Belbin's self-perception inventory. The four teams of four people were then compiled by analysing their role preferences and discipline background and selecting appropriate members from the sample group.

3.1 Application of an Evolutionary Analogy

Prior to observation of the design teams in action, it was necessary to establish a method for understanding the way that ideas would develop during team interactions.

[1] Scott Wilson Group plc
[2] Platt, S. and HART Ltd. *Teams*, Gower Publishing Ltd. Aldershot, 1988

For this, the theory that ideas behave in a similar way to biological organisms was adopted. In a conceptual and simple sense, this relates to the process of "heredity with copying" (Steadman 1979 p79) and Simonton observes that design is a response to imposed selection criteria which causes some aesthetic variants to fail and others to succeed (Simonton 1999).

A more scientific approach is offered by meme theory which suggests that ideas (described as 'memes') may behave in a similar way to genetic material, though processes of replication, variation and selection in response to pressures exerted by the cultural environment (Dawkins 1989; Distin 2005). This theory also implies that the evolution of problem and solution definition may be controlled by assuming a conceptual design environment where ideas mutate and become successful according to their fitness value. Whilst other factors, such as the nature of the brief or time constraints will exert selection pressures on the evolving design idea, the collective attributes of the team itself, defined by personality and disciplinarity of its members are also likely to be a significant element in determining the environment for Darwinian adaptation. In response, a hypothesis can be drawn that, *if team dynamics are closely controlled then so can design outcomes*.

Hence, by creating different design environments through the design of teams with varying disciplinary or personality characteristics, it may be possible to discern differences in the nature and style of their product and it may also be possible observe differences in the efficiency and prolificacy of their idea generation.

3.2 Observing and recording performance

The design teams were blind to the purpose of the study and each given the same design brief to which they responded over the course of two sessions. The brief set constraints for design parameters, timing of the workshops as well as the deliverables. Each team was asked to produced one A1 sheet communicating their design as well as one A4 sheet of supporting text. Observation and recording methods were based on the analysis of three aspects of performance:

1. Observing the teams in action;
2. Observing the evolutionary patterns of ideas; and
3. Observing design outcomes

1. Observing teams in action

An observer was present during the design sessions who was not a team member and did not offer assistance. In addition, the design sessions were filmed. During observation and analysis of the film footage, the interactions of team members were analysed for three key behaviours:

a. physical interaction (e.g. whether working together or separately);
b. communication flow (nature, amount, sender, direction and participants); and
c. demonstration of behaviours relating to individuals' preferred team role (as defined by Belbin)

Individuals were seen to demonstrate behaviours according to their team role preference and this appeared to influence the design process. For example, team three, an unbalanced team, began to work as a unit but struggled to define principles or concepts on which they could base their design. The three individuals who had identified a 'shaper' role preference displayed 'shaper' characteristics as they had their own strong views on design themes but rather than synthesise these to form a coherent response to the brief, the team dynamics caused them to separate their proposal into three distinct and different elements of their scheme – a building, a landscape and a written proposal, each developed separately. With no individual whose team role was to chair or co-ordinate the group, the submission remained fragmented.

2. Observing the evolution patterns of ideas

In evolutionary biology, the genetic history of a species can be depicted in a hierarchical and graphical format known as a 'phylogenetic tree' and this can be used to analyse the genetic relationships between individual species. If the hypothesis that an idea behaves in a similar way to a biological organism is valid, in that it evolves against a set of fitness criteria defined by the design environment, then it follows that the phylogenetic tree could offer a potentially valuable tool for idea generation pattern analysis. An analysis of the ideas generated during the design workshops using the phylogenetic tree format, could therefore yield insights into the prolificacy, diversity and longevity of the idea population. In this case, diversity would indicate the richness of creative production and longevity would indicate its capacity for survival, whether through its adaptability or appositeness.

It may be noted that such mapping is not new to studies of ideation as it is also derivative of existing tools relating to the idea generation process, such as mind mapping (Buzan 1993) and protocols for design conversations (Goldschmidt 1990; Cross 1997; Goldschmidt and Tatsa 2005). Ideas (which occur internally but are recognised externally as "design moves" (Goldschmidt 1995)) were plotted over time, according to whether they survived into the final submission or were rejected, that is to say, became extinct. This informed an analysis of efficiency and productivity within the design process which might be related to environmental events as defined by the team dynamics.

Ideas presented in the workshops were mapped as a series of phylogenetic trees for each team. The analogy of the idea as biological organism was continued by treating each new development of an idea as a new species which had evolved as an adaptation toward survival in its design environment. Hence, as each new species of idea was presented in conversation, it was allocated a number and plotted in chronological order in a linked sequence with the previous related design move. Ideas were also grouped by subject into an 'idea family'.

The final submissions were then analysed to see which ideas had managed to adapt to survive into the final submission. Those which had survived were coloured green and those which had not survived were coloured brown. Subsequent analysis of the resulting patterns implied some interesting conclusions.

An analysis of the multi-disciplinary / unbalanced team's phylogenetic tree shows that although the team produces the highest number of 'idea families,' these were predominantly established in the early stages of the first workshop with comparatively few ideas being extensively explored (*Figure 1*). This results in an apparently numerous clusters of ideas, though the length of the threads remain short. This may suggest that that ideas were apposite, that is to say suitably fit and adaptable to their environment. However, observation showed that the design was physically carried out by the two members who shared the 'organiser' team role preference, effectively excluding two members of the design team. This apparent fragmentation of the team together with the recording of a high rate of extinction amongst many of their ideas would suggest that their capacity for production and resolution of robust ideas within the more narrowly defined domain of knowledge was limited.

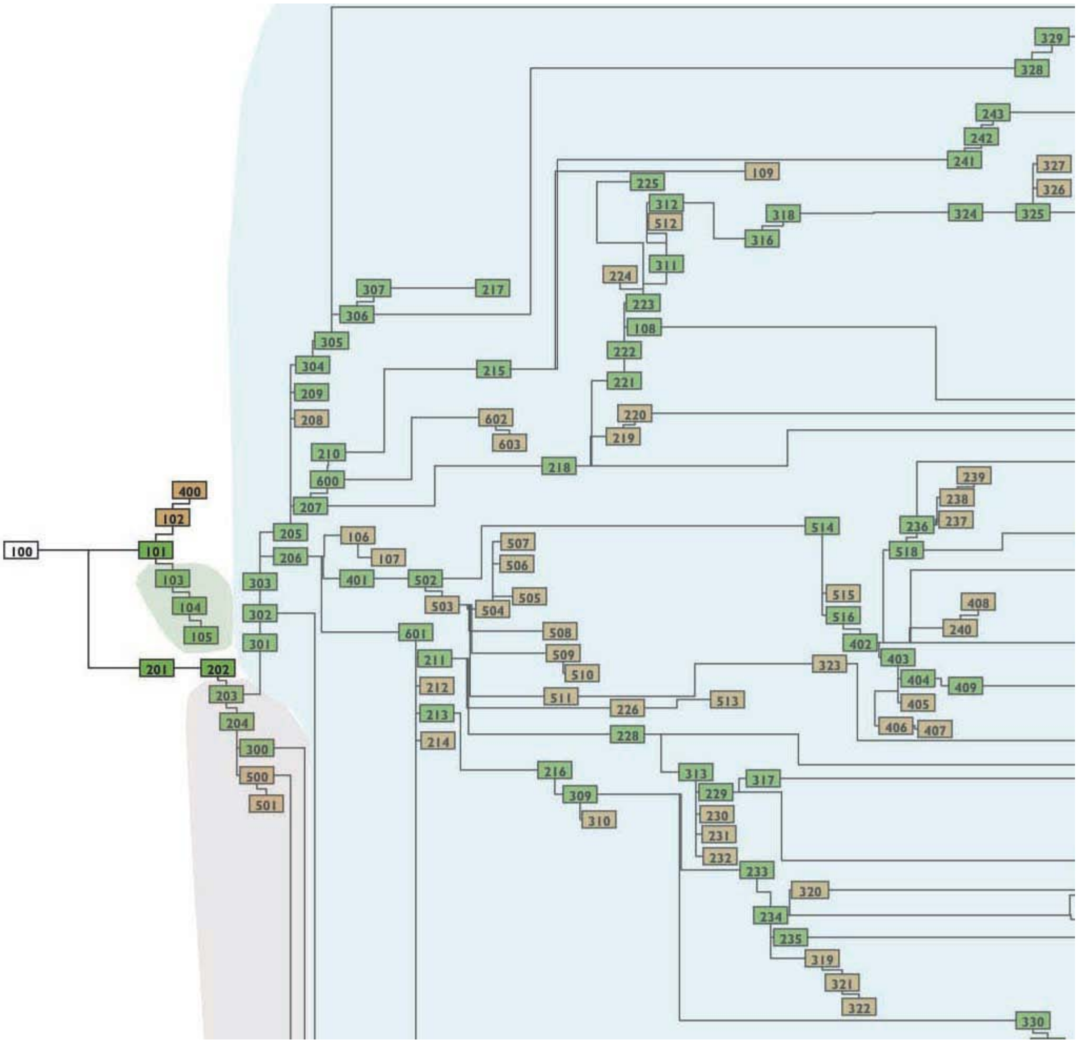

Figure 1: Extract from the phylogenetic tree of the multi-disciplinary/unbalanced team.

The extract exhibits the successful ideas (green), which are not explored at length and a high proportion of ideas which became extinct (brown).

As ‘organisers,’ the two members of this design alliance were extremely sensitive to time pressures and the volume of work to be produced. The phylogenetic tree shows that more evolutionary threads become extinct as time progresses. During the latter part of the second workshop, the two ‘organisers’ ruthlessly selected stronger ideas so that they could be quickly incorporated into the final submission. In application of the evolutionary analogy, it could be said that the environmental change implied by the increase in time pressure caused the process of natural selection to gather pace, forcing the weaker species toward extinction. This is a significant issue for the management of design, as this could be a significant period in which some of the better ideas may be lost.

This issue is manifested by an analysis of the team’s level of idea production. The team worked at a general consistent level of production but in the second workshop, the number of ideas which are rejected outweighs those that are retained, demonstrating the creative cull carried out by the two organisers to allow organisational efficiency at the expense of efficiency in creative output.

The tree for the multi-disciplinary / more balanced team clearly showed a different ideation pattern to that of their unbalanced counterpart (*Figure 2*). There is a striking pattern of exploration of two ideas in the early stages of design. One idea relates to the use of ‘green technology’ in the development whilst the other relates to the spatial and visual attributes of the site. The latter idea came from a graphic designer whose preferred team role was an organiser whilst the former idea was considered by an engineer who acted as Evaluator in the team. The productive attrition during this conversation appears to derive from a combination and interaction between both their disciplinary background and team role preferences. The tree and the excerpt shows that both proponents drive the exploration forward to create two themes which have been rigorously tested for their fitness within a team environment which has a large domain of knowledge (compared to that of a single discipline team). It could be argued that this is more likely to create a more successful design outcome as the idea is already robust and is more likely to survive, should it be subject to different environmental dynamics, such as the influence of client, critic or end user. It appears that the balanced nature of the team enabled conflict to be a positive factor in the design process rather than a barrier to its progress.

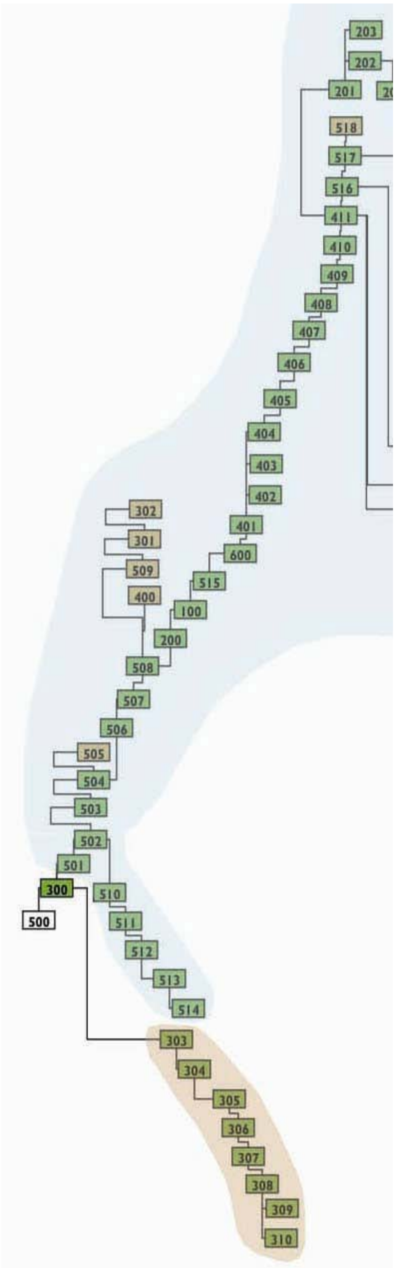

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Figure 2: Extract from the phylogenetic tree of the multi-disciplinary/more balanced team.

Extract shows the lengthy exploration of two ideas in the early stages of design. A very high proportion of these ideas are successful and ‘extinct’ ideas remain low in number.

this team demonstrate efficiency in the design process as the threads leading to ‘extinct’ ideas are short as they focus their energies on the more fecund and successful ideas. This means that most of their ideas are fruitful and are represented in the final submission.

3. Observing design outcomes

It is beyond the scope of this research to be able to define suitable parameters of design excellence with a view to assessing the quality of the outcomes of the design teams’ work. However, the evolutionary analogy would support an assumption that an assessment of design quality is simply a test of the ideas’ robustness and adaptability within a different environment. In design projects, this new environment would be defined by client, user or critic. Hence, to assess the design outcomes, an experienced client was invited to comment and ‘judge’ the submissions. The client had not been part of the workshop process and performed a ‘blind test’ of the submission documentation to determine which proposal would be more attractive in response to the requirements of the brief. The client’s feedback reflected the findings from the analysis of the phylogenetic trees. He found that the multi-disciplinary teams had clearly responded more efficiently and effectively to the task. He also noted that the unbalanced team had created a more conceptual, yet more imaginative response, whilst the balanced team was appreciated for its efficient and effective delivery of the product. An example of this would be the sketchy and colourful nature of the unbalanced team’s presentation compared with the computer generated images of the more balanced team.

4. CONCLUSIONS

The evolutionary analogy proved a useful vehicle for testing the fitness and fecundity of ideas in the design environment. It must be emphasised that the experiment was designed and run as a preliminary investigation into how disciplinarity and personality might influence the idea generation process. The three key conclusions are, therefore, tentative:

1. It was found that team dynamics in respect of team balance did influence design performance. The two more balanced teams were found to be more efficient in generating ideas that would survive than their unbalanced counterparts.
2. The multi-disciplinary, unbalanced team produced the highest number of ‘idea families’ and may therefore be considered to exhibit more creative proflicacy.
3. However, it appeared that the multi-disciplinary, more balanced team was more able to take advantage of the inherent knowledge and skills base to co-ordinate and synthesise their detailed solution in comparison with the unbalanced team which inadvertently excluded certain functional skills where they presented a challenge to the team’s organisational process.

These conclusions offer some suggestions relating to how design teams may be formed and managed throughout the design process. In practice, there is usually a specific requirement for the inclusion of a number of relevant disciplines to be included in the design team but these are usually selected based on the parameters of cost, familiarity and availability rather than team role. Team members are usually retained in their original combination throughout the life of the project with adjustments to team dynamics (and hence, the design environment) only occurring accidentally and unmanaged. However, should a multi-disciplinary team be unbalanced, they may struggle to resolve their ideas in the detailed design phase which we have seen to be crucial for delivering success in sustainable design. However, the multi-disciplinary, unbalanced team exhibited diversity in the range of ideas produced in the early stages of the design process. If "quantity breeds quality" (Goldschmidt and Tatsa 2005), it may be the case that for the initial idea-finding stages of projects, it is actually desirable to create an unbalanced team. If this strategy were adopted, it would then be necessary to restore the team's balance during detailed design to ensure that these ideas are well-resolved, interfaces managed and solutions integrated toward a sustainable built outcome.

These tentative conclusions will be developed as a hypothesis to be tested using a larger sample and also within the context of a live design process in the built environment, toward a predictive and diagnostic tool for designing and managing effective teams for sustainable building.

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