An Exploratory Study of Collaboration In Built Environment Design Teams

A Social Psychology Perspective

by

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VOLUME ONE

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ABSTRACT

In recent years, existing research and industry studies have noted that, whilst there has been significant progress in the performance of built environment teams, scant attention has been paid to the behavioural aspects of collaborative design. These recent performance improvements also tend to respond to a techno-operational and positivist dominance within the architecture, engineering, construction (AEC) domain. This has resulted in tools, technologies, and guidance which fail to address the socio-behavioural context of collaborative design in AEC. Alternatively, generic socio-behavioural management theories are applied with the aim of improving collaborative practices, despite operation in an industry that has critical differences to mainstream business.

This thesis aims to counterbalance that positivist and techno-operational dominance, by conducting an exploratory study which expands and deepens knowledge relating to the social aspects of design collaboration in the built environment. To this end, the study begins with a systematic review of literature from the field of social psychology. This field maintains a long history of experimental and field study in relation to group interaction. The social psychology literature is examined to identify areas of knowledge and key themes which are likely to hold relevance for built environment design teams and may be supplanted within the AEC sector-specific research frame.

Themes emerging from this review are: (1) motivation and reward, (2) risk attitudes, and (3) social climate. These themes, and the social phenomena described within them, are subsequently investigated in a series of studies. First, an exploratory survey of industry perceptions has been conducted. Findings from this survey direct and inform two further, complementary studies, which include focus group interviews and observations of a live design team in a case-study project. Resulting data sets are qualitatively analysed using a thematic analysis complemented by quantitative social network analysis. The proposed framework synthesises the findings from these studies. The framework comprises thematic content which is specific to collaborative practice in the built environment, rooted within a social psychology perspective. Findings detail a multiplicity in the role agency of project team members as actors in industry, discipline, company, and individual contexts. Normative and adaptive responses within the team interaction space, thus, transforms agency and thought to collective systems of meaning, within which creative thinking can flourish, and from which innovation can thrive.

The framework enables the built environment sector to make progress in detailing its own critical success factors for effective collaboration. The framework can now be applied in research and practice, to establish clear directions for new research; development of interdisciplinary industry and practice guidance; and, industry-specific curricula content for professional practice training, teaching, and learning for cognisant disciplines. Thus, the current practice of applying generic theory to AEC collaborative practice can now be repealed in favour of a directed and industry appropriate approach.

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ABBREVIATIONS

3d	3-dimensional
ADePT	Analytical Design Planning Technique
AEC	Architecture, Engineering and Construction
ANOVA	Analysis of variance
ARCOM	Association of Researchers in Construction Management
AU	Action Unit
BAU	Business as usual
BEP	BIM Execution Plan
BIM	Building Information Modelling
BRE	Building Research Establishment
BREEAM	Building Research Establishment's Environmental Assessment Method
CA	Conversational Analysis
CAD	Computer Aided Design
CAT	Consensual Assessment Technique
C.E.	Common Era
CIAT	Chartered Institute of Architectural Technologists
CIBSE	Chartered Institution of Building Services Engineers
CIC	Construction Industry Council
CPD	Continuing Professional Development
CRISP	Construction Research and Innovation Strategy Panel
DA	Discourse Analysis

ABBREVIATIONS continued

D&B	Design and Build
DIY	Do-It-Yourself
DPoW	Digital Plan of Work
EIR	Employer's Information Requirements
GDP	Gross Domestic Product
GSL	Government Soft Landings
Hr	Hour
IABSE	International Association for Bridge and Structural Engineering
ICD	Integrated Collaborative Design
IDBE	Interdisciplinary Design for the Built Environment
IFC	Industry Foundation Classes
IP	Intellectual Property
IPA	Interaction Process Analysis
ISTRUCTE	Institute of Structural Engineers
KTP	Knowledge Transfer Partnership
I.T.	Information technology
LI	The Landscape Institute
LOD	Level of Development/Detail
MEP	Mechanical, Electrical, Plumbing
MIDP	Master Information Delivery Plan
MIP-G	Motivation information processing in groups
M4i	Movement for Innovation

ABBREVIATIONS continued

nCRISP	National Construction Research and Innovation Strategy Panel
NEDO	National Economic Development Office
OGC	Office of Government Commerce
PAS	Publicly Available Specification
PFI	Private Finance Initiative
PLQs	Plain Language Questions
PPP	Public Private Partnerships
QS	Quantity Surveyor
RIBA	Royal Institute of British Architects
RICS	Royal Institute of Chartered Surveyors
sBIM	social Building Information Modelling
SCOT	Social construction of technology
SNA	Social Network Analysis
SPAFF	Specific Affect Coding System
tbc	to be confirmed
TCI	Team climate inventory

1 INTRODUCTION

During the twentieth century, our world was transformed by the urban explosion that generated exponential growth in towns and cities across the globe. This urban fabric is composed of complex networks interconnecting a plethora of individual buildings, too numerous to count. These buildings, in turn, are constructed from equally complex systems of solid materials, arranged through the design process to be functionally appropriate, spatially poetic, structurally sound, environmentally sustainable, and aesthetically satisfying. No single human being is able to conceive this complexity and communicate it coherently to those who will build it. So, as it is the vast numbers of people who inhabit the city to bring it identity and life, so it is groups of people that can bring the same to the individual building. The built environment design team collaborates to synthesise the specialist skills of the practitioner to design and realise a whole that is far greater than the sum of its parts.

Yet, within the twentieth century construction industry, to collaborate was "*to participate in a sort of post-Cold War socialist idyll within the capitalist corporation*" (Woodhuysen & Abley 2004, p48). Collaboration was neither valued nor well-understood, with the industry selecting, instead, to seek improvement via the enticing efficiencies of the machine age. The industry was transformed by process improvements inspired, in particular, by the Japanese automotive industry (Hellard 1993; McCabe 2004). Thus, the vocabulary of design embraced 'value engineering,' 'lean systems,' and 'total quality management.' Whilst these improvements were vital and overdue in an industry reportedly fraught with adversarial relationships and litigious claims, it also began a process of polarisation of the new urban fabric which now exhibits architecturally branded trophy buildings conspicuously located amongst the standardised architecture comprising constituent components and systems.

It may be argued that this polarisation of the urban fabric resulted from a one-sided approach to the industry's challenges. Whilst the industry was focussed upon systems improvements, it omitted to consider its people. After all, people collaborate to design and realise a building, and people will inhabit it.

It may be considered that, in the twenty-first century, the philosophical and socio-political landscape is now open to a redirection of inquiry. The imperative is made more urgent by the environmental challenges that lie ahead, which require buildings and cities to be designed in such a way that they do not bring about the destruction of those who will inhabit them. It is, therefore, appropriate that the lens of improvement now be turned toward the groups of people who must employ their communication, negotiation and social influencing skills to the process of collaborative design.

Such a radical redirection within the domain must be based on knowledge rather than speculation. It must be signposted according to systematic definition of the research frame and inductive collation of practitioner experience. Furthermore, the twenty-first century challenges of building require new leaps of creativity and transformational innovative solutions. A similar systematic framing and understanding of the creative power of groups is also necessary, so that effective methods can be consciously employed within the collaborative design process.

The field of social psychology maintains a long and prolific history in determining the scope and nature of creativity in groups. To date, this knowledge remains largely underexploited in the Architecture, Engineering and Construction (AEC) domain. Given that the social psychology field would accept the principle that the social dynamics of a group have a clear and observable influence on decision-making, then it would be judicious to supplant and recontextualise this knowledge within the construction industry toward improvements in performance and outcomes.

If the premises hold that the collaborative team embodies a synergistic creative power and that the social dynamics of the team have a causal relationship with design outcomes, then industry requires significant expansion of the knowledge and guidance in this field to support its success. Project success and competitive advantage will be dependent on the focussed and informed education of its employees and on the availability of appropriate tools to manage and evaluate project processes and outcomes.

1.1 Aim and purpose of the research

Direct aim

A study of AEC-specific literature, and the subsequent exploration of the potentially relevant constructs in the social psychology domain, suggested that there are further concepts that have relevance for the management and practice of collaborative project teams. A subsequent review of social psychology literature identified concepts which may influence collaborative creative performance and potential for innovative outcomes within the AEC sector.

The direct aim of the thesis is, thus, to provide a framework for expanding and deepening the AEC domain-specific knowledge in relation to (1) the socio-behavioural aspects of design team interaction, and (2) their influence upon creative thinking and innovative outcomes.

Benefits of the framework and contribution to knowledge

The framework contributes to the extant body of knowledge via an expansion of the constructs that hold relevance for the research of AEC design teams in practice. The framework, therefore, expands the boundaries of the domain and provides a greater and informed clarity to research direction, signposting previously unexplored directions for future research. The framework also contributes AEC-focussed, thematic content, which highlights key factors that are likely to influence creative propensity in built environment project teams. This thematic content may be used to evaluate and direct industry guidance, curriculum content, and project management. The framework is also expected to serve as a prelude to future research. It enables researchers to set clear agendas for future studies, contributing further knowledge in relation to the mechanisms and processes involved in the creative performance and innovative performance of project teams.

In addition, the framework offers a source of guidance for the development and adaptation of pedagogical models for industry-preparedness in the professional education of cognate professionals. The framework may also support professional institutions and industry improvement organisations in the development of recommendations, tools, and guidance for interdisciplinary collaboration and project delivery.

Defining the framework intention

The aim to build a 'framework' requires further clarification as the term can be interpreted subjectively and is associated with a variety of intentions. Frameworks can be described as theoretical or conceptual or re-named as 'models.' The specific epistemological definitions remain subject to ongoing semantic debate (Anfara & Mertz 2006).

For clarity of the research aim, the framework will be understood as a visual and narrative device that indicates key domain-specific factors, potential relationships between them, and the contextual dimensions in which they are expected to occur. This responds to a definition of that conceptual framework that does the following:

> *"explains, either graphically or in narrative form, the main things to be studied – the key factors, concepts or variables – and the presumed relationships among them."*
>
> *(Miles & Huberman 1994)*

In providing the framework as a scaffold for new domain-specific directions, a landscape informed by social psychology domain theory is constructed and this, in turn, is built upon to expand and deepen AEC knowledge. This responds to a definition of the purpose of a conceptual framework which comprises:

> *"characteristics identified from previous inquiry that provide an internal structure that provides a starting point for observations and interview questions, and for analysis. The research proceeds by building on these structures or categories, padding them out or 'giving them flesh' and organizing the ways that they fit together."*
>
> *(Morse et al. 2002)*

In achieving the aim of providing this broad, sector-wide framework, it must be acknowledged that the variables and conclusions will be determined by the future work of industry practitioners and academic researchers. The thematic concepts of the framework presented here are not intended to offer generalisable findings relating to specific factors, but to support the formulation of future research questions and hypotheses. The framework, then, must exercise restraint in identifying causalities or predicting outcomes, although these may be tentatively implied.

1.2 Research objectives

The following objectives will support achievement of the direct aim of the research:

There are two primary objectives of the research:

- To investigate whether the social psychology concepts relating to creative performance and innovation identified in the literature review hold validity within the AEC domain.
- To collate the domain-specific constructs within a multi-level framework which expands and deepens our broad understanding of the social aspects of

creative performance and innovation in teams, and which can support future research, pedagogy, and practice directions.

These are fulfilled by detailed research objectives:

- To investigate whether the social psychology themes identified as holding potential significance for design team creative performance in the AEC sector were perceived or experienced in professional practice.

- To investigate whether there were any domain-specific factors that mediated or appended the social psychology themes identified as holding potential significance for design team creative performance in the AEC sector.

- To explore how the socio-behavioural constructs emerging from the literature review and survey manifest themselves in AEC practice.

- To elicit key socio-behavioural themes that influence creativity and innovation in AEC teams.

- To examine the relationships between the socio-behavioural themes that influence creativity and innovation in AEC teams.

- To arrange the key emergent socio-behavioural themes within a multi-level context reflecting the industry dimensions that influence creative performance and innovation.

- To propose a structural framework based upon the above research which captures, arranges, and communicates the key factors and their broad relationships that influence to the creative performance and propensity for innovation in built environment design teams

Research methodology

The research methodology used to generate the framework responds to the above objectives, supported by a redirection of the AEC research lens from the traditional positivist approach to one of abductive and retroductive interpretation of practitioner observation and report. This departure from tradition signifies a paradigm shift from the hypothetico-deductive understanding of industry to one that allows the interpretation of the dynamic contexts and plurally interpreted realities.

In response to the adopted research paradigm, three complementary studies of practitioner experience were conducted, each analysed through the socio-behavioural lens and using research methods commonly used in social psychology. Each study was also informed and retroductively analysed in relation to the findings of two literature reviews. The first literature review examined the body of knowledge that exists in relation to creativity and innovation in the AEC sector. The second literature review systematically explores the knowledge and theoretical constructs within the social psychology domain. This latter, systematic review generated a series of potential theories, constructs, and phenomena which may hold relevance for creativity and innovation in built environment project teams.

The first study employed a quantitative method of analysis, applied as a broad-brush litmus test of industry attitudes to test whether the social psychology theories, constructs, and phenomena identified in the systematic literature review are experienced in practice. Data were collected using a survey method from a sample which comprised practitioners who were actively engaged in collaborative, built environment design teams.

Subsequent studies applied qualitative analysis methods to data generated from case-study observation and focus group interviews. Additional quantitative analysis of thematic interactions recorded during observation of the case-study design team was also included. This deduced different, but complementary, findings from the same dataset using a social network analysis method.

Resultant findings were then reviewed, synthesised, summarised, and re-contextualised within the AEC domain to generate the proposed framework. The overall research strategy is summarised in Figure 1.1. The research strategy is communicated in further detail in chapter 4 (Research Design), with applicable methodologies for each individual study documented in respective chapters. The survey methodology is presented in section 5.2. The methodology describing data collection and subsequent analysis of focus group perspectives is contained in sections 6.2 and 6.3. Case-study observation and analysis methodologies are presented in sections 7.2 and 7.3, with the associated methodology for the social network analysis discussed in section 8.2.

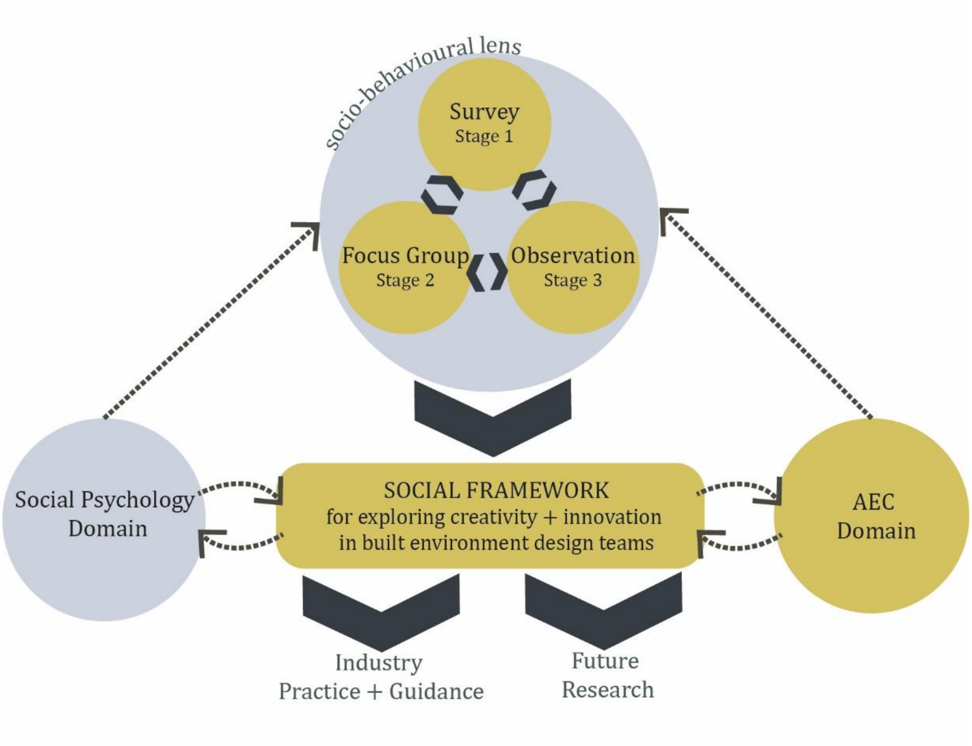

Figure 1.1: Summary of the research strategy

1.3 Scope of the research

Delimiting the domain

The AEC sector may be semantically described by its constituent professional activities of architecture, engineering, and construction. This forms a subset of the overarching construction industry which The Department for Business, Innovation and Skills (BIS) defines by the following divisions:

(i) construction contracting industry,

(ii) provision of construction related professional services, and

(iii) construction related products and materials.

(Department for Business Innovation and Skills 2013)

This definition excludes distribution and sales of construction products as well as self-build, the DIY market, and the black economy, which also account for a significant proportion of the industry's UK GDP contribution (Saxon 2003).

The aims and objectives of this research stated above apply to the BIS category (ii), the construction related professional services. Of these, the research focuses solely on those professional services that are typically involved in the design phase, namely from the strategic definition of the project (RIBA Stage 0) until technical design (RIBA Stage 4) prior to commencement of the construction contract (RIBA 2013).

Delimitation of the design phase as a pre-construction activity is based upon the understanding of this phase within traditional forms of procurement. Whilst this is still widely understood and accepted in today's industry, the recommendations for reform accrued by twentieth-century construction reporting has necessitated, in many projects, a departure from this tradition. This departure has generated new forms of contract, and new project team roles have caused traditional role boundaries to be blurred and historic hierarchies to be deconstructed (Austin et al. 2007; Mills & Glass 2009; Morrell 2015). Similarly, the delineation between the design phase and construction operations has also become less distinct as design, supply, and construction teams become more integrated to support positive relationships and more effective communication in the interests of client service, economy, and resultant building quality (CRISP 1997; Murray & Langford 2003; Constructing Excellence 2004; M4i 2004; Barrett & Sexton 2006; nCRISP 2014).

As a result, whilst the focus of the current research remains on the pre-contract design phase, it acknowledges the contemporary integration of the construction team (BIS classification (i)), which affords a looser definition of what might traditionally be termed 'design.' Thus, it includes roles that, traditionally, may not be found in the construction design team. This is reflected in the Industry Foundation Classes (IFC) data model, which is used to describe and standardise building and construction industry data. From a pan-disciplinary, neutral, and not-for-profit perspective, the IFC aim to facilitate the interoperability of building information modelling which can support effective design communication and collaboration. In sharing these aims, the current research reapplies their domain delineation as the architecture, engineering, and construction (AEC) sector (International Organisation for Standardisation 2013; buildingSMART 2016).

It is also noted that the AEC sector is responsible for the design and construction of many projects, not all of which are buildings (Department for Business Innovation and Skills 2013). The focus of the research remains on the traditional building project, necessarily excluding facility management and civil engineering projects (such as roads and tunnels), as well as specialised construction activities such as demolition and site preparation.

Defining creativity and innovation

The terms 'creativity' and 'innovation' also have a multiplicity of meanings, depending upon their contextual application. As it is important to delimit the domain of operation by defining 'design' and 'construction,' so is it equally vital to ensure clarity in the subject for discussion. To this end, appropriate definitions are proposed below, selected for their ability to be accepted and interpreted similarly across both the AEC and social psychology research domains, as well as being accepted and easily understood by industry.

Early and classical psychology have primarily been concerned with the study of deviance, weakness, and damage (Seligman & Csikszentmihalyi 2000). However, the objectives of this research are not intent on addressing the pathology of failure to innovate in the design team nor interventions that might 'cure' its creative ailments. Rather, the research objectives seek to investigate and examine factors that will bring forth and foster inherent positive, collective behaviour toward a fulfilling and productive outcome. This directed the selection of definitions and associated methodologies towards a perspective of positive psychology (*ibid*.); that is to say, it will promote further improvements to creative performance and aspirations for innovation within the 'normal' range of human responses and behaviours expected in the professional context.

Amabile et al.'s (1996) highly cited work describes creativity in a workplace context as "*the production of useful and novel ideas*" (*ibid*. p1155), differentiating innovation as "*the successful implementation of ideas*" (*op.cit*.). This is consistent with West's (2002) work, which suggests that creativity is characterised by ideation and occurs typically in the early stages of innovation processes, whilst innovation itself is the implementable or commercialisable outcome. In earlier writing, West also summarises the differentiation between ideation and implementation, aphoristically noting that creativity is thinking about new things, whereas innovation is doing new things. However, this is qualified by the suggestion that innovation, as a process, encompasses creative thinking. Thus, for this thesis, both creativity and innovation are relevant to the research question (West & Rickards 1999).

The concept of innovation implies that something new has been produced. Production of new things may be of varying significance, but a degree of novelty is implied (West 2002). It is this novelty that is widely accepted in management thinking as necessary for competitive advantage and business success (Egbu 2004). Innovation as 'novelty' is also frequently discussed in relation to the output of new products and technologies, whether as radical or as incremental changes (Damanpour 1987). Von Stamm (2003) summarises Olsen et al.'s (1995) four levels of innovation:

1. New to the world products: Products that are new both to the company developing them and to the marketplace using them.

2. Line extensions: Products that are new to the marketplace but not to the company.

3. Me-too products: Products that are new to the company but not to the marketplace.

4. Product modifications: Existing products that have been simply modified i.e. they are new neither to the company nor to the marketplace.

This draws attention to the multiscale nature of innovation, which may not always be radical or instantly recognisable. Variability in scale is also accompanied by variability in typology. Echoing Schumpeter's (1934) economic principle of 'creative destruction,' Abernathy and Clark (1985) identify four typological categories:

1. Architectural innovation: Defines the basic configuration of product or process and establishes the technical and market agenda that will guide subsequent development.

2. Market niche innovation: Opens new market opportunities through the use of existing technology, conserving and strengthening established designs.

3. Regular innovation: Builds upon established technical and production competence, with cumulative effects on cost and performance.

4. Revolutionary innovation: Disrupts and renders production competence obsolete.

The distinction of 'process' as well as 'product' is particularly useful in its applicability to the AEC context. Also useful in this context, is the consideration of innovation as something that offers added value to the client i.e. improved functionality, cost saving, and reduced disruption. However, a converse situation may occur where excessive focus on cost-reduction and risk transfer may drive out opportunities for innovation or enhanced quality (Hopkins et al. 2011).

Management literature definitions of innovation as radical or incremental, as well as process, product, or added value, are likely to apply to the study of AEC project teams too, but these definitions tend to derive from organisation-based observation. In project-based industries, such as construction, differences may apply. For example, innovation within organisations supports specialisation, whereas innovation within project teams is an outcome of collaboration between disciplines and functions. In addition, the role of the project leader in project-based industries is considered to be geared more toward knowledge transfer and diffusion of the innovative outcome within the respective organisation for implementation on future projects than on driving innovation within the current one. (Blindenbach-Driessen & van den Ende 2010). This indicates that the current research will need to be mindful of these and emerging differences and unique characteristics.

These definitions and clarifications of the term ‘innovation’ are supported and accommodated within the AEC sector, as evidenced by the Construction Research and Innovation Strategy Panel (CRISP), which defines innovation as *“the successful exploitation of new ideas where ideas are new to a particular enterprise, and are more than just technology related – new ideas can relate to process, market or management.”* (CRISP 1997, p5). This convergence of the definitions suggests that they will be equally interpreted by both the AEC and social psychology domains, whilst descriptions beyond the CRISP definition will also be transferable and valuable for consideration in research design and outcomes.

1.4 Limitations of the research

As an investigative and exploratory study, the research contributes key themes to the AEC domain of knowledge in relation to social influence on creativity and innovation. However, such a study sustains inherent limitations. Whilst the framework offers overarching themes, with specific detail in relation to AEC, the exploratory methodology is insufficient to describe robustly the causalities and correlations that exist within it. That is to say, the three focus groups and single-case-study are not sufficient as a sample set to capture all the aspects of social influence in design teams. Hence, where causalities and correlations are implied within the framework, these are offered only as demi-regularities and tentative hypotheses, based on the findings from the adopted sample set.

The expansive and variable nature of the construction industry and its projects limited the ability of the research to explore a total or representative sample of design teams. In fact, the critical realist perspective of the research was adopted, partly, in response to these inherent dynamic characteristics. This perspective allows the framework to evolve within future and parallel realities, ecologically determined by the external social, economic, and political landscapes. As a result, the framework may offer only a partial and fragmentary view of the social constructs that exist across the whole AEC sector in relation to creativity and innovation. Despite those limitations, the framework is proposed as a vital and timely contribution to the AEC body of knowledge.

2. LITERATURE REVIEW: THE RESEARCH CONTEXT IN THE AEC SECTOR

2.1 Introduction

This chapter reviews the body of knowledge that exists in relation to collaborative creativity and innovation in architecture, engineering and construction (AEC). This review is set in the context of the long history of construction reporting that documents industry aspiration and reform. The review also highlights the current sectoral research gap, demonstrating a dominance of the techno-operational aspects of built environment design and production. The existent socio-behavioural aspects of AEC literature are discussed in response, with particular attention paid to the prevalent topics of integration, cohesiveness, procurement, and reward. This discussion is further informed by a number of viewpoints, which suggest that a redirection of the traditional research paradigm is required to support fully a re-balance of knowledge production in this area.

The chapter concludes with a summary of multi-level themes emerging from the sector-specific literature. A brief justification of the purposeful omission of management science literature relating to creativity and innovation in groups is also provided.

2.2 Industry aspiration and reform

A twentieth-century history of construction reporting affords gathering weight to the links between team-based relationships and the success of the resultant constructed outcomes (Murray & Langford 2003; Baiden & Price 2011). From Sir Ernest Simon's 1944 '*The Placing And Management of Building Contracts*' (Simon 1944) through further reports contributed by Emmerson (1962), Banwell (1964), Lofthouse (1965), Tavistock (1966) and the NEDO report (1988) to the step change in construction industry reform precipitated by '*Constructing The Team'* (Latham 1994) and '*Rethinking Construction'* (Egan 1998) and its subsequent '*Rethinking Construction:*

Accelerating Change' (Egan 2002), and '*Review of Skills for Sustainable Communities'* (Egan, 2004), the importance of understanding, and addressing collaboration, relationships, and interaction behaviour were established. The above reports not only deemed this significant for the competitiveness and success of the industry, but also made plain a national imperative, due to the industry's contribution to national economic productivity and Gross Domestic Product (GDP) (Murray & Langford 2003).

In parallel, construction research in the 1980s highlighted that innovation was restricted in the construction industry, due to the fragmented nature of the design, construction, production, and manufacturing processes. Further fragmentation occurred during the 1990s, when technological advances contributed to increases in project complexity. This complexity prompted firms to 'de-risk', resulting in increased specialisation (Loosemore 2014). This encouraged a positive re-focussing of the research lens towards intangible industry assets such as "*reputation, organisational culture, tacit knowledge and social capital*" (Loosemore 2014, p98) as vehicles of innovation in the interest of competitive advantage, with knowledge consolidated further during the early 21st century (Egbu 2004; Loosemore 2014), as reflected in documents with intentions towards further industry reform, such as '*Building Down Barriers'* (Cain 2003). This document was aimed primarily at clients, encouraging leadership, measurement, and procurement of integrated teams, thereby promoting longevity of relationships towards continuous improvement.

In summary, the catalogue of government-sponsored construction reports have observed that the success of constructed project outcomes is highly dependent on the effective management of the social processes within the team environment. They advocate that the highly interdependent AEC disciplines must collaborate effectively and with measurable positive outcomes for user, client, and industry (Murray & Langford 2003; Austin et al. 2007), introducing and encouraging the major themes of "*interdisciplinary working, flexibility and adaptability*" (Loosemore 2014, p101).

A strategic view of the specifically architectural profession (White & Morgan 2005) extends Egan's (1998) emphasis on behavioural change towards reform. Via extensive multidisciplinary consultation, key drivers for change specific to architects were noted as resulting from recent developments in procurement methods e.g. Private Finance Initiative (PFI) and prime contracting, which strengthen demands for architects to consider their place in collaborative working environments, and integrate their work within the overall supply chain.

Despite this positive approach, adversarial culture and antagonistic relationships are common themes throughout this history of construction reporting and research to the present day (Elmualim & Gilder 2014; Loosemore 2014). Against this background, the '*Constructive Change*' report (White & Morgan 2005) emphasised that non-confrontational behaviour, which are more extrovert in engaging with the multi-disciplinary nature of the construction industry, are required to enhance further the performance of the professions. The most recent construction report, the Farmer Review, also highlights that there are still knowledge gaps and dysfunctional relationships that inhibit the production, dissemination, and adoption of industry innovation (Farmer 2016).

2.3 Identifying the knowledge gap

Despite these appeals from the post-war construction reform literature and the substantial improvements in design management techniques and tools over the last 25 years, the behavioural pathogens to the inevitable, prolific, and expensive disputes in the construction industry are still perceived to be endemic (Love et al. 2010; Loosemore 2014; Broft et al. 2016; Farmer 2016). These pathogens are noted to correspond with economic downturn (Brooks et al. 2016; Farmer 2016) and are expected to increase post-Brexit as labour and skills decrease, and construction contracts require disentanglement from cross-jurisdiction (Braldwood et al. 2016; LexisNexis 2016).

The dominance of the techno-operational response

The intensifying, global challenges of climate change and sustainable development necessitate closer and more effective collaboration between the design team disciplines (Özmen & Ünay 2011). Yet many note that research into AEC collaborative performance improvements centres upon operational improvements or technological advance, 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).

In response to these 21st century construction research observations, Loosemore (2014) suggests that these problems may be minimised in the following ways:

> “- *Choosing partners who are willing to share information*
> - *Providing incentives to collaborate*
> - *Rationalising supply chains to build stronger relationship between fewer partners than having amorphous and dispersed relationships with a large number of partners*
> - *Training and education to enable firms and people to work across new boundaries*
> - *Communicating the clear mutual advantage to participants of long-term collaboration rather than competition*
> - *Resolving contractual issues to ensure that firms take a longer view of collaboration and that there are clear contractual rules of IP[1] ownership and value appropriation*
> - *Resolving communication problems by having effective knowledge management systems to facilitate the transfer of information by maximising opportunities for people to meet (through rotation programmes, co-location and communities of practice etc.) and by making maximum use of information technologies to lower the search cost associated with finding information.”*
>
> *(Loosemore 2014, p148)*

However, the solutions presented here remain strategic and biased towards a systems approach to innovation and the underpinning relationships that support it. This is evidenced by his sub-heading “*Systemizing Innovation*” within chapter 6 (*Organizing for Innovation*) (Loosemore 2014, p154), offering little in terms of

[1] Intellectual Property

furthering understanding and delivering a sector-specific, behavioural approach to innovation.

Loosemore's (2014) reductive approach to the 'people' aspects of innovation management in the field of AEC is paradigmatic of its affiliated domain's body of research and industry literature. The AEC domain has frequently discussed and accepted social relationships as pertinent to the building design team, but this literature has tended to consider them in the context of the design and appropriateness of the operational or technological solution (Merschbrock 2013). For example, interaction is analysed in that context in inquiries into the value of using virtual design space (Tang et al. 2011; Rahimian & Ibrahim 2011) and artificial intelligence in design processes (Gero 2007). Alternatively, social relationships within innovation strategy are explored in relation to procurement (Cicmil & Marshall 2005) and associated financial incentives (Boukendour & Hughes 2014). Frequently, this is at the expense of qualitative aspects such as knowledge and ideas, which are more difficult to measure , yet are more likely to play a significant role in innovative outputs (Salter & Torbett 2003).

Furthermore, design management methods have tended to be structured according to conventional and linear planning, monitoring, and controlling principles (Forgues & Koskela 2009). They have failed to penetrate the creative and subjective nature of architectural design, especially in the concept phase (Sebastian 2004) with design activity relegated to the domain of a discrete group of individuals, segregating processes of design and construction (Austin et al. 2001b).

In a review of innovation in construction presented to the Association of Researchers in Construction Management (ARCOM), Asad et al. (2005) offer 3 overarching drivers that influence the climate for innovation in construction: (1) the client, (2) the procurement method, and (3) attitudes and processes. Whilst social behaviour may be implicit within each of these drivers, the authors did not make social behaviour explicit in the subsequent evaluation, with only the well-integrated team, no-blame culture, professional working together, and effective leadership being suggested as elements which may be considered broadly within this category. Innovation was then framed as a resultant outcome of a system protocol which fails to accommodate the nuances of social interaction. Such unparticularising discussion is typified by the prescriptions of critical success factors for construction performance, which tend to be assessed by applying non-behavioural variables, focussing primarily on the quantitative and typological. For example, in one study of the performance of design and build/design-bid-build contracts, only one of 59 anticipated variables was allocated to collaborative interaction, and limited to a broad title of "*communication among project team members*" (Ling 2004, p481). Such empirical evidence or best practice case studies which link collaborative behaviour and performance remain limited (Baiden & Price 2011).

Towards a bisociative response to collaborative creativity and innovation

A theory of 'social construction of technology' (SCOT) posits that technological innovations depend on the social contexts jointly established amongst a team, thus suggesting that technology does not determine human action, but rather human action shapes technology. Such innovations may, then, be described as wholly dependent on the social contexts from which they emerge (Bijker et al. 1987; Bijker 1997; Bijker et al. 2012). From this perspective, it may be inferred that communication technologies alone do not provide industry solutions, but are the product of an awareness of the social characteristics of the group and their technological needs.

SCOT theory is embedded within Kocaturk's domain-specific work which describes 'collective creativity' in the early stages of the design process as being facilitated by the technology infrastructure, but also requiring effective exchange of multi-disciplinary knowledge (Kocaturk 2013). This expedites innovation by establishing a connective web between previously unconnected components and processes (Figure 2.1).

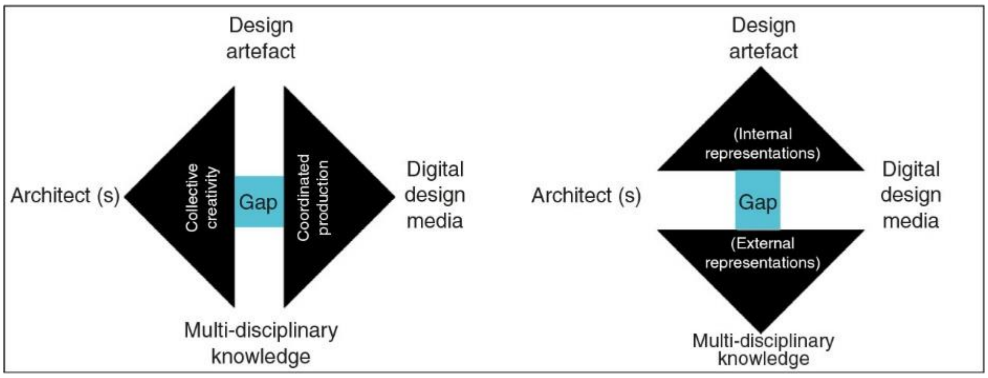

Figure 2.1: Innovations 'bridge the gap' between components and their associated processes (Kocaturk 2013)[2]

Consistent with the SCOT perspective, it may be suggested that the recent democratisation of technological innovation must be mediated by an awareness of social relationships, with careful planning and control procedures. The management of design, therefore, needs to embrace the interactional nature of design to the same degree as that achieved in the systems approach to delivery.

Design management methodologies must also respond to the social aspects of design management by dealing with the creation process rather than being limited to production of an end product, thus transferring focus from an engineering rationality to a better understanding of social and behavioural complexities (Sebastian 2004). This is supported by the component analysis of Salter & Gann (2003) who reported that in a case study of employees at engineering firm, Arup, designers, although keen users of ICT solutions, still maintain a significant reliance on social exchange for processes of problem solving and innovation as part of their work. This is consistent with the findings of den Otter and Emmitt (den Otter & Emmitt 2007; den Otter & Emmitt 2008) who found that, despite the growing use of asynchronous communication (e.g. email), design teams favoured synchronous (e.g. face to face) communication "*because interaction enabled understanding, stimulated sharing of expert design knowledge and encouraged team building*" (den Otter & Emmitt 2008, p128) They noted that different technologies are used across organisations, resulting in a 'rivalry' between tools (den Otter & Emmitt 2007). Similarly, an overdependence

[2] Image reproduced with permission of the author, Dr. Tuba Kocaturk

on asynchronous communication neglected the team's social development, which is also crucial to performance (den Otter & Emmitt 2007). As asynchronous communication was found to be useful in maintaining and sharing factual information, synchronous communication was found to support the collective framework for meaning (den Otter & Prins 2002; Emmitt & Gorse 2007).

Barrett and Sexton (2006) reported that the process of innovation is in fact predominantly behavioural. They suggested that teams work towards narrowing of the gap between existing and desired performance levels, employing a cyclical process of diagnosing, action planning, taking action, evaluating, and specifying learning. This is consistent with the review of sector specific literature by Baiden et al. (2003) which inferred that "*high quality teamwork stimulates on-going innovations*" (*ibid.*, p234), but was tempered by the idea that individuals must be psychologically empowered to engage in such teamwork (Tuuli & Rowlinson 2009; 2010).

Following a series of interviews with employees of 4 construction companies conducted by Egbu et al. (1998), innovation in construction is reported as a "*complex social process*" (*ibid.*, p613) but the 'soft' and human issues need to be integrated with the 'hard' tools and techniques (*op.cit.*). Within these 'soft' issues, the authors identified three areas of focus in research and practice, if a climate and culture of innovation are to be sustained in organisations. These were (1) cultures that encouraged multi-directional communication, (2) climates of risk-tolerance, and (3) cultures of security, which engendered a sense of ownership and of being valued (*ibid*.).

Following interviews with a number of high profile architectural practices, Kocaturk (2013) concludes that, in development of the next generation of technologies, it would be beneficial to consider the dynamics of the architectural team as a "*social network of people and knowledge modules*" (*ibid*., p34). Where this awareness is neglected in favour of a dominant focus on the operational via optimal task ordering co-ordinated across disciplines, this adversely affects project success, which can present itself as unnecessary reworking of the scheme, ultimately producing cost issues and delays (Koskela et al. 2002) as well as barriers to innovation itself (Blayse & Manley 2004). Thus, creative performance must be directed by knowledge, guidance, procedures, and tools informed by an understanding of the bisociative relationship between available technologies and the social dynamics of the group.

2.4 Switching the lens

In re-balancing sector-specific knowledge with an understanding of social dynamics, a "*switching of lenses*" from the operational to the behavioural is essential (Love et al. 2011a, p51). A useful point of departure would be an understanding of people as the construction industry's key resource, and the recognition that an industry-wide culture of innovation must be fostered by motivating individuals to release ideas and utilise these to the benefit of business and projects (Steele & Murray 2004). A switch to the behavioural paradigm is also endorsed by Emmitt & Gorse (2007) who argue acknowledgement of and research into the social life of projects based on the explicit premise that the construction project should be undertaken in a dynamic social system.

This 'switching of lenses' requires an accompanying purposeful paradigm shift. Hugill (1998) asserts that an understanding of the full range of actions involved in the fragmented and convoluted arrangement of the construction industry requires not just knowledge of social psychology and its application to the AEC domain, but also a challenge of traditional methodology. Hugill objects to construction's traditional quantitative techniques and suggests a phenomenological approach as a means to interpret social and psychological metaphor and synecdoche.

A similar paradigm shift from AEC positivism to an epistemology of critical realism is also suggested. This is deemed applicable to the study of social phenomena in the multidisciplinary design team as so many contextual factors, such as actions at different levels and scales of analysis (e.g. industry, organisation, project, individual) conflate to influence the interactive domain (Cash et al. 2015; Poirier et al. 2016) (Figure 2.2).

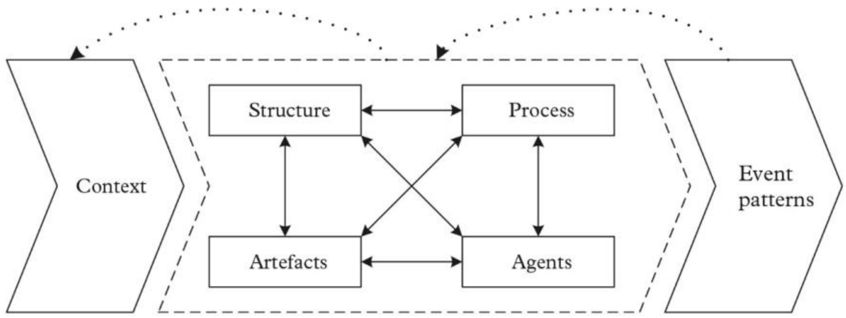

Figure 2.2: The collaboration system, the context that conditions it, and the events it causes (Poirier et al. 2016)[3]

This fresh intention to reunderstand the complex, multi-faceted dynamism of collaboration is given further weight by Mogendorff's (2016) challenge to traditional construction management research and its normative, science based research findings. Instead, a 'non-hegemonic' and performative basis for future studies is advocated, in a response to contemporary performative directions emerging in the social sciences, deploying approaches such as linguistic anthropology and discursive psychology.

Neither the broad terminology of teamwork, nor the more ambitious paradigm shifts have been thoroughly researched, either at the micro, day-to day team level, or at a strategic, macro-scale (Baiden et al. 2003). The AEC sector is, therefore, firmly urged to collaborate closely with the social sciences (Sunding & Ekholm 2015) and to re-understand the design space as a multilevel social entity (van Amstel et al. 2016).

2.5 Social directions in AEC research: Integration and cohesion

The social facet of operational integration

An example of the operationalisation of collaboration using emerging communication technologies is Building Information Modelling (BIM), highly significant due to the proliferation of its use in practice. Seeking time, cost, and value efficiencies (Garber 2014), the multidisciplinary integration of the networked design environment through BIM technologies is now commonplace. Industry-led innovations such as

[3] Image reproduced with permission of the rights holder, Taylor & Francis

BIM (Garber 2014), as well as the Analytical Design Planning Technique (ADePT) (Austin et al. 2001a), and subsequent Integrated Collaborative Design (ICD) framework (Figure 2.3 & Figure 2.4) (Austin et al. 2007) all aim to provide the technological and intellectual framework for successful collaboration. Each acknowledges the importance of team member participation and interaction, yet does not accommodate it as its primary purpose.

The Integrated Collaborative Design (ICD) process model (Austin et al. 2007) offers much by recognising the need to enhance organisational compatibility through identification of shared values, cultures and ways of working as one of the four key areas which require attention when integrating design teams from across disciplinary and organisational boundaries. The ICD prescribes early agreement of a team and project value system, but as the process itself focusses solely on mechanisms for information exchange, cultural, and behavioural aspects of team performance become limited to a task-based project gateway, rather than explored qualitatively as a social phenomenon that might hinder or improve design outcomes.

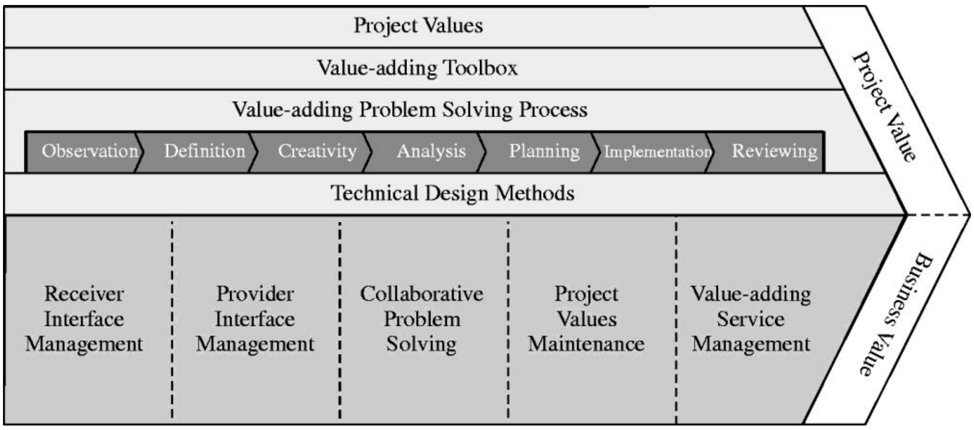

Figure 2.3: The ICD value chain (Austin et al. 2007)[4]

[4] Image reproduced with permission of the rights holder, Emerald Group

	Strategic practices	Tactical practices	Operational practices
Applying process management	Business practices:		
	Planning Design Process Management (BS1)	Applying Process Management in the Business (BT1)	Modelling Business Processes (B01)
	Project practices:		
	Planning Project Design Management (PS1)	Applying Design Management Practices (PT1)	Applying ADePT to Design Management (PO1) Applying DePlan to Design Management (PO2) Modelling Project Design Processes (PO3)
Adopting supply chain management practices	Business practices:		
	Planning Supply Chain Management Business Practice (BS2)	Aligning Supply Networks (BT2) Applying Supply Chain Management in the Business (BT3)	Auditing the Supply Network (BO2) Auditing the Supply Network for Technical Competence (BO3)
	Project practices:		
	Planning Supply Chain Management Project Practice (PS3)	Applying Supply Chain Management to Projects (PT3) Selecting Supply Chain Members at the Project Level (PT4)	Assembling Supply Chains (PO1)
Establishing value frameworks	Business practices:		
	Planning the Implementation of Integral Value Engineering across the Business (BS3)	Applying Integral Value Engineering in the Business (BT4) Conducting a Value Survey (BT5) Performing an ADePT Review (BT6)	Gathering Value-adding Tool Feedback from Projects (BO3)
	Project practices:		
	Planning Integral Value Engineering Practice Practice (PS1)	Planning the Implementation of Integral Value Engineering on a Project (PT4)	Applying Value-adding Tools to Design Problems (PO5)

Figure 2.4: The ICD strategic, tactical, and operational practices support the 3 ICD principles (Austin et al. 2007)[5]

[5] Image reproduced with permission of the rights holder, Emerald Group

Recognition of the dominance of operationalisation and automation in BIM process is increasingly recognised in emerging studies which highlight a need to embrace more comprehensively design process (Abrishami et al. 2014) and social relationships (Adamu et al. 2015), thus prompting proposals for the development of a Social BIM (sBIM). Based on the premise that participants can get carried away with using technology at the expense of collaboration, sBIM acknowledges that;

> *"in addition to group tasks and group outputs, the composition of groups, their mode of communication, 'group consciousness' and group size can also impact on the overall outcome."*
>
> *(Adamu et al. 2015, p236).*

The BAA Project Process/Process Protocol (Kagioglou et al. 2000) and RIBA Plan of Work (RIBA 2013) are examples of such industry standard design management models. Evolved from an action research methodology, the Process Protocol was used for supply chain integration by British Airports Authority, including T5, the new airport terminal at Heathrow (Austin et al. 2007). Its teamwork component focusses primarily on linear information flow across a number of work stages rather than acting as a socio-behavioural model of practice. This is also true of the RIBA Plan of Work (RIBA 2013), which, despite its role as an industry standard, adopts a linear prescription of task execution, indicating that good teamwork is required without explaining how that might operate in practice.

The integrative intentions of industry technologies and protocols tend to focus upon information and communication flows at a project level. Pryke's work, however, seeks to address collaborative activity beyond project-level environments using social network analysis (SNA) (Pryke 2004; Pryke 2012). Pryke explores the macro-scale, as a non-dyadic, complex, creative, and problem-solving exchange network. He refers to Nohria and Eccles (1992) in providing the following reasons for taking the network perspective:

- *"All organisations are social networks and therefore need to be addressed and analysed in terms of a set of nodes linked by social relationships.*
- *The environment in which an organisation operates might be viewed as a network of other organisations*

- *Organisations are suspended in multiple, complex, overlapping webs of relationships and we are unlikely to see the overall pattern from the point of view of one organisation.*
- *Actions, as well as attitudes and behaviour of actors in organisations, can best be explained in terms of their position within networks of relationships.*
- *The comparative analysis of organisations must take into account their network characteristics."*

(Pryke 2004, p792)

From this, it may be inferred, that the behavioural lens must seek to explore both the macro and micro scales of social interaction, which Pryke posits could form the basis of new and non-dyadic procurement and contractual relationships (Pryke 2004).

Loosemore (2014) identifies such social networks and resultant 'social capital' as having critical roles in achieving business success via innovation;

> *"innovation is highly interactive and cyclical, involving many people with multiple interests 'co-creating' new knowledge under the influence of market and many other social, political and organisational forces."*

(Loosemore 2014, p44)

Yet, architectural design teams have particular characteristics which differ from the characteristics of management teams. This difference requires a different context for research and conventional project management techniques are not automatically applicable (Sebastian 2004).

The temporary, project-based team

When considering industry distinctiveness at the macro-scale, Groak (1992) and den Otter and Prins (2002) recognise the building industry as a turbulent and chaotic environment as a result of the uncertainties inherent within it. Within this context, it is noted that there exists a plethora of temporary, multidisciplinary teams with a distributed location. This inherent fragmentation is necessitated, in part, by the fact that "*few firms in the construction industry have the full range of competencies necessary to innovate*" (Loosemore 2014, p84) and so must collaborate to achieve their aims (*ibid*.). Whilst they respond to the brief of a single client, that brief is extended by the multiplicity of requirements presented by a variety of stakeholders (den Otter & Prins 2002) and by the complexity and bespoke nature of the product, which, as a craft-based activity, differs from the output of other complex manufacturing processes, such as those in the microelectronic or aerospace sectors (Austin et al. 2007). Some argue that the temporary nature of the project team alone, is a significant barrier to information. The short-term relationships inhibit knowledge and innovation transfer between projects and organisations (Barrett & Sexton 2006) as team members are often unsure how to act, or may not feel safe to contribute ideas, due to the unfamiliar situations, group cultures, and norms that are repeatedly presented (Emmitt & Gorse 2007). Familiarity, therefore, breeds effectiveness (Morton et al. 2006).

Blayse and Manley (2004) concurred with this view and added that this can sometimes lead to an 'experimental workshop' environment that can actually promote innovation. In a study of project management students, Emmitt and Gorse (2007) noted that there were barriers to creative thinking in a group situation, such as turn blocking and embarrassment. In the groups they observed, individuals made a limited contribution to the brainstorming exercise, compared with working individually. However, the group setting was better able to facilitate the evaluation of ideas towards an appropriate solution and, over time, the students' interactional abilities improved towards an improved creative performance. Such findings highlight group performance as a dynamic state, which is likely to alter over time, and is consistent with Tuckman's (1965) stages of group development.

Whilst industry guidance may suggest 'teambuilding' activities to enhance team identity, cohesiveness, and ultimately performance, the temporary nature of construction project teams and role ambiguity across projects presents barriers to the effectiveness of these activities (Russell et al. 2007; Kleinsmann et al. 2013). Such ambiguity is translated more positively as role 'flexibility' in the French model of construction management, which was highlighted as being more conducive to innovation in the comparative analysis of French and British approaches to the construction of the channel tunnel (Blayse & Manley 2004).

The temporary, project-based nature of the sector and the temporary nature of the resultant ecological factors makes innovation diffusion across projects problematic (Reichstein et al. 2005). This is exacerbated as teams disband at the end of projects and opportunities for repeatability are limited. Team members expend effort in establishing new working cultures and re-inventing processes in the early stages of new jobs, typically during the critical concept design phase, where product development tends to occur (Macmillan et al. 2001; Reichstein et al. 2005). Yet, whilst this design phase is typically a place where innovation tends to dominate and be encouraged, existing research into the impact of social behaviour on innovative performance in this design phase and the processes of innovation in the overall design process remains limited (Salter & Torbett 2003; Panuwatwanich et al. 2009).

From a series of interviews and case studies with members of temporary, project-based teams, Gann and Salter (2000) revealed a dissonance between inter-organisational and intra-organisational cultures and processes. Staff work off site, have limited contact with their senior management, and work in teams with members of other firms. As a result, the processes set up within a well-intentioned organisation to promote learning and innovation are not transferred to the project-based team and have little benefit to in-project and inter-firm innovation. Inter-organisational processes may be further hampered by differences in intra-organisational systems and procedures, which becomes a particular problem with increasing building production and complexity, where the number of design specialists involved rises, further exacerbated by the politics of information sharing. Information sharing, expected to underpin collaboration, is frequently corrupted by psychological factors typical of professional behaviour, and more particularly where design team colleagues may, in future projects, be competitors for the work (den Otter & Prins 2002). Over time this may be tempered by the prescribed 'teambuilding,' but the temporary nature of the project team renders the establishing of emotionally intelligent norms impossible to replicate and continue across projects (Love et al. 2011a).

The duality of organisational and project team membership results in individually defined objectives which can be in conflict with one another (Sebastian 2004; Baiden & Price 2011). Individual definition of objectives arises from the diverse expertise of its individual members, each from separate organisations (with their own cultures and reward systems), and each responsible for separate subsystems or elements of the overall design project (Oyedele 2013). Project teams are formed based on competition, with less attention given to the compatibility of its members, making it particularly difficult to ensure that members contribute to discussion or undertake activity which offers no benefit to the team member, but may benefit the team or the final outcome (Baiden & Price 2011).

Disciplinary difference

This fragmented and distributed macro-landscape is further confounded by differences in disciplinary perspectives within the project team. When considering AEC design as a social process, it is acknowledged that different participants negotiate across subcultures, otherwise described as 'silo cultures' (Austin et al. 2007; The Edge 2015). They work within different worlds and speak different languages and hold differing norms, values, objectives, and preferences (Sebastian 2004; Elmualim & Gilder 2014). Design management methodologies are yet to bridge those gaps, linking process to outcome (Sebastian 2004) despite the acknowledged influence on innovative practices (Ankrah & Langford 2005). Many of these 'subcultures' are ingrained within team members who participate as human beings, and are, therefore, subject to the usual entrenched behaviour, such as the prejudices that exist between social groups, either on a personal or occupational level. For example, in a sample of 100 multidisciplinary professionals, it was found that prejudicial attitudes existed between the disciplinary groups, with contractors' relationships with architects and quantity surveyors being the most problematic due to the negativity and strength of the stereotypes held between those two occupations (Loosemore & Chin 2000).

Subcultural division may be a result of the historic separation of the architect and the builder, which has been articulated as a root of chaos in the building industry, due to their differing conceptual frameworks of various aspects of building design, for example, relating to 'functionality' (Groak 1992; Morrell 2015). This role confusion relating to the architect is a historical hangover as the role of the architect as traditional project team leader has drifted, particularly on more complex projects (Loosemore 2014). Beyond the disciplinary boundaries lie further unhelpful labels, such as 'consultant,' 'contractor,' and 'supplier,' which imply an outdated hierarchy and historically shaped roles and behaviour (Austin et al. 2007).

Much effort of organisations goes into developing and maintaining client relationships and these are seen as an important influence on innovation (Barrett & Sexton 2006), yet the design team members are also daily challenged to integrate their diverse design competencies with those of others, to create a product that is greater than the sum of its parts (Austin et al. 2007). In response, the Edge Debates think tank (Morrell 2015) made the salient point that it will be difficult to encourage integrative and collaborative thinking amongst practitioners when the professional bodies to which they belong are still operating as vestigial institutionalisation of professional difference and protectionism. They suggest that inclusivity and collaborative interaction must first begin at the macro-industry scale, nominating the Construction Industry Council (CIC) as the most appropriate organisation to facilitate the unified voice (Morrell 2015).

In addition to the interdisciplinary, hierarchical, and interorganisational boundaries that might exist, disparities of project team role definition and role fragmentation are also highlighted. One study found that 23.8% of survey respondents thought that the project architect played the major role, with 21.7% believing it to be the design manager. A smaller fraction (14.7%) believed this responsibility lay with the project manager (Elmualim & Gilder 2014). However, over half of the respondents agreed that innovation brought project benefits, including customer value and construction efficiency. 73% believed that the major responsibility should lie with the design manager (*ibid*.)

These observations add considerable gravity to the idea that it is futile simply to put the different construction disciplines into a room and expect an innovative result (Hosey 2009; Kululanga 2009). Kululanga (2009) observed that a more pro-active approach is necessary. In teams involving construction contractors, he concluded that innovation via generative learning must be managed via orchestration of three separate competency divisions:

- Cognitive competence (skills, abilities, and personal styles);
- Social competence (ability to interact with others in a team and to articulate ideas);
- Physical competence (making visible the abstract and tacit into practical manifestation).

These are expressed diagrammatically in Figure 2.5.

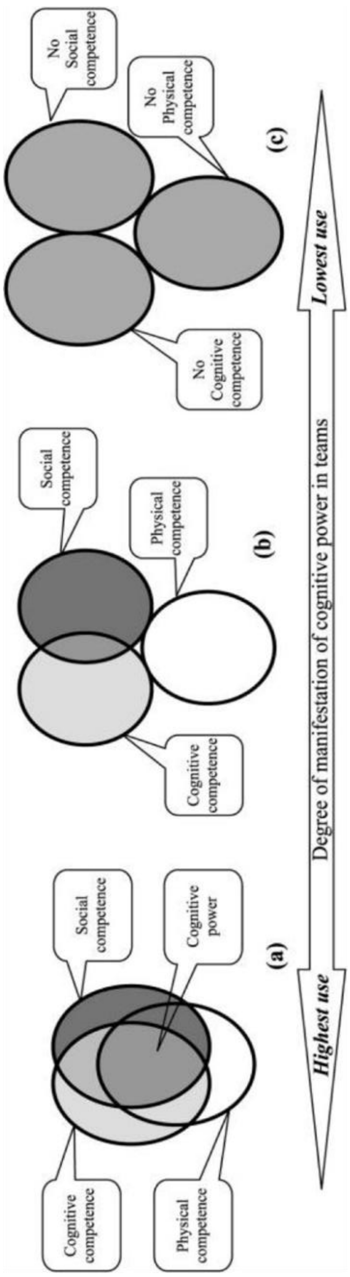

Figure 2.5: High to low generative learning in some teams (Kululanga 2009)[6]

[6] Image reproduced with permission of the rights holder, Emerald Group

In relation to the process of collaborative design, both the Process Protocol and the RIBA Plan of Work are members of a long lineage of models and frameworks which seek to map or predict it. However, it is perceived that the real design methods of architects in practice may differ from those formally described (Sebastian 2004). Of these, notable examples include the Markus Maver maps (2001) as well as others from Archer (1984), Pugh and Morley (1988); Pahl and Beitz (1988); Cross (1989); and Austin et al. (2001b; Macmillan et al. 2002). Each of these derives models from observation of designers' activities. However, each either observes designers as individuals, or limits observation to task/information flow or cognitive function, which leaves the social paradigm still not fully understood.

It has also been observed that the traditional approach to the architecture of the information management system and communication protocols is at odds with the nature and preferences of the designer. Whilst information systems are designed to co-ordinate technical data and measurable activities, the design process revolves around a series of 'sketches' - pictorial documents which may contain;

> *"subjective multimeaning layered properties, ranging from the poetic cultural interpretation of the design to technical production information."*
>
> *(den Otter & Prins 2002, p165)*

The sketches cannot easily be organised into design stages and their meaning and cognitive purpose cannot easily be transferred without face-to-face and informal interaction. Further, designers are frequently reluctant to adopt modelling, protocols, and structuring into a process, which is perceived to be cognitive and tacit (*ibid*.).

Knowledge and understanding of the social design space in practice may be considered to be the domain of the recently emerged role of 'design manager.' This role is perceived as a force that can unite the different creative cultures that exist within the project team. However, despite the emergence of this role in the multidisciplinary project team, the realisation in the construction domain of design as a social process has been hindered by its intuitive and iterative nature, and the difficulty in framing and naming acts of creativity. Sense-making studies of collaborative design and their resultant models, which intend to direct design in practice, tend to continue the tradition of underlining the importance of social dynamics, without clear direction of the mechanisms involved or how they should be addressed on a day-to-day level (Austin et al. 2007).

In design research, behavioural aspects have been explored widely in terms of design process and creative thinking, but research in this field, historically, has tended to be weighted towards exploration of design activity as an individual and cognitive process (Mackinnon 1965; Goldschmidt 1995; Goldschmidt & Badke-Schaub 2010), as a process of negotiation (Bucciarelli 1994), or via mapping of social macro-networks in construction (Pryke 2004; 2005). Whilst these studies are of significant value for understanding aspects of collaboration in construction, there is little exploration of the influence of social behaviour on collaborative design, despite the findings suggesting that social interaction and team maintenance account for between 10 and 40% of design time (Austin et al. 2001b; Oyedele 2010).

Building ideas as social facts

In a review of the prominent design process models, Macmillan et al. noticed that these models do not define what constitutes individual or collaborative activity (Macmillan et al. 2002). Additionally, they found that they do not address the social aspects relating to team working, which would promote effective collaborative design activity, such as the challenging and chaotic period of conceptual design when consensus, common vision, and shared ownership of design problems are crucial to successful solution-finding. Despite this, in observations of collaborative design activity in interdisciplinary design teams, it has been recorded that designers perceive that they have performed better as a team when they agree on, and subsequently follow, a design process. Formal design process is, thus, perceived to mediate the varieties in approach and subsequent response to a multidisciplinary problem which may in reality be due to behavioural factors including leadership style, low-level conflict, and a lack of cohesiveness (Austin et al. 2001b; Macmillan et al. 2002). These studies further observe that;

> *"if a team does not agree on a design process to follow, individual team members tend to make opportunistic forays into particular areas of the problem in an ad hoc manner. If other team members do*

not agree on the direction of that foray then this can lead to a lack of synchronisation in the team effort and a lack of input from one or a number of its members."

(Austin et al. 2001b, p231)

This observation, in the context of a lack of design process models based on behaviour and interaction, raises concern about this specific gap in knowledge and practice guidance.

The work of Donald Schön (1983) may be cited as an early example of a bridge between the dominant 'rationalist' paradigm of the study of professional design processes and the 'experience' of design practice. However, Schön's study of professionals' 'reflection-in-action' and the dynamism of professional judgement again focusses primarily on the individual. Stompff et al. (2016) redeploy Schön's work with reference to the collective design practices of the multidisciplinary team, for which they observe a dearth of empirical study. In doing so, they enfold a socio-technological dimension into Schön's ideas. During an intra-firm participatory field study, data were collected by an in-house designer who filmed regular meetings. The data were coded and following analysis of emerging patterns, it was found that 'surprises' in the design process prompted a social process that sought to interpret and respond to the situation, with such 'surprises' sowing the seeds of innovation in the design process.

The social nature of creativity in design groups is also discussed in de Souza and Dastmalchi's (2016) protocol analysis of multidisciplinary design team workshop observations. Here the terms '*Little-c(p) events*' and '*Big-C(p) events*' emerge from ratings of creativity by an expert panel using Amabile's (1983) Consensual Assessment Technique (CAT). Little-c(p) events are identified as smaller events in the ebb and flow of creative discussion, such as asking provocative questions that can trigger more ideas, or bringing a different viewpoint and insight into an existing discussion. Big-C(p) events describe the more palpable recognition of the creative event, such as the sense of collective and rapid convergence toward a solution, and the realisation of finality.

Detailed exploration of collaborative design discourse draws upon constructs defined by gestalt psychology to investigate common behaviour of individual designers within groups, such as 'fixation,' which presented a cognitive hindrance during problem solving (Cardoso et al. 2016). The study of design cognition of individuals in group contexts, however, may not be sufficient to describe the social phenomenon of collaborative design practice.

Indeed, although few, there are in existence, notable examples of research publication which address social themes and apply them to building design process and outcomes. These include the studies of 'design moves' using protocol analysis[7] (Cross & Clayburn Cross 1995). Medway and Clark (2003) go further to establish that the idea of a building may be described as a 'social fact,' – a complex of ideas that is known in great detail to the project participants, but is not yet real. This extends beyond building function and structure to a virtual and shared understanding of the inexpressible and unimagined (McDonnell & Lloyd 2014), existing only in the consciousness of the design team.

Cross's work on design thinking (Cross 2011) and the outcomes of the associated Design Thinking Research Symposia (DTRS7) (McDonnell & Lloyd 2009) also make a valuable contribution to understanding the collective design process. These publications, with a number of other recent and related papers (Cross & Clayburn Cross 1995; Dong 2007; Emmitt & Gorse 2007; Matthews 2009; Visser 2009; Oak 2011) seek to analyse communication (drawn, written, gestural, or verbal) in the design process as a tangible representation of the mutual expectations and shared understandings of the design team. These studies can provide valuable knowledge about what happens during collaborative design and how it may be analysed, providing the foundations to carry out further research.

The context of interaction is also usefully distinguished, where 'face-to-face' meetings can transmit nuance and feeling beyond basic information. This is used to establish the relevance of the combination of verbal and non-verbal communication to information exchange in the design process, and even as a valid phenomenon within groups (den Otter & Prins 2002).

Observational research has also acknowledged the significance of informal and formal verbal interaction between design team participants, with internal robustness apparent as a key factor to successful design team working (Macmillan et al. 2002).

[7] Method of empirical analysis of patterns in a designer's cognitive and information processing during the design process, using transcribed recording of designer's verbalised thinking (Sarkar & Chakrabarti 2013)

These observations considered whether and how role allocation and the transfer of normative values enable design team participants to gain a comprehensive understanding of the shared and 'imagined' building and its innovative possibilities (Goldschmidt & Eshel 2009; Lloyd 2009; Luck 2009). This is further developed by den Otter and Prins (2002), who noted that as the design process moves across information exchange phases (data, information, communication, knowledge, and document), the problem of personal and subjective interpretation caused distorted or lost meaning.

McDonnell and Lloyd (2014) examined client-architect dialogue on the subject of the unrealised building, noting that where a shared understanding of the imagined building is well-aligned and satisfactorily progressed, the audience's expectations are most likely to be met. This is paralleled in conversations between architects and building users who, although not traditionally part of the design team, are observed mutually and socially to construct attributes of a building or space as a socio-semiotic process, referring to an abstracted form of 'the building' rather than 'the future building' (Luck & McDonnell 2006). Thus 'the building' becomes a socially constructed object based on a phenomenological reality (Luck & McDonnell 2006).

Medway & Clark (2003) traced design development and transformation across communicative transactions in two Canadian practices to map interactions and to abstract, code, and analyse the semiotics of ideational progression, thus recognising ideas as a "*socially distributed mental construction*" (*ibid*., p271). That study emphasised the power of social communication via language as a conveyor of metaphor and meaning, relegating the drawing to only a partial communication tool. Indeed, Hugh Whitehead of the Specialist Modelling Group at Foster and Partners, by way of a case study of the Swiss Re building, described that many of the problems faced, were problems of language, rather than technology (Kocaturk 2013).

Glock (2009) video-recorded a design conversation between architect and client. Using a socio-linguistic analysis, he observed that the client repeatedly appeals to informal social relationships with their implied common ground, as a way to convey her concerns. This exchange of informal and social cues changes the communication of client requirements from being typically understood as a specific set of factual information to the outcome of a protracted social interaction, despite the fact that, in this case study, the designer is selective in engaging with the client's appeals. Thus, Glock (2009)observes that both parties adopt natural linguistic styles, with an inherent vagueness, to weave an interpretative flexibility into conversations. This inherent flexibility is considered crucial to the design process as it forms the key mechanism for sharing and shaping meaning behind design intention (Glock 2009).

Creative cultures and cohesiveness

In addition to these cognitive and linguistic studies of collective creative thinking, there are some initial studies, focusing on the socio-psychological constructs at play in the collaborative design process. Loosemore (2014) reviewed some vital theoretical constructs from social psychology as well as management and organisational science in his exploration of innovation, strategy, and risk in the construction industry. Concepts, behaviour and constructs offered from the social, psychological, management, and organisational sciences include the following:

- Meaning (*relating to group identity as a driver for motivation*)
- Experimentation and risk taking (*promoting tolerance of failure*)
- Trust (*respect without fear of criticism*)
- Creative conflict (*efficient teams vs. creative teams*)
- Collaboration and integration (*'deep integration' and risk/reward sharing*)
- Belbin's Team Roles (*via Belbin, 1997*)
- Groupthink (*via Janis, 1982*)
- Evaluation apprehension (*via Paulus et al., 1993 - individuals censor their own ideas in favour of making a good impression*)
- Social loafing (*leaving others in the group to do the thinking*)
- Crowd/group behaviour (*via Le Bon, 1908 and Freud, 1921*)
- Cognitive dissonance (*via Festinger, 1957 - avoidance or discomfort arising from conflicts with pre-existing belief systems*).
- Social conformation (*via Aronson, 1999*)
- Power in groups (*via Wilder, 1977 and French and Raven, 1959*)
- Negative perceptions of innovators (*via Aronson, 1999*)

Despite his detailed documentation of the problems and challenges associated with delivering innovation in the construction industry, the identification of key theoretical constructs and contributors from the field of social psychology, and the explicit message that social networks and relationships are critical to success, this valuable information is not sufficiently comprehensive to facilitate a rich understanding of the role of social behaviour in project teams. Neither is it applied to or contextualised within the specific needs and challenges of the construction sector's unique characteristics and proven problems in delivering innovation. These recommendations are maintained in their original context of the long-term collaborative relationship within a single firm, rather than applied via empirical study to the construction industry with its unique characteristics and complexities, including those of the temporary, multidisciplinary, multi-organisational, diversely procured project team. More positively, these recommendations signpost a potential seam of valuable material that might be mined further, and applied to the construction industry, to expand and deepen our understanding of the social aspect of collaborative design team function.

Deeper understanding of the 'group consciousness' that influences design outcomes, expanding the discussion of 'teamwork' and 'communication' is offered by Dainty et al. (2006) who explored the subject from a psycho-social perspective. They identified verbal and non-verbal messages that may influence interpretation, norms, values, and outcomes in construction project teams; the need to select appropriate communication media according to intention (face to face, online, or written); as well as some of the barriers to effective communication. They derived methodologies and terminologies from the human resource management domain of literature. The human resource management domain, in turn, derived the methodologies from the social psychology domain. These include Torrington and Hall's (1998) communication skill set, and Huczynski and Buchanan's barriers to effective communication, which are grounded in an understanding of human interaction and relations (Dainty et al. 2006). The psycho-social lens is similarly employed by Emmitt and Gorse's (2007) application of social relationships researcher, Bales's (1950) Interaction Process Analysis (IPA) tool, which is used to explore and understand the nature of socio-emotional and task-based interaction in face to face meetings and their influence on subsequent decision-making. Emmitt and Gorse observed live project teams, using IPA to code, define, and analyse interactions based on Bales's defined categories.

Emmitt and Gorse's IPA findings noted that a socio-emotional interaction event had a big impact on group behaviour. For example, incidences of anger displays prompted increased attentiveness amongst remaining members. The findings also noted a very low level of socio-emotional interaction in the groups they observed in comparison with task-based interactions, and also in comparison with comparable research using adult groups. However, a lack of parallel research into work-based groups makes it difficult to conclude whether there was any sector-related significance. Nevertheless, such low socio-emotional interaction is usually associated with newly-formed groups. The observed groups did not fit this description. The researchers speculated that this 'regression' in the group dynamics may be explained by the unstable nature of the group, resulting from its temporary state, as is typically the case in the construction sector (Emmitt & Gorse 2007).

The psychological concept of 'emotional intelligence' is also explored as a key contributor to successful team performance. Following analysis of causation associated with construction dispute cases, Love et al. (2010) made an emphatic call for firms to consider such psychological factors further, alongside skills requirements in the recruitment of staff. They also called for particular attention to be paid to hiring of staff according to the appropriateness of personality type and level of emotional intelligence with respect to the "*affective context of the organisation and the projects they will be involved with*"(*ibid.*, p420). They argued that this will promote development of an "*emotionally intelligent team that is able to stimulate creativity and solve problems that arise during design and construction*" (*op. cit*.) as well as being more able to negotiate effectively and resolve any conflict that arises. Construction teams must then work to create "*emotionally intelligent norms that support behaviours for building trust, group identity and group efficacy*" (Love et al. 2011a, p59), yet these notions of individual, team, and organisational emotional intelligence remain largely unexplored in the construction context, despite being well researched in the psychological field (*ibid*.).

Whilst these studies underpin an increasing body of work which considers social influence as a driver or limiter of innovative design (Agars et al. 2008; Runco 2008; Wong et al. 2009), this knowledge is still to be transferred and applied comprehensively within and specifically to the AEC field (Kululanga 2009).

The role of motivation is discussed as a vital component in the ability to innovate in design projects. This is well-established in studies of the design process in relation to individuals. However, when the role of motivation in innovation is applied to the perceptions of architects and engineers, it can also be considered relevant to design in groups. Motivational attributes such as "*harmonious working relationship within design team*;" "*good communication within the design team*" (Oyedele 2010, p184), and shared goals were found to have significance for motivational levels and creative performance levels, in turn (*ibid*.). Conversely, in a further exploratory factor analysis of demotivation amongst architects, poor interpersonal relationships were linked to a decline in creative performance (Oyedele 2013).

Although discussion of construction literature would support post-war concerns that the construction team is plagued with adversarial relationships and antagonistic behaviour, studies of disciplinary cultural differences have found that this is a 'likelihood' of conflict, suggesting that knowledge and skills in collaboration have the potential to transcend this likelihood towards learning and innovation (Spence et al. 2001). For example, the success of the Downland Gridshell (Edward Cullinan Architects/Buro Happold) is attributed to the technical innovations applied to create the complex timber structure. This is documented as attributable to the risk tolerant, non-adversarial, and positive team climate facilitated by the client and maintained in project team interaction (Harris et al. 2003).

Positive intervention to minimise this likelihood is offered by the Construction Excellence companion document '*Effective Teamwork'* (2004) which offers some practical solutions couched in a social approach to construction team behaviour. The document recommends a self-assessment matrix, developed by Eclipse Research Consultants, which employs a more psycho-social context for collaborative project delivery justified by the acknowledgement that;

> *"simply bringing people together does not necessarily ensure they will function effectively as a team or make appropriate decisions. Teams are composed of people who have a variety of emotional and social needs which the team can either frustrate or help to meet"*
>
> *(Constructing Excellence/Eclipse Research Consultants 2004, p5).*

Within the recommendations, psycho-social concepts such as shared goals, group think, motivation, role definition, leadership, social climate, shared risk and responsibilities, shared reward, social recognition and reward, conflicting loyalties, familiarity, social loafing, and an environment of safe expression are all identified as social constructs which contribute towards effective fulfilment of goal and purpose and achievement of "*task-related objectives*" (*ibid*., p5).

Three years later, the possibilities for innovation were communicated as benefits of an integrated project team in the Office of Government Commerce (OGC) Procurement Guide 05, which aims to brief clients and industry leaders on "*Achieving Excellence In Construction"* in the integrated project team (2007). Unfortunately, while this connection is now recognised, the social constructs detailed in '*Effective Teamwork'* (2004) are not carried through to the recommendations, which return to a systems-based solutions approach, such as cost target-setting and performance measurement, with the notable exception of incentivising collaboration and innovation.

More recently, the *'Construction Skills Integrated Collaborative Working Toolkit'* (Strategic Forum for Construction 2015a) offered practice guidance for forming and managing the integrated project team in the 21st century. Social factors and constructs are implicit within the toolkit, although ideas deemed crucial by the toolkit, such as 'cohesion' and trust,' remain vague in their description and proposed methods. For example, practitioners are encouraged to take stock of cohesiveness and do the following:

> *"At regular points in the project, team effectiveness should be measured using a stocktake tool. This enables progression of the team to be monitored and corrective measures and/ or additional training or development to be applied as necessary"*
>
> *(Strategic Forum for Construction 2015b, webpage accessed 12 April 2017)*

Despite this, team dynamics command considerably more space within the toolkit than in previous iterations (Wilkinson 2005; Strategic Forum for Construction 2015a; Strategic Forum for Construction 2015b).

The importance of team-level aspects of the design process has only more recently become a subject for academic research, which considers issues of leadership, teambuilding, the creation of cultures, commitment, and shared values as subjects of exploration. This responds to, as well as prompting, new forms of procurement which seek to improve the process and quality of construction projects through enhanced integration, such as partnering (Barrett & Sexton 2006).

Ankrah et al. (2009) recorded that construction project culture is manifested as the "*relationships between participants, their actual behaviours, attitudes of people and the conditions on site*,(*ibid.*, p31)" determining the following dimensions of culture from qualitative analysis of interviews with experienced practitioners. A further questionnaire and factor analysis also observed that relationships exist between project culture and disciplinary dominance. For example, it was observed that as quantity surveyors became more influential, the project culture became more performance orientated. Similarly, as project complexity increased, the culture became more client orientated, but, counter-intuitively, there was lower orientation towards teamwork (Ankrah & Langford 2005). Although these findings are not clear in terms of the causal relationships that exist between disciplinary dominance, teamwork, and team culture, they are particularly interesting in that no reference is made to the architectural discipline, despite including discussion of the design process.

Oyedele (2013) summarised design team cultural requirements, stating that;

> *"co-ordination, communication, commitment, competence, compatibility and co-operation among other things are therefore the essential ingredients for the success of the design team as a whole."*
>
> *(Oyedele 2013, p344)*

The role of interactional elements such as exchange, negotiation, trade-off, and consensus to bring efforts into coherence are noted as key elements of the design process which need to be managed in a manner appropriate to brief and outcome (Sebastian 2004). This implies the requirement for group cohesiveness, which Baiden and Price (2011) translate within the AEC sectoral context as 'integration' which describes "*collaborative working practices, methods and behaviours that promote an environment where information is freely exchanged among the various parties*" (*ibid*., p129) towards improved project delivery.

'Integration' of the disparate goals, needs, and cultures is linked to project delivery team effectiveness - of which the ability to innovate is a factor. In discussing the influence of group cohesiveness, Baiden and Price (2011) also suggest the importance of diminished boundaries between individuals and the importance of a collective team identity, with failures and successes being collectively shared, emphasising the relevance of social and behavioural factors in project team effectiveness. This confirms studies by Austin et al., who observe that teams who realise the need for integration of disciplinary issues into simple systems, tend to be the most successful (Austin et al. 2001b).

2.6 Social directions in AEC research: Systems of motivation and reward

During this early part of the 21st century, government and industry institutions have sought to promote cohesion, integration, and enhanced collaboration as recognised mechanisms by which design teams generate innovation. Most notably, these have been championed by organisations such as nCRISP (CRISP 1997; nCRISP 2014) and exemplified by the demonstration projects recorded initially by M4I, the Movement for Innovation programme, then the Rethinking Construction demonstrations programme, as disseminated by the cross-sector organisation, Constructing Excellence (2004). These organisations have noted how "*poor communication between the team and defensive protection of respective positions*" (Constructing Excellence 2004, p5) leads to low expectations and outcomes in relation to delivery and quality of building projects. Evidence for this viewpoint is offered via demonstration projects that record improved understanding and communication derived from early collaboration between project participants can enhance the quality of the end product. These demonstration projects necessarily highlight the significant role of procurement in providing a conducive project framework for collaboration and integration towards enhanced cohesiveness (*ibid*.).

Procurement methods and mechanisms

Early collaboration is not necessarily a feature of traditional procurement arrangements, which are considered problematic in that they reward competition between participants, rather than co-operation (Blayse & Manley 2004). Hence, newer forms of contract such as 'Partnering Agreements' and longer term 'Strategic Partnering Alliances' were promoted and adopted at the turn of the millennium and are considered instrumental in their role as mechanisms for managing the portfolio of relationships towards innovation (Blayse & Manley 2004; Constructing Excellence 2004; Constructing Excellence/Eclipse Research Consultants 2004; Loosemore 2014).

Thus, the significance of the pre-commission activities of the client is evident in their role in determining procurement method, selection criteria, and payment/penalty structures. The industry has already taken steps to improve in this area by seeking to develop more cohesive teams in the form of new procurement mechanisms such as Partnering arrangements or Public Private Partnerships (PPP), which take advantage of longer term team and client relationships to promote better collaboration towards value return (Aouad et al. 2010). This is evidenced during the design process, with the effects of client-architect communication relating to cost limitation presenting a barrier or facilitator of creative performance (Wallace 1987).

Via a socio-constructivist comparison of two design teams, Forgues and Koskela (2009) noted differences in dynamics and abilities to innovate between teams who are appointed using traditional contractual networks and those who are appointed using more contemporary, integrated methods. In the traditional design team, the authors reported that relationships were transactional in nature, resulting from formalised one-to-one and parallel, contractual agreements between the client and each of his suppliers, splitting the coalition into three groups – the design team, the client representatives, and the sustainability adviser. These parallel relationships promoted the formation of 'in-group' relationships and thus hampered the development of shared ownership of the design.

In particular, it was observed that the architect forced and controlled the creation of a parallel process of design, disrupting team cohesion and channelling team effort to meet contractual deliverables instead of optimising design solutions. Conversely, the study of the 'integrated' procurement route (ProCure21) observed increased value generation, which was attributed to the relational nature of its contractual relationships via redefinition of traditional hierarchies and polarised relationships to allow a client-led design process. That team was observed to generate more innovations in terms of building product and process, and subsequently delivered the project to time and budget. Nevertheless, the study does not discuss the quality of its 'architecture' and implies a paradigm shift in such contracts away from design of 'architecture' towards production of 'building.' This is echoed in analysis of new procurement routes, such as ‘design and build,’ which transfer design responsibility to the principal contractor, rather than placing it within the architect’s remit, where it has traditionally resided (Mills & Glass 2009).

The positive influence of a more equitable risk/reward model of procurement was observed in a sample of Australian construction case projects, where more collaborative behaviour were considered to have been promoted by the form of contract, which shared risks and rewards more transparently and equitably amongst team members. In these cases, the more equitable framework was considered to have directly encouraged positive team behaviours such as increased interest in and commitment to the project, its decisions, and its outcomes. Traditional adversarial boundaries were observed to have disappeared due to the incentives in place (Love et al. 2011b). Thus, equitable risk and reward sharing in a pro-project – rather than pro-self – environment is identified as a key factor in facilitating ‘deep integration’ (Loosemore 2014). Lloyd-Walker et al. (2014) also identified that the ‘no-blame’ culture, embedded in the behavioural expectations and risk/gain sharing in new procurement routes such as ‘Project Alliances’ (PAs), is key to fostering a collective culture, norms, and motivation supportive of innovation.

On the basis of survey analysis of construction practitioners, Ankrah et al (2009) argued that a dichotomy exists between the expectations of greater integration embedded in these newer procurement routes, and actual reality. They suggested that further exploration is required to ascertain whether the spirit of collaborative procurement arrangements, such as partnering, which encourages open interaction, trust, commitment, mutual advantage, learning, innovation, and productivity, is indeed played out in practice. Their subsequent study did not find any evidence that different procurement routes result in different cultural orientations, so they advised that it should not automatically be assumed that adopting particular procurement frameworks will determine the appropriate cultural orientations. Instead, they argued that it is the participants’ abilities to demonstrate the appropriate cognitive and behavioural aspects that are critical to collaborative functioning and the success of the original procurement philosophies. The authors recommended future research into interdisciplinary and inter-organisational cultural differences or similarities to examine how these differences or similarities combine to influence the culture of the inter-organisational and interdisciplinary construction project team.

Non-financial reward

Bresnen and Marshall's (2000) study of the effectiveness of the newer procurement reward mechanisms recognised that incentives are arranged between organisations, not between the individuals who perform the collaborative tasks. In their qualitative analysis of semi-structured interviews exploring motivation and incentivisation in 6 construction projects, it was emphasised that project participants' evaluations of equity and reward may well differ from that of their company's. In addition, the extrinsic rewards offered by companies and procurement arrangement were not a full picture of the individual's motivation within collaborative relationships. In reality, individual motivation and commitment may well be driven by intrinsic rewards relating to a sense of achievement or interest in the work itself.

Whilst many studies reviewed in this chapter have noted the increased potential for construction innovation where a conducive *organisational* culture and climate exists, in a survey of experienced professionals in 'Innovation Generating Organisations' in the construction industry, 71% recorded that it is the communication among the *project team* which acts as a significant enabler of innovative productivity (Gambatese & Hallowell 2011). In Akintoye and Main's (2007) ANOVA analysis of contractors' perceptions of collaboration success and failure in the construction industry, financial benefits were rated significantly lower than interpersonal relationship concepts, with senior management's close involvement in, and support of, the collaboration process being perceived as most important, coupled with the shared reward for benefits delivered.

The ground-level dynamics between individuals are highly significant in the success of projects, but this is frequently given less consideration by the strategic 'above-ground' management (Burtonshaw-Gunn & Ritchie 2007). This argument may be developed further in considering the highly individualised nature of emotion, which plays out during group interaction. Thus, when the group is under pressure, interaction is likely to compromise task-based interaction (Emmitt & Gorse 2003; Dainty et al. 2006).

In the construction industry, motivation, and incentivisation are traditionally financial. Whilst financial incentives may be valid to encourage teams to exceed 'business-as-usual' (BAU) performance, they may have limited effectiveness if poor social relationships exist within the team (Rose & Manley 2011). This was observed in a subsequent case-study observation where specific aspects of the procurement approach and associated incentivisation critically impacted on the motivation towards above BAU goals, comprising:

> *"- the inability of the project team to control the financial incentive performance due to perceived inequitable contractual risk allocation*
>
> *- The late involvement of the managing contractor, who could otherwise have influenced design and construction cost risks*
>
> *- The inconsistency between contract intentions and relationship intentions causing stakeholders to distrust the client*
>
> *- The inaccuracies in the guaranteed construction sum (GCS) price estimate due to tender submission time pressures and a hasty negotiation process resulting in a low expectancy of goal achievement and receiving the incentive reward*
>
> *- The misalignment between the project performance goals and the incentive goals resulting in a perception of procedural injustice and decreasing the expectancy of goal achievement*
>
> *- The unfair and inflexible incentive performance measurement process under the project conditions"*
>
> (Rose & Manley 2010, p154-155)

The well-intentioned newer forms of procurement arrangements may well establish the framework for improvement in innovative performance, but they may yet be considered as skin-deep reform (Loosemore 2014). The focus still remains predominantly upon operationalism and systemised approaches to interaction, such as mechanisms of risk transfer and corporate incentive, with thin offering of similar solutions to improve team communication and collaboration at the day to day level.

2.7 Key findings of the AEC literature review

The timing, nature, and variability of interaction may change further as internet-based communication technologies trend towards commonplace, internationalised, and rapid communication, particularly on complex building projects (Loosemore 2014). Loosemore presents this prediction as a growing concern, which could exacerbate a negative industry climate towards further social fragmentation. However, if a comprehensive framework for understanding design team dynamics can be developed meaningfully to direct industry, education, and research, in balance with the dominant techno-operational approach, then teams could be better equipped to support industry improvement, its growth, and environmental sustainability.

To commence this process, the framework in Table 2.1 summarises the key findings of the literature review. It indicates AEC studies from academic sources that have been included in this review and that can be meaningfully included within a social paradigm of AEC collaboration, according to their place in the multi-level agency of industry practice (i.e. actions of and by industry, organisations/disciplines, and team-based). For context, the table is appended with the literature sources that focus primarily on design cognition, rather than purely social constructs. The list is by no means exhaustive, as the literature review has sought to be representative of sectoral knowledge rather than catalogic. Nevertheless, when the literature is analysed against the multilevel nature of agency in the construction team, significant knowledge gaps are detected.

Overall, the review summary highlights limitations in the body of work which expresses teamwork and collaboration through the social lens. Only a limited number of social constructs have yet been explored by empirical study. Where research does exist, it tends to occur at team level and focuses primarily on design process and the way in which emerging technologies influence social relationships and communication in teams, and vice versa. Additional work considers the ‘integration’ objectives promulgated by industry reform literature via studies of cohesion and effects of new procurement project processes.

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Team-based Cognitive
Risk management			Egbu et al., 1998 Lloyd-Walker et al., 2014	
Design process	van Amstel et al., 2016 Abrishimi et al., 2014		Bucciarelli, 1994 Austin et al., 2001b Macmillan et al., 2001 den Otter & Prins, 2002 Salter & Torbett, 2003 Sebastian, 2004 Reichstein et al., 2005 Hosey, 2009 Kululanga, 2009 Panuwatwanich et al., 2009 Oyedele, 2010 van Amstel et al., 2016	Bucciarelli, 1994 Cross & Clayburn Cross, 1995 Goldschmidt, 1995 Austin et al., 2001 den Otter & Prins, 2002 Lawson, 2001, 2004 Medway & Clark, 2003 Dong, 2007 Den Otter & Emmitt, 2008 Glock, 2009 Goldschmidt & Eshel, 2009 Lloyd, 2009 Luck, 2009 Matthews, 2009 Visser, 2009 Goldschmidt & Badke-Schaub, 2010 Cross, 2011 Oak, 2011 Kocaturk, 2013 McDonnell & Lloyd, 2014 Amstel et al., 2016 D'Souza & Dastmalchi, 2016 Cardoso et al., 2016 Stompff et al., 2016
Project management	Groak, 1992 Kagioglou et al., 2000 den Otter and Prins, 2002 Austin et al., 2007 Cash et al., 2015 Poirier et al., 2016	Gann & Salter, 2000 Barrett & Sexton, 2006 Love et al., 2011a Cash et al., 2015 Poirier et al., 2016	Kagioglou et al., 2000 Koskela et al., 2002 Blayse & Manley, 2004 Barrett & Sexton, 2006 Oyedele, 2013 Cash et al., 2015 Poirier et al., 2016	Cash et al., 2015 Poirier et al., 2016

Table 2.1: Literature framework of socio-behvioural concepts in construction teams (continued overleaf)

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Team-based Cognitive
Client	Asad et al. , 2005		Wallace, 1987	Glock, 2009 McDonnell & Lloyd, 2014
Procurement mechanisms	Blayse & Manley, 2004 Ling, 2004 Asad et al., 2005 Barrett & Sexton, 2006 Mills & Glass, 2009 Aouad et al., 2010		Ankrah et al., 2009 Forgues & Koskela, 2009 Baiden & Price, 2011 Lloyd-Walker, 2014	Ankrah et al., 2009
Integration and cohesiveness	Pryke, 2004 Asad et al., 2005 Pryke, 2012	Den Otter & Prins, 2002 Baiden & Price, 2011 Oyedele, 2013	Austin et al., 2001b Macmillan et al., 2002 Baiden et al., 2003 Blayse & Manley, 2004 Morton et al., 2006 Emmitt & Gorse, 2007 Baiden & Price, 2011	Love et al., 2011 Macmillan et al., 2002
Incentive and reward	Steele & Murray, 2004	Akintoye & Main, 2007 Burtonshaw-Gunn & Ritchie, 2007 Oyedele, 2013	Bresnen & Marshall, 2000 Love et al., 2011b Rose & Manley, 2011 Oyedele, 2013	Steele & Murray, 2004
Technology solutions and appropriateness	Garber, 2014		den Otter & Prins, 2002 den Otter & Emmitt, 2007 Kocaturk, 2013 Adamu et al., 2015	Kocaturk, 2013
Managing adversarial relationships and group pressures			Egbu et al., 1998 Austin et al., 2001b Spence et al., 2001 Emmitt & Gorse, 2003 Harris et al., 2003 Dainty et al., 2006 Russell et al., 2007 Love et al., 2011b Kleinsmann et al., 2013 Morrell, 2015	

Table 2.1 continued

	Levels of agency			
Emerging concepts	Industry-wide	Organisation /Discipline	Team-based	Team-based Cognitive
Interdisciplinary relationships		den Otter & Prins, 2002	Loosemore & Chin, 1999 Sebastian, 2004 Ankrah & Langford, 2005 Austin et al., 2007 Kocaturk, 2013	Groak, 2002
Communication methods and media			Egbu et al., 1998 Salter & Gann, 2003 Emmitt & Gorse, 2007 den Otter & Emmitt, 2007 den Otter & Emmitt, 2008 Gambatese & Hallowell, 2011	Cross & Clayburn Cross, 1995 den Otter & Prins, 2002 Medway & Clark, 2003 Luck & McDonnell, 2006 Dong, 2007 Emmit & Gorse, 2007 Glock, 2009 Goldschmidt & Eshel, 2009 Lloyd, 2009 Luck, 2009 Matthews, 2009 McDonnell & Lloyd, 2009 Visser, 2009 Cross, 2011 Oak, 2011 McDonnell & Lloyd, 2014
Individual capabilities and empowerment			Bresnen & Marshall, 2000 Tuuli & Rowlinson, 2009 Tuuli et al., 2010	Love et al., 2010 Kululanga, 2009

Table 2.1 continued

There is significant work to be done in fulfilling knowledge gaps relating to all aspects of currently identified social constructs, particularly in relation to industry, organisational, and disciplinary levels of influence. Additional constructs that have been flagged up in research performed through a systems and procedural lens, but are likely to be relevant to the social context of collaboration, will need to be identified. These constructs include the ‘no-blame’ culture, impacts of relationship longevity, collaboration skills training, social networks, knowledge management, and social capital.

In areas where empirical research has shed light at a micro level, then this will need to be extended to the macro level, and vice versa. For example, a relatively large body of work exists in relation to understanding of the interrelationships between the social act of design and emerging technologies that either support or hinder it. This has been explored at design team level to a degree, but an understanding of industry and organisational factors must also be examined.

In the absence of this sector-specific knowledge, a valid approach would be to explore the social sciences, to determine whether there are socio-psychological constructs which have yet to be reviewed within an AEC context. These constructs must be examined to ascertain whether they can offer additional concepts that have not yet found a place in the domain-specific literature and the methodologies for its future research. Whilst studies in social psychology may not specifically consider their application to the design process (or even the process of building), it is assumed that the human condition remains constant, and that the social phenomena which influence creative performance in other sectors will also do so within design teams.

2.8 The irrelevance of business and management research

Prior to embarking on a review of literature in the social psychology domain, it is prudent to pause momentarily, to acknowledge the considerable wealth of knowledge contributed by business studies and management science to the study of creativity in teams.

Management and organisational theory has embraced the social and behavioural aspects of group performance since well before the post-war emergence of construction industry reform literature. From Aristotle's (384-322B.C.E.) (Aristotle 2000) and Plato's (c.380B.C.E.) (Plato & Reeve 2004) acknowledgement of group processes to Elton Mayo's Hawthorne Studies (Mayo 1949), work group decision-making has long been scrutinised, drawing knowledge from the field of social psychology to connect human social behaviour with organisational performance. In the later years of the twentieth century, this work gathered pace, resulting in an array of models and tools, which continued to be implemented in organisational settings. These included Hofstede's Multi-focus model (Hofstede 2001), and the renowned works of Mintzberg (1973) and Handy (1999).

Creativity and innovation have been investigated and empirically observed extensively in behavioural psychology, culminating in prolific production of tests, measures, and methods during the 1950s and 1960s. These have been subsequently applied within management thinking and practice, and also to a variety of artistic endeavours (Akin & Akin 1996). Recent management literature has more clearly identified the 'diffusion' of ideas as a further stage to append to their traditional delineation of 'production,' and 'implementation,' and this is highly relevant to innovation within a project-based, team setting. Furthermore, the effectiveness of idea transfer through diffusion is considered to be a complex change process occurring within a team's social system and its success is defined by the nature of social relationships, and complex interactions (Rogers 2003).

This area of discussion sits adjacent to the field of 'knowledge management,' where an Eastern view supports the notion that it is human interaction which acts as the principal motor of knowledge and that it is the self, who is responsible for shaping the knowledge environment (Nonaka & Takeuchi 1995). This fuels the idea adopted by Western thinkers, that knowledge management is a complex social process, which relies on the conscious management of a pro-knowledge culture, as propounded by influential management theorist, Peter Drucker (Drucker 1992). A summary of that recent literature may imply a move away from the historic notion of knowledge as a resource - that is to say that if you employ creative individuals, you will have a creative organisation - towards the emerging perception from the individual to the social, which suggests that fostering a culture which promotes innovation is the optimal approach for sustaining innovative output.

Such world-leading studies certainly appear worthy of review within the research frame. However, since this business and management research draws directly from, and operationalises, the diverse paradigms and multitude of theories from the wider social sciences (Bresnen 2017), it would be more pertinent to focus on the sources of these models to ensure authenticity and clarity in methodology and scope in the current thesis. This authenticity and clarity ensures that new knowledge can appropriately address and inform the unique characteristics of the AEC sector context. Additionally, the PhD research outcomes may benefit from a consideration of a wider set of research paradigms than those traditionally supplanted from management science to project process and protocol, which may hold limited relevance for the social experience of designing and making (Koskela 2017).

2.9 Summary

This chapter has presented the findings of a review of literature within the AEC domain in relation to creativity and innovation in design teams. In response to the primary objectives of the research, a further review of literature in the social psychology domain has been executed. This has been conducted with the purpose of establishing which knowledge and constructs may be directly applicable to the management of creative and innovative performance in multidisciplinary AEC project teams. The findings of the exploratory review of literature in the social psychology domain are presented in the next chapter.

3. LITERATURE REVIEW: EXPLORING THE DOMAIN OF SOCIAL PSYCHOLOGY

3.1 Introduction

A further examination of literature has been conducted as an exploratory study of knowledge and theoretical constructs within the social psychology domain. This body of work has been reviewed and summarised as a series of overarching themes and sub-themes which may be relevant to creativity and innovation in built environment design teams. The current thesis will then present studies, which test these emergent thematic outcomes for their validity within the AEC domain towards production of the framework.

3.2 Methodology

In the review of the AEC literature, survey of the DTRS7 proceedings (McDonnell & Lloyd 2009) highlighted a salient point, which is helpful in defining the scope and clarifying the purpose of the exploration of the social psychology domain of literature.

> *"The very identification of designers' normative orientations (e.g. to the local relevance of talk) is one important step towards the creation of formats of interaction that might be able to 'tamper' with social order, in similarly mild ways, so as to be more conducive to design objectives."*

(Matthews 2009, p75)

With Matthews's comment in mind, the literature review presented in the current chapter seeks to expand and deepen the AEC domain-specific understanding of how this 'social order' at work in built environment design teams, influences collective ability to think creatively and to produce innovative outcomes.

Thus, the following aims for the social psychology literature review are established:

1. To examine the social constructs emerging from the AEC domain-specific literature review relating to creativity and innovation (Table 3.1) in their original contexts; and

2. To identify which concepts and theories present in the social psychology field are likely to be important in the expansion of AEC knowledge relating to the social aspects of collaboration towards creative performance and innovation.

These aims will facilitate a study of the social psychology literature, expanding the AEC knowledge of what is already known to be applicable, summarised in Table 3.1. Further, it will append to this knowledge additional social constructs which may also be pertinent, but have not been fully explored to date.

AEC: Emerging concepts
Risk Management
Design process
Project management
Client
Procurement mechanisms
Integration & cohesion
Incentive and reward
Technology solutions & appropriateness
Managing adversarial relationships and group pressures
Interdisciplinary relationships
Communication methods and media
Individual capabilities & empowerment

Table 3.1: Socio-behavioural concepts emerging from the review of AEC-specific literature

For the point of departure, two seminal texts were selected as signposts to potentially productive seams of knowledge. The first, '*The Social Animal*' (Aronson 2007) introduced the broad themes of human social behaviour with methodological emphasis on experimental study and case observation. The second text, '*The Handbook of Group Research and Practice*' (Wheelan 2005), details the legacy of scholars at the Research Center for Group Dynamics at the Massachussetts Institute of Technology as well as connecting historical and contemporary research theory, practice, and applications, most usefully to work-based teams.

The originating epistemiological sources of the concepts described within these texts holding potential relevance to AEC collaborative creativity were examined. By turn, the literature sources of each a priori contribution to the field of social psychology were reviewed. This inevitably produced a considerable and potentially unmanageable body of work for review. Therefore, literature was prioritised according to the following ordered criteria:

1. Its focus upon creativity and innovation.
2. Constraint within the interactional domains of groups, the social environment, and wider cultural influences, as shown in Figure 3.1; and
3. Its significance to the field of social psychology, measured via assessment of impact of the publication, as defined by the Web of Knowledge citation data within psychology and applied psychology journals.

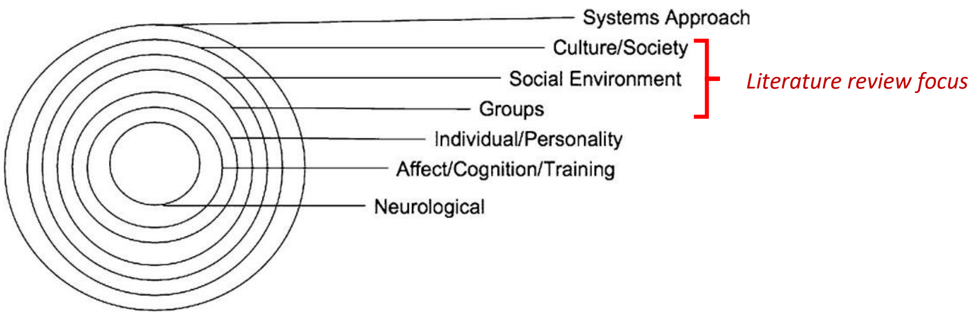

Figure 3.1: Simplified schematic representing the major levels at which creativity forces operate (Hennessey & Amabile 2010), adapted to identify the focus of the social psychology literature review1

Following collation of this body of literature, each publication was examined for potential applicability to collaborative, creative performance, and innovation in AEC design teams. Review of such an extensive body of literature presents a challenge in deriving a meaningful narrative for discussion. Hence, the sample of the literature selected as representative of the body of work was subjected to a process of systematic analysis. This process was selected, not least, for its value in assisting interpretation, but also for its prevalence in the social psychology discipline.

From the systematic analysis of the social psychology literature, four areas emerged as having special and specific significance for built environment design teams. These four themes are as follows:

[1] Original image reproduced with permission of the rights holder, Annual Reviews

(1) Social climate

(2) Risk attitudes

(3) Motivation and reward

(4) Leadership

These themes were used to structure and group the literature review narrative, with the exception of (4) leadership. This purposeful omission is justified by the premise that the study of leadership deals with individual personality characteristics and attitudes, and not the direct social processes that occur *between* individuals in small groups (Davis et al. 1976). Whilst there are many reasons to believe that team leaders can be important in creating a shared and task-adaptive understanding (van Ginkel & van Knippenberg 2012), discussion of this large area of empirical study is beyond the scope of the PhD study. Therefore, within the PhD, I am mindful that aspects of leadership are likely to exert an influence, where it is embedded within the discussion of the previous three themes. Hence, the review of literature directs, limits, and maintains its focus towards *collective* interactions that may influence innovation and creativity in small groups.

The review of social psychology literature is, thus, structured and presented according to the three themes of (1) social climate, (2) risk attitudes, and (3) motivation and reward. During the thematic analysis, further sub-themes were identified. These are described under the thematic section headings and summarised at the end of this chapter.

3.3 Motivation and reward

A key aspect of collaborative creative performance is that of motivation. This is explored in-depth and multiple contexts in the work of Theresa Amabile (Amabile 1983; 1988; Amabile et al. 1996) where she and her team explored the social environment as a driver of motivation towards creative performance, identifying it as a crucial building block of innovation. The wide internalisation of this work within the fields of business, government, and education and its focus on creative performance suggests that it may also offer insight into how design team members' motivation may influence their innovative performance.

Intrinsic motivation

Of particular interest is the role of 'intrinsic motivation,' defined as the degree to which an individual is excited about the task and engages in the activity for its own sake (Amabile 1983; Utman 1997; Shalley et al. 2004). Individuals who are highly 'intrinsically motivated' to engage with the group's activity are more likely to contribute to its collective creative performance since they are more likely to be curious, cognitively flexible, risk-taking, and persistent in the face of barriers, all aspects which support creative ideation (Amabile et al. 1996; Utman 1997; Zhou & Shalley 2003; Shalley et al. 2004). Intrinsic motivating factors such as personal autonomy, intellectual challenge, and satisfaction in achievement can enhance creativity (Amabile 1983). Theory and research suggests that techniques, such as goal-setting, can influence this motivation towards the desired goals (Amabile 1983; Paulus 2000).

In addition to these situational factors, personality factors are also likely to play a role in the propensity for creative behaviour, with a transactional relationship between the two (George & Zhou 2001; Shalley et al. 2004). In fact, each contextual factor influences creative capacity via its effects on the individual's intrinsic motivation (Shalley et al. 2004).

George and Zhou (2001) applied the Five-Factor Model of personality (McCrae & Costa Jr. 1989) to examine creative predispositions. In adopting an interactional perspective, they prioritised two of the model's five factors – 'openness to experience' and 'conscientiousness.' 'Openness to experience' has been extensively linked, in theory and research, to creative performance across a variety of domains (McCrae & Costa 1997; Feist 1999; Hakstian & Scratchley 2000; George & Zhou 2001; Shalley et al. 2004). George and Zhou expanded the term of 'openness to experience,' describing those who demonstrate it as:

> *"…the extent to which individuals are imaginative, sensitive to aesthetics, curious, independent thinkers, and amenable to new ideas, experiences, and unconventional perspectives."*
>
> *(George & Zhou 2001, p514)*

They also expanded the term, 'conscientiousness' describing it as follows:

> *"…[having] a strong sense of purpose and will, are dependable, reliable, and self-controlled; work hard to achieve their goals; obey rules and conform to norms; desire to achieve; and are responsible and scrupulous."*
>
> *(George & Zhou 2001, p515)*

In the same study by George and Zhou (2001), traits amongst 149 office employees from a United States petroleum drilling company were analysed. The authors noted that relationships exist between the two personality factors and the situational factors that are presented by the management approach. Those who were open to new experiences were more likely to be creative when the task's ends and means were not immediately clear and when positive feedback loops were established (see Figure 3.2). The authors also challenged the generalisation that 'conscientiousness' is always advantageous in employees. This was based on the premise that conscientious individuals become less creative when they are subject to close monitoring and control procedures in environments where co-workers are not supportive of creativity (see Figure 3.3), (George & Zhou 2001).

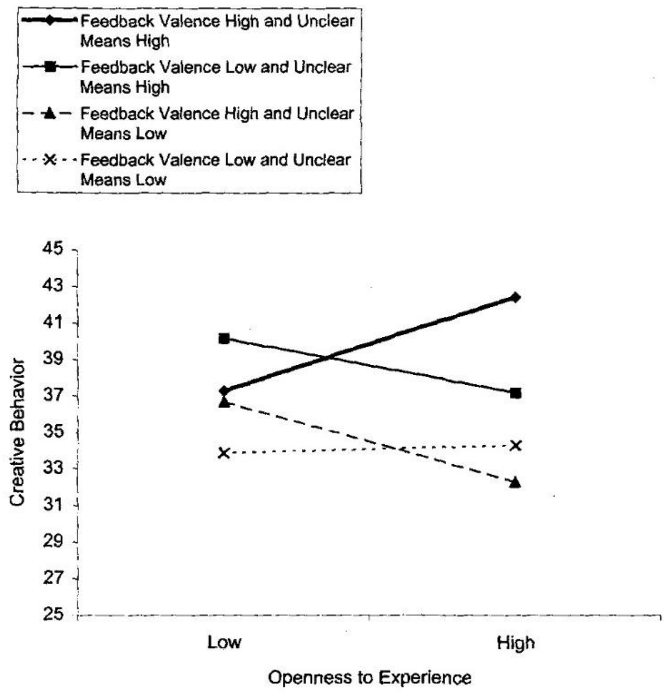

Figure 3.2: Effects of openness x feedback valence x unclear means on creative behaviour (George & Zhou 2001)[2]

[2] Image reproduced with permission of the rights holder, American Psychological Association (APA)

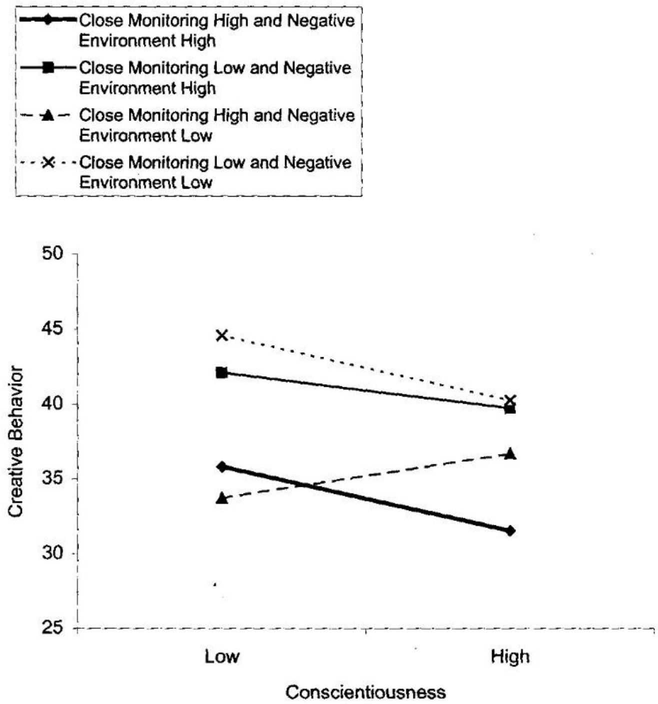

Figure 3.3: Effects of conscientiousness x close monitoring x negative work environment on creative behaviour (George & Zhou 2001)[3]

The influence of inherent personality may be further moderated by positive or negative mood state. A further study by George and Zhou (2002) found that individuals will use affective state as a deciding factor relating to how much effort to exert in coming up with creative ideas. Counterintuitively, positive mood state may be negatively associated with creativity, for example by signalling that all is going well and so creative performance is not required. A negative mood may direct the individual toward the extra effort required to reach the new and useful idea. Conversely, these behaviour were observed in a study of helicopter design engineers and manufacturers, though the conclusions bear the caveat that organisations are not advised to foster negative moods amongst their employees. Instead, the study highlights that affect in the workplace needs to be understood and also that teams must be given opportunities for reflection to obtain clarity in such thoughts and emotions (George & Zhou 2001).

[3] Image reproduced with permission of the rights holder, American Psychological Association (APA)

Alternatively, creativity may be fostered by a conducive social environment which further enhances intrinsic motivation within the individual. This may, in part, be achieved by encouraging collaborative idea flows and a shared commitment to creative thinking (Amabile et al. 1996; Tierney et al. 1999). This intrinsic motivation to contribute to creative endeavours may be maintained by increasing the accountability for individual performance (Paulus et al. 1993; Shepperd 1993) via explicit feedback, as well as facilitating intragroup competition (Paulus et al. 1993; 1996).

This emphasises the interactional basis of motivation to be creative, consistent with findings that when employees work with supervisors who share this motivation, performance is enhanced (Tierney et al. 1999). Unfortunately, this performance improvement does not occur where supervisory motivation to be creative is not shared by the employee. Thus, although motivation has the potential to be influenced towards performance improvement, the need still exists to recruit individuals who share the cognitive and motivational skills that support innovative performance (*ibid*.).

Extrinsic barriers

A dynamic cognitive-motivational relationship exists between intrinsic motivators and the extrinsic context (Amabile 1983; Parker et al. 2006). Whilst intrinsic motivators can enhance creativity, these can be undermined by extrinsic pressures (Amabile 1983). Such pressures may include rigid organisational control or in-group strife, with predictions that particular extrinsic barriers will be found to limit innovative thinking in the design process. These barriers may include insufficient time, insufficient budgets, and conflicting workloads. When these barriers are present, intrinsic motivation is expected to be lowered, as individuals succumb to pressure limiting their abilities for cognitive processing (Amabile et al. 1996; Amabile et al. 2002; Shalley et al. 2004; Shalley & Gilson 2004). In terms of resources, however, Csikszentmihalyi (1996) argued that ample resources can have a 'deadening effect' on creativity as individuals can become too comfortable hence reducing opportunities for inventiveness. This is consistent with the aforementioned George and Zhou study (2002) which attributed positive mood states to a decline in the motivation to 'try harder' and invest further effort in solution-finding as individuals perceive that all is going well

Interestingly for the AEC sector, Amabile's (1996) research also concludes that opportunities for face-to-face social interaction are more significant in creating opportunities for innovation than the knowledge management tools which support information access – arguably, it is the latter that have received more attention in recent AEC research and practice. With this in mind, design managers who wish to enhance innovative performance must endeavour to establish a collaborative, face-to-face culture, which fosters the intrinsic motivation to be creative and minimises the extrinsic barriers to idea generation and flow (Amabile et al. 1996; Nijstad et al. 2010).

Shalley et al. (2004) divided the extrinsic contextual factors into two aspects: informational and controlling, positing that when the controlling aspect is more 'salient,' individuals may feel loss of authorship of creative thought and action. This results in a reduction of intrinsic motivation in relation to the creative task. This view is informed by Deci & Ryan's (1985) 'Cognitive Evaluation Theory,' which also supported the converse position. When the informational factor is more 'salient,' individuals tended to perceive this as feedback related to their personal competence and were likely to feel supported and encouraged to continue.

This discussion of control and feedback suggests that the behaviour of leaders, managers, and colleagues are highly influential in improving or diminishing intrinsic motivation towards creativity. Shalley et al. (2004) argued that individuals can be expected to contribute higher levels of creativity to the task when colleagues are nurturing and encouraging. The converse is true for non-supportive, competitive colleagues, who can undermine intrinsic motivation and, thus, creative output.

Leaders, managers, and colleagues are also able to influence the definition of the individual's job characteristics and role within the group. Role orientation may be restricted within an 'it's not my job' attitude where roles are prescribed, routinised, inflexible, and non-autonomous. This can ultimately stifle innovation. This introduces the notion that it is not only the intensity of motivation that is relevant, but also the direction (Klein 1976; Shalley & Gilson 2004; Parker et al. 2006). The value of autonomy is emphasised further within 'autonomy syndrome' (Amabile et al. 2004). This occurs where leaders fail to clarify roles and objectives effectively and fail to monitor activities, resulting in low leader support amongst individuals and, thus, low levels of intrinsic motivation to engage in creative tasks

The daily behaviour of leaders and managers are also found to be able directly to influence the perceptions and feelings of subordinates, and ultimately their overall creative performance. In a longitudinal study of leader behaviour and subordinate perceptions, Amabile et al. (2004) applied multilevel regression analysis to coded responses in daily diary narratives of both the leader and subordinate categories of participants. This microscopic analysis was further supplemented by a macroscopic qualitative review of broader perspectives involving two teams selected from the larger longitudinal sample. The findings articulated that perceived intellectual competence and technical competence of the leader were more dominant in their influence, than character-based perceptions, and recommended that managers attend to their own day-to-day work patterns if subordinate performance is to be enhanced.

From the history of studies and analyses, it is not yet clear whether these situational, extrinsic barriers impact directly upon intrinsic motivation, or whether they act in multiples as mediating factors, in conjunction with individual personality variables and mood states. More research in this area is deemed necessary (Shalley et al. 2004).

The extrinsic barriers to motivation towards creativity may be extended from the situational social context to that of the physical. A number of studies have observed that densely populated settings with few boundaries can distract attention from the task, due to repeated interpersonal intrusion, eventually lowering intrinsic motivation (Sundstrom 1986; Oldham et al. 1995; Shalley et al. 2004).

Extrinsic motivators and rewards

Extrinsic motivators also exist to encourage creativity in groups, more usually understood as systems of reward (Deci 1976; Kruglanski 1978; Amabile et al. 1994). In classical psychology, reward is understood to underpin behavioural control as a method of reinforcement of desired outcomes in a process of ‘operant conditioning’ (Skinner 1938). Subsequent theorists contested the simplicity of this assumption, suggesting that the offer of a reward for desired behaviour can actually undermine its subsequent expression under certain conditions (DeCharms 1968; Deci 1971; Lepper et al. 1973; McGraw 1978). To support this, in a study of creativity tasks performed by schoolchildren, Amabile et al. (1986) found that working for reward can even lead to decrements in creativity. Intrinsically motivated individuals were more likely to be creative if rewarded for their 'engagement,' rather than 'contracted-for' output.

Intrinsic and extrinsic motivators do not necessarily work in opposition to each other, although some studies have observed the two to be incompatible when fostering innovative thinking (Deci 1971; Lepper et al. 1973; Amabile et al. 1994). For example, the offer of external compensation or reward for creativity may be perceived as 'controlling,' which can undermine the sense of autonomy and intrinsic motivation in the individual. Alternatively, those who are already highly intrinsically motivated towards their work can also be further motivated by the promise of reward (Amabile et al. 1994).

Whilst intrinsic motivation and extrinsic motivators are not necessarily in opposition, nor do they exist on a bi-polar spectrum. Vallerand and Bissonette (1992) posited that a four stage continuum of extrinsic motivation exists, along which individuals can determine and regulate their behaviour. The four stages are summarised below, from lower to higher levels of self-determination:

a: External regulation:
Task performance for extrinsically regulated rewards (or avoidance of sanctions).
b: Introjected regulation:
Internalised reasoning for actions materialising as pressure towards aims.
c: Identified regulation:
Perception that the task was chosen by oneself, materialising as direction and purpose towards aims.
d: Integrated regulation:
External regulation is harmonious with individuals self-concept and valued goals.

(Vallerand & Bissonnette 1992)

The value of this framework to the study of social creativity is the link between levels of self-determination and persistence. Where individuals or groups demonstrate inherent persistence, so might they be more likely to be successful in developing creative solutions to the task problem (Nijstad et al. 2010). Findings suggested that where individuals are more dependent on extrinsic motivators, then levels of persistence are likely to be lower. This work is consonant with similar studies, which suggest that self-determined forms of extrinsic motivation are more likely to have positive effects on task outcomes (Ryan & Connell 1989; Vallerand & Bissonnette 1992).

As a point of note, Vallerand & Bissonette's (1992) study of French-Canadian college students also recorded gender differences in preferences for positioning within the internal-external motivation spectrum. Their findings showed that females were more likely to be intrinsically motivated than their male counterparts. Although the authors acknowledged that this finding requires more research both within and outside the educational environment, it may present an important issue for the traditionally male construction industry.

Leaders and managers are usually those in control of reward for role or task performance, which can have a significant effect on creative performance by influencing the mood states of individuals and groups, with justice and procedural fairness playing a role in influencing affect (Brief & Weiss 2002; George & Zhou 2002; Wang et al. 2011). In the previously discussed George and Zhou study (2002), where positive mood was recorded to correlate negatively with creativity, performance was enhanced by the recognition of the input from co-workers and managers.

In motivating workers to fulfil the role or task, leaders may establish a constructive transaction to determine the reward for meeting expectations. Known as 'contingent reward' (Judge & Piccolo 2004), this has been observed to motivate appropriate role or task fulfilment. However, contingent reward is not necessarily sufficient to encourage creative performance above expectations (Wang et al. 2011). For this social exchange to be effective, the elevated role demands are moderated by the perception of the fairness of those demands (Janssen 2000).

This social transaction highlights the relevance of 'social exchange theory' to the reward structures influencing definition of creative tasks. According to this theory, two types of reward may be transactionally employed to influence employee behaviour: 'economic exchange' and 'social exchange' (Blau 1964). 'Economic exchange' is the (usually monetary) contracted transaction, whilst 'social exchange' refers to the relationships that are established towards long-term, discretionary, 'above-role' acts (*ibid*.). This clearly requires the presence of interpersonal trust and fairhandedness for mutual reciprocation to be maintained, but it can facilitate innovative behaviour that exceeds the contracted job description (Blau 1964; Janssen 2000).

Co-operation versus competition

The way in which the reward is proffered and received is a vital aspect of motivation and influential in facilitating innovation. Team members can receive individual reward or receive it as part of the collective, dependent upon inherent and situational tendencies. The theory of co-operation and competition (Deutsch 1949) sets the foundation for exploring differences in the behaviour and performative potential of groups, when individual motivation is either prosocial or proself (Pruitt & Rubin 1986; Beersma & de Dreu 2005; Bechtoldt et al. 2010). In prosocial behaviour, individuals are working towards the collective success of the group. In proself behaviour, the individual is seeking to 'win' at the expense of group consensus or harmony. It is to be expected that in collaborative teams, collaborative behaviour, such as information-sharing, communication of goals and priorities, and giving and making concessions, will enhance performance. Indeed, more effective problem solving behaviour has been observed in prosocially motivated groups, with egoistic motivation driving out problem-solving, inhibiting motivation to collect full information, and overconfidence, all damaging to innovation capacity (de Dreu et al. 2000).

Counter-intuitively, the presence of proself behaviour has been found to enhance collective results in the long run (Beersma & de Dreu 2005). An individual's attempts to create further value in a competitive environment are considered to be more conducive to divergent thought processes (e.g. during the early stages of design, when idea generation towards project opportunities and potential is explored) (Nielsen et al. 2008). This is influenced by social comparison processes, which are more engaged when working in competition (Paulus 2000). Hence, the group overall is more prolific in producing original ideas. However, when integrative behaviour are required (e.g. during resolution of a single design solution towards efficient project delivery), it is the convergent thought processes that are needed as the usefulness of ideas is the goal rather than their number (Nielsen et al. 2008). Hence, it is asserted that a prosocial environment is required for delivery (Beersma & de Dreu 2005). A collaborative reward structure may, then, have a negative effect on speed of project delivery and resultant innovative output (Beersma et al. 2003; Johnson et al. 2006). This has clear implications for the design process, which requires both divergent and convergent thought processes, corresponding simplistically with the concept and implementation phases.

A game theory approach provides an alternative view. A study that abstracted the rules of task and reward into gameplay, observed that, when collectively rewarded, team productivity slowed and likelihood of 'social loafing' increased (Erev et al. 1993). However, when the team was placed in competition with another group, productivity increased over time. By changing the reward structure, the researchers were able to enhance motivation to succeed via group-based altruism (*ibid*.)

De Dreu et al. (2008) added a further dimension, which is particularly helpful in understanding the endogenous-exogenous relationship of individual-group as well as the group centrism dilemma. This is established by employing 'lay epistemic theory' and offers a dual framework for processing group information across 'epistemic motivation' and group centrism (Kruglanski 2012). Epistemic motivation refers to the degree to which the individual will expend effort to achieve a rich, thorough, and accurate understanding of the world. Group centrism, described as 'social motivation' represents the degree of pro-self or pro-social motive. The authors combined the dynamics of the two motives in a motivated information-processing (MIP-G) model (see Figure 3.4), corroborated in a study of a range of Dutch organisational groups (de Dreu et al. 2008). The model expands upon four possible scenarios:

1. *Low epistemic motivation/Proself:*
   Characterised by social loafing; inaction; tendencies to withhold effort; unwillingness to give in.

2. *High epistemic motivation/Proself*
   Characterised by forceful arguing and counterarguing; advocacy, lying and deception; independent thinking.

3. *Low epistemic motivation/Prosocial*

   Characterised by harmony and consensus; collective bolstering; self-censoring; mutual enhancement.

4. *High epistemic motivation/Prosocial*

   Characterised by information driven processes; preferences for accuracy and harmony; attentiveness.

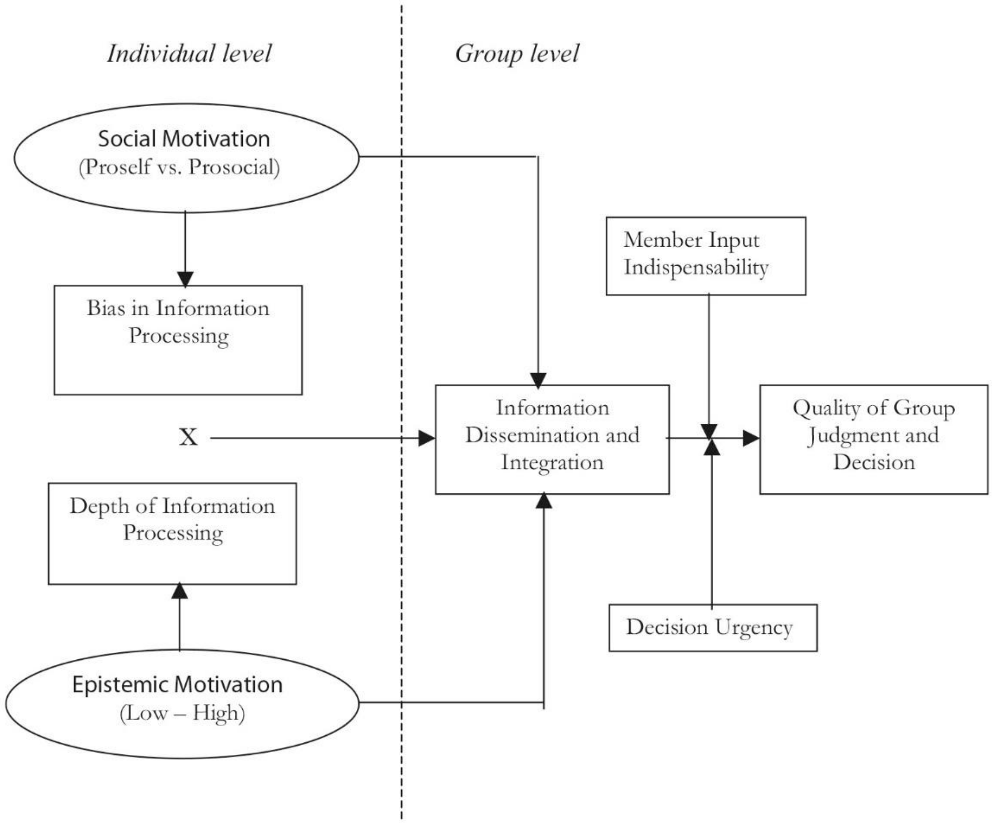

Figure 3.4: An heuristic overview of the motivation information processing model in groups (MIP-G) (de Dreu et al. 2008)[4]

The MIP-G model supports the argument that pro-social behaviour are valuable for creative performance. This, however, must be coupled with high levels of epistemic motivation, which exhibits a higher tolerance of deviance and dissent. A group of

[4] Image reproduced with permission of the rights holder, Taylor & Francis

individuals with high levels of epistemic motivation is also less likely to tolerate autocratic leaders and more likely to promote participatory interaction, thus stimulating creative ideation and information sharing (de Dreu et al. 2008).

An additional spectrum is offered by the 'competitive altruism' construct (Roberts 1998). Seemingly oxymoronic, this suggests that a person may perform an action that is at cost to themselves if it can deliver a public good, thus working against the group but not in an entirely selfish capacity. In groups, the individual cost may be taken as the risk of rebuke following dissent. In built environment design teams, public good might be described as the ethical and professional considerations or building quality at stake. However, there may be some covert benefits to the individual. Where the action is observeable by others, then the individual stands to gain kudos for their dissent or alternatively, the outcome which forms part of the 'greater good' may pay dividends indirectly back to its instigator (Hardy & Van Vugt 2006).

3.4 Risk attitudes

An implicit assumption exists in social psychology literature that an increased tolerance or propensity for risk is needed for creative thinking (Diehl & Stroebe 1987; Amabile et al. 1996; Utman 1997; Zhou & Shalley 2003; Shalley et al. 2004; Edmondson & Mogelof 2006; Gibson & Gibbs 2006; Wong et al. 2009). However, empirical studies that report a significant link are limited in number (Dewett 2006; 2007). As established in the previous literature review chapter (chapter 2), the relevance to the AEC sector of team-based risk propensity and project risk management is significant. It, therefore, warrants review within the available social psychology literature.

Much of the social psychology literature explores risk in the non-work setting, for example, in relation to socio-emotional contexts associated with age and social factors (Kühberger 1998; Best & Charness 2015). However, in a workplace context, presentation of new ideas can raise levels of collective uncertainty and perceptions of control, as their introduction may bring with it a challenge to the status quo.

Innovation itself, as the creative idea implemented and disseminated by the group, is a risky strategy as it carries an inherent risk of failure and mistakes (George 2007).

In philosophical terms, the social influence of risk and decision-making is considered at a macro scale. In the assessment of whether a risky proposal is acceptable or not, decision-making groups will prioritise the many dimensions of risk by a range of macro parameters. These parameters, collectively known as a 'risk acceptability set,' are broadly grouped as technical, economic, and socio-political (Chicken & Posner 1998). Depending on the nature of the activity, decision-makers will be influenced by these parameters to varying degrees and will add weight according to their importance – "*a process which itself carries risk of error that could invalidate the whole process*" (*ibid*., p7). The perception of costs and benefits will be considered differently by individuals within the group. Hence, the decision-making process may become driven by group dynamics, reflecting the balance of power at the time of the debate (Fischoff et al. 1981). Despite the group norms and individual perceptions, a soundness of decision-making made by the group is critical to the acceptability of its decisions to third party groups (Luhmann 1993).

Risk as a group value

If 'risk' is identified as a group value, and one which holds significant relevance to creative performance, then the broad theories of social climatic influence will apply to this value as a group held construct. Individuals' willingness to take risks will, therefore, be influenced by the response to socially extracted cues as well as by their own inherent risk nature. Groups, then, can be categorised by their propensity to promote 'riskier' novel decisions or may converge to a risk averse processing style, which tends towards elimination of alternatives and repetition of favoured solutions. Based on the convergent results of five experiments involving a series of visual cue and response tests, participants were observed to adjust their individual cognitive processing style in relation to 'risky' strategies according to social cues (Friedman & Förster 2001).

This hypothesis was confirmed in a study of employees in advertising agencies, which demonstrated that 'willingness to take risks' was indeed a strong predictor of radical – as opposed to incremental – creativity. Results from this study also demonstrated that social cues relating to risk acceptability norms were important for individuals' subsequent willingness to take risks, and not necessarily influenced by the simple presence of other 'creative' co-workers (Madjar et al. 2011).

The risky shift

In a study of the effects of group interaction on risk and caution in decision making, a significant Master's thesis study by Stoner in 1961 (Stoner 1968; Cartwright 1971; Pruitt 1971) noted that greater risk-taking occurs during social interaction than during individual evaluation and that the risk taken is collectively higher than the individual average within that group. This phenomenon, known as the 'risky shift' is represented visually in Figure 3.5. In response to Stoner's work, Wallach et al. (1962) later posited that this is due to a spreading of responsibility for risks across the group and the fact that individuals with a previous propensity for taking risks are more likely to become dominant within that group. Interestingly, Wallach also noted that group members were likely to maintain the higher level of risk-taking for two to six weeks following the interaction. This risky shift (Stoner 1968) initiated further study on the phenomenon of group convergence on risk as a value, though the simplicity of Stoner's model was challenged (Cartwright 1971).

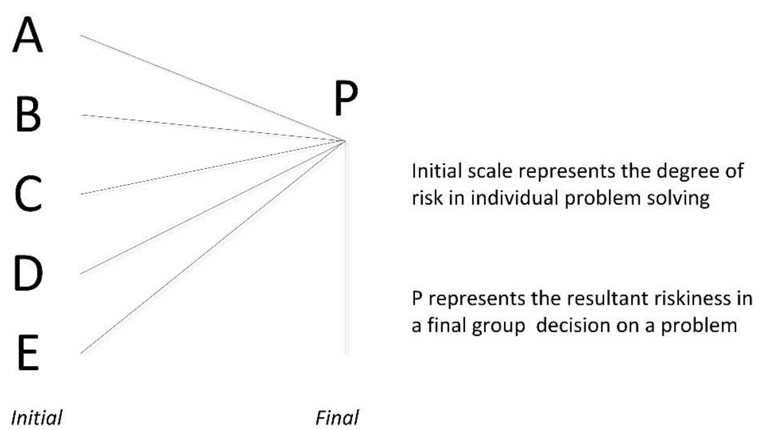

Figure 3.5: The risky shift phenomenon (adapted from Butler, 1981)

The presence of high risk-takers has also been found to 'release' individuals from their individual norms of cautious behaviour within a group setting (Pruitt 1971), which is linked to Pruitt and Teger's (1969) report of a positive correlation between group cohesiveness and the size of the risky shift. It has since been found that this cohesiveness and conformity to group norms does not always cause a propensity for collective risk-taking. However, in discussion of the prevalence of risk-takers within the group as a predictor for collective risk propensity and in the context of the male-dominated construction industry, it is important to draw attention to the possible impact of gender difference. Studies have demonstrated the increased risk propensity of males in comparison with females resulting from motivational differences, which suggest that males have a higher motivation for returns (Powell & Ansic 1997). However, a review of this study is now necessary to establish whether this result is due to twentieth-century situational stereotypical expectations. In terms of capability for decision-making under risk, studies in fact show no gender difference (Hudgens & Fatkin 1985; Johnson & Powell 1994).

The role and characteristics of group leaders are also found to be relevant in 'leader-confidence theory,' as leaders who are higher risk-takers are likely to be more persuasive as a result of their assumed confidence (Burnstein 1969). It is also confident leaders who are required to facilitate risk-taking (Butler 1981).

Cohesive groups and risk-taking

Cohesiveness has also been examined as a negative factor in creative performance, where cohesiveness is described by groups that possess strong intergroup ties. Where weak social ties occur in less cohesive teams, individuals may be more able to take advantage of the diversity of information and resources available to them. Conversely, a high level of conformity to group norms may encourage habitual and routine ideation and action, resulting in low or only incremental creative performance (Miron et al. 2004; Zhou et al. 2009).

The impact of the social climate may also be examined through a process of social comparison and subsequent tuning of risk attitude, as individuals adjust their propensity to take risks to a normative group level (Brown 1965; Bishop & Myers 1974). Individual response to the group's normative risk propensity will, then, be subject to the individual's preferences for rejection or acceptance of those norms. Individuals may be accepting of the norm or privately prefer the risk propensity of the group to be lesser or greater, though research suggests that an individual's preferred risk levels are frequently higher than those of the imagined average. The 'imagined' average is constructed by individuals from the belief that no-one thinks the way they do, a concept known as 'pluralistic-ignorance' (Levinger & Schneider 1969). So, individuals may avoid suggesting riskier ideas to avoid potential dissent or conflict between their preferences and the imagined preferences of the group. Where this occurs, not all alternatives across the risk spectrum will have been fully explored (Schwenk 1984; Miller & Nelson 2002; Westphal & Bednar 2005). The normative risk propensity of the group can also increase as discussion actively seeks the 'relevant arguments.' This theory suggests that an individual or individuals will use the group to elicit supportive arguments of higher risk strategies rather than to gain a balanced view of 'pros' and 'cons' (Nordhoy 1962; Brown 1965).

Social support for risk-taking

It is not only the information and cues received through interaction that promote confidence in risky decisions, but also the social interaction itself. In a survey of students at Stanford University, findings confirmed that social interaction enables us to increase the quality of the decisions where we had insufficient information available. On assessment of their reasons for interacting with others on important decisions, students reported the role of social interaction to increase confidence in making that decision, suggesting a supportive purpose of the social context (Heath & Gonzalez 1995). The Stanford study, which investigated a student sample, is paralleled in similar workplace studies (Chung & Ferriso 1971; McDonald & Westphal 2003; Appu & Kumar Sia 2015; Hvide & Östberg 2015). McDonald and Westphal's (2003) study, for example, confirms that executives' social interactions have a significant and supportive influence on strategic decision-making, response to poor performance, and commercial adversity.

Albrecht and Hall (1991) posited that the structure of personal relationships can influence whether individuals are likely to take a risk in introducing new ideas. In their study of school staff, they observed the existence of a central group of 'elites', with a less dominant, or even isolated, group of outsiders. Members of the 'elite' group cohered due to personal and work connections, but were considered by other members to be more innovative, based on their perceived communication skills.

Innovation was more likely to be discussed amongst this 'elite' group, with little idea transfer to outsiders. Based on their findings, the authors suggested that the 'elite' group was more able to burden the weight of the uncertainty inherent in the implementation of new ideas, due to the familiarity that they jointly shared with each other. Thus, outsiders were less likely to contribute new ideas as they lacked that familiarity and support. This echoes the social network perspective of Kameda et al. (1997), as well as ideas of psychological safety, both of which are likely to be relevant to the likelihood that individuals will contribute new ideas to the group (Edmondson & Mogelof 2006; Gibson & Gibbs 2006). This is consistent with Caldwell's (2003) study of MBA students, which found that when groups develop norms that risk-taking is both accepted and encouraged, individuals are more likely to present ideas and solutions.

Resources and risk

Contrary to Csikszentmihalyi's (2002) aforementioned assertion that resource availability can 'deaden' the motivation to be creative, when discussing risk-taking behaviour as a pre-cursor to creativity, the opposite may be true. When investigating creativity via the perspective of the risk-taking behaviour required to support radical ideas, it is suggested that, in actuality, more resources are required. Resources, in terms of a diverse array of available expertise, more time flexibility, and more material means for experimentation, in this case are considered necessary to buffer and support the pro-risk culture (Christensen 2000; Madjar et al. 2011).

3.5 Social climate

Culture and conformity

If the cliché 'thinking outside the box' describes a route to innovation by way of independent creative thought, then the social psychology literature presents to us a problem. Landmark experiments of the 1950s (Asch 1955; Deutsch & Gerard 1955; French 1956) demonstrated the effects of social pressures on judgement and decision-making. Findings showed that an individual will change their opinion when faced with a unanimous majority, even when correct. Hence, our ability to 'think outside the box' and foster independent thought and offer clear judgement is compromised by the cultural norms (Kelman 1961). This influences our future behaviour via our own senses of reward and failure. Conformity to group norms promotes feelings of self-esteem and self-approval, whilst non-conformity causes feelings of anxiety and guilt (Deutsch & Gerard 1955).

Further studies identify the effects of 'group culture' and 'group standards' that define the extent to which group members hold consensus on the values, norms, and appropriate behaviours related to their work (Levine & Moreland 1990; Postmes et al. 2001; Baron & Kerr 2003). If opportunities for innovation are omitted from these shared values or receive low priority, then a group norm will have developed in which innovation does not form part of the accepted focus or task effort. This is known as 'social tuning,' where group norms and values – which may either foster creativity/ originality or convergence/conformity – evolve from intra-group validation and reinforcement (Adarves-Yorno et al. 2007; Bechtoldt et al. 2010).

This is given further clarity by 'social comparison theory' (Festinger 1954), which suggests that individuals tend to move in the direction of a social comparison referent. Hence, whilst there is a convergence of values to a median referent, there will be an upward convergence in relation to ability (Paulus & Dzindolet 1993; Roy et al. 1996; Paulus & Dzindolet 2008). This would help to explain the differences in group norms in relation to the valuing of creativity and innovation as well as their abilities to deliver it. Social comparison is also suggested as a reason for group convergence on a relatively low standard of performance in face-to-face groups in response to the goals members set (Paulus & Dzindolet 1993; Kerr & Tindale 2004).

If the value of creative work is communicated positively by organisations and group leaders, if colleagues communicate their perception of the individual as creative, and if individuals perceive themselves to be creative employees, then creative performance is likely to be high (Farmer et al. 2003). Work-based creative performance can additionally be influenced by the non-work context. Where family and friends also perceive the individual as creative, this will also influence creative performance (Madjar et al. 2002). However, the degree to which 'norms for creativity' may be unleashed towards the generation of creative ideas is likely to be moderated by a variety of factors (Goncalo & Staw 2006).

In work groups, individuals, typically, are required to respond to multilevel climates, across industrial, organisational, disciplinary, and group-level contexts, as well as interaction with historical, societal, and individual cross-cultural factors (Hennessey & Amabile 2010). In this context, therefore, the definition of 'group' requires multilevel definition. This is investigated in an extensive study of production workers (Zohar & Luria 2005). In this study, individuals were observed to hold dual roles within both their organisational climate as well as the subunit in which they worked on a day to day level. 'Climate,' in this instance, was defined as the *"socially construed indications of desired role behavior"* (*ibid*., p616). Whilst the organisational climate was seen to predict sub-group climate, the dual climates were frequently observed to have complex and contradictory norms and values. In this context, it was observed that it was the social interaction between individuals that facilitated the sense-making and mutual understanding of these extracted cues. Via social process, individuals were able to make judgements against competing demands and generate their own distinctive sub-group climates. Whilst this study observed two levels of group climate, the authors noted that this could be generalised across a more complex cascade of units. The authors conjectured that, with increasing complexity, variability in interpretation and incompatibility of cross-level goals are likely to intensify. This would, then, lay greater emphasis on discretionary judgement within mid-level social climates (Zohar & Luria 2005).

Aspects of work group climate for innovation are summarised in West's four factor theory which identifies predictors of group innovativeness:

> *Vision:*
> *"Vision is an idea of a valued outcome which represents a higher order goal and a motivating force at work."*
>
> *Participative safety:*
>
> *"Participativeness and safety are characterized as a single psychological construct in which the contingencies are such that involvement in decision-making is motivated and reinforced while occurring in an environment which is perceived as interpersonally non-threatening."*

Task Orientation:

"A shared concern with excellence of quality of task performance in relation to shared vision or outcomes, characterized by evaluations, modifications, control systems and critical appraisals."

Support for innovation:

"…the expectation, approval and practical support of attempts to introduce new and improved ways of doing things in the work environment."

(West 1990, p311-313)

The four factor theory was applied as a self-report measure of team climate, specifically in relation to propensity for innovation, and named the Team Climate Inventory (TCI). The TCI was piloted and validated across teams from a variety of professions and organisations. The measure is considered particularly useful as it focusses upon this specific facet of group work, rather than the broad measures which are orientated towards the variety of possible effects of work group cohesiveness (Anderson & West, 1998).

The concept of social behaviour in design teams driven by the multilevel agency of its individual members is consonant with a gestalt theory of psychology. Gestalt theory emerged in Germany in the early part of the twentieth century, conceived by eminent psychologists including Köhler, Wertheimer and Koffka (Humphrey 1924; Higginson 1926; Burnes & Cooke 2013). It introduced the concept that individual internal conceptualization of a coherent reality is a result of a dual interpretation of not only external stimuli but also the dynamic and interdependent elements of the person's perceptual environment, cohered to produce behavior which cannot simply be described as the sum of its parts and, thus, must be understood as a whole (Read et al. 1997; Burnes & Cooke 2013). Kurt Lewin expressed gestaltism in social psychological terms suggesting that social behaviour was a manifestation of co-existing and interdependent forces that influence the person or group and define the space in which life takes place (Brown 1929; Lewin 1935; Read et al. 1997; Burnes & Cooke 2013). These forces, he posited, are dynamic and responsive to the subject's perception of reality grounded in the totality of the present (Lewin 1935; Lewin & Lippitt 1938), rather than being static and objective viewpoints of an observer.

Lewin's theory was summarised by a person-situation relationship represented by his formula B=*f*(PE), where B=behavior; P=person; and E=environment (Lewin 1936).

From Lewin's contemporaneous and comparative studies of early twentieth century German and American attitudes to minority groups, Lewin's work also provides a valuable resource for understanding the principles of ingroup/outgroup scenarios (Lewin 1935). Thus, the psychological environment needs to be considered as a whole before presence and interdependence of specific forces can be fully understood (Read et al. 1997; Burnes & Cooke 2013). Within the gestaltian perspective, the design process may be interpreted as analogous to associated behavioural processes of dynamic interaction (Reynolds et al. 2010), which stimulate individual and situation (or team environment) toward a collective responsive and adaptive outcome. The dynamism of person, environment and group interactionism is represented by Lewin's expanded formula where B=*f*(PE)=*f*(LSp), where LSp describes 'life space.' (Lewin 1954).

In addition to the multi-level dimensionality of team climate implied by gestalt theory, a distinct area of research in social psychology literature explores a number of perceptional facets, with one common perspective pertaining to innovation capacity (Anderson & West 1998). This research area has expanded to consider antecedent relationships and moderating factors between team climate, team performance, and task outcomes (González-Romá et al. 2009) necessarily moving beyond organisational-level research to that of work groups (Anderson & West 1998).

Hülsheger et al. (2009) examined three decades of research relating to the interactionist approach to creativity and innovation in a retrospective, quantitative meta-analysis. They reported a summary of the antecedent variables to a climate conducive to creativity and innovation, across two levels of relationship strength – (1) team process variables displaying substantial and generalisable relationships with innovation; and (2) team process variables displaying relatively small and variable relationships with innovation. Associated antecedent variables were detailed as follows:

1. *Team process variables displaying substantial and generalisable relationships with innovation*

   External and internal communication: Findings confirmed that

communication, especially outside the work team, is a crucial element in fostering innovation as newer, fresh ideas are brought to the table.
Vision: The 'idea' of the outcome where, if highly valued, visionary in nature, perceived as attainable, and team members are committed to its attainment it is likely to motivate individuals towards innovative performance.
Support for innovation: The organisational expectation, practical support, approval, public recognition, and reward for new ideas.
Task orientation: The shared concern, monitoring, and feedback in relation to the vision or outcomes of the task.
Cohesion: The commitment and desire for individuals to maintain group membership.

2. *Team process variables displaying relatively small and variable relationships with innovation*

Goal interdependence: Distinct from task interdependence, this describes the degree to which the goals or rewards for the individual team member are dependent upon those of the other team members
Job-relevant diversity: Distinct from background diversity, this describes the collective diversity of team's task-related attributes, such as function, profession, education, knowledge, and skills
Team size: The proposition that team size is positively related to innovation as more diverse viewpoints, skills, and perspectives are likely to be found.

(Hülsheger et al. 2009)

The researchers recorded the existence of a negative relationship between team longevity and innovation, but the variability of measurement methods limited the significance of these findings, although it was acknowledged that team longevity is generally understood to contribute to team cohesiveness and, thus, to innovation. It is also interesting to note, that the analysis identified that cohesive strength was not found to have a clear positive relationship with innovative performance. In fact, weak ties were found to be 'non-redundant,' requiring team members to access and consider diverse and new pieces of information and perspectives, affording some protection against group pressure and false consensus.

Unlike West's (1990) four factor theory, participative safety was found to have only a weak relationship with innovation, which the authors suggested might be the result of team member's perceiving that 'good' teamwork requires minimisation of conflict and maintenance of a positive affective tone, thus hindering autonomous thinking and leading to increased conformity (Hülsheger et al. 2009).

Group cohesiveness and psychological safety

As Hülsheger et al. (2009) reported, the degree of group cohesiveness is a climatic factor which is likely to influence members to stay in the group or to conform to its normative values in their individual decision-making or behaviour (Sherif 1936; Schacter 1951). A group norm which values innovation may, thus, influence the existence of a conducive team climate which is supportive of innovation and can enhance performance in this domain, with even small differences having significant effects (Hurley 1995; González-Romá et al. 2009). Group norms are also likely to influence the perception of what the group will deem to be 'creative' (Adarves-Yorno et al. 2007). Individuals may fear contradicting these norms, which may inhibit presentation of the full array of potentially innovative solutions (Walton 2003).

Where a more inclusive, socially cohesive group dynamic exists, a psychologically safe environment is created, which is more likely to promote creativity (Baruah & Paulus 2011). Psychological safety may be considered a crucial antecedent to creativity as the latter requires a considerable amount of risk-taking, experimentation, and frequent failure (Edmondson & Mogelof 2006; Gibson & Gibbs 2006). Thus, team members are more likely to contribute their ideas if there is a high level of trust and a shared understanding of the team environment as a safe place for risk-taking (Amabile 1988; Burnside 1990; Nystrom 1990; Edmondson 1999; Chatman & Flynn 2001).

Where such an environment is not nurtured, members may feel socially anxious and therefore, may not feel able to contribute their ideas (Camacho & Paulus 1995). This can also occur where a group norm of highly evaluative behaviour exists, causing feelings of apprehension regarding presentation of new or 'riskier' ideas (Diehl & Stroebe 1987; Wong et al. 2009). Establishing creativity and innovation as a group value, then, tells only half the story. Collective valuing of failure may additionally be seen to increase the likelihood that individuals will share new or risky, but potentially useful, ideas, thus creating a psychologically safe environment conducive to collective creativity (Wong et al. 2009).

Climate affect and creativity

The link between positive mood states and the perceived psychological safety of the group environment was explored by Wiltermuth (2009), with specific attention paid to the social hierarchy and its impact upon creative performance. Via application of an interpretative lens provided by the Interpersonal Circumplex Model (see Figure 3.6), Wiltermuth argues that a positive mood conducive to creativity can be brought about by a complementarity between individuals' preferences for dominant or submissive roles. Where such complementarity exists, individuals will share two important goals: (1) achieving a comfortable relationship, and (2) performing well on tasks. Wiltermuth further argues that complementarity can also reduce the number of perspectives within the group, accelerating the rate at which ideas converge, as well as making individuals more attuned to the non-verbal behaviour of their colleagues, with subsequent adaptive behaviour in response. Thus, social hierarchical complementarity can lead members to think along the same lines as their interactive partners. This may, however, limit the number and variety of ideas discussed by the group. This is consistent with the idea that divergent thinking, facilitated by conflict and dissent, may have positive effects in the problem identification and idea generation stages. However, as teams move into an implementation phase, conformity may be better suited to the execution of ideas, via improved co-ordination and information exchange (Forgas 2000; Kaplan et al. 2009).

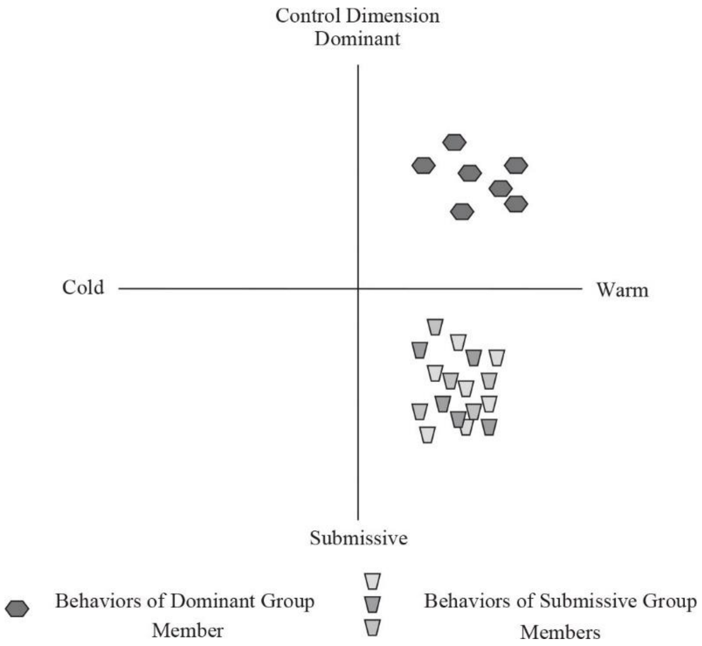

Figure 3.6: Interpersonal Circumplex Model displaying complementary behaviour of a dominant person and several submissive people within a group across orthogonal dimensions of affiliation and control (Wiltermuth 2009)[5]

In addition to a sense of psychological safety, positive mood states arising from good social cohesiveness have been observed to enhance attentiveness to other team members. This, in turn, supports increased cognitive flexibility and, hence, an increased likelihood that creative or novel solutions will be found (Paulus & Yang 2000; Paulus & Dzindolet 2008; Wong et al. 2009). The converse does not necessarily hold true. When a negative climate induces negative mood states which prompt an active response (e.g. anger, fear rather than sadness or depression), creative performance can be enhanced through sheer persistence (Nijstad et al. 2010).

Conformity to group norms may generate a convergence of judgements to a cultural norm, with development towards group ‘cohesiveness’ (Rousseau 1990). Group cohesiveness refers to the degree to which members are attracted to and motivated to stay with the group and is generally considered causally to link team efficacy and creative performance (Zaccaro et al. 1995). However, high degrees of cohesiveness may prove detrimental to creative problem solving should such convergence result in ‘groupthink.’ This social phenomenon includes symptoms such as the ignoring of alternative ideas and clouding of rational thought (Janis 1982; Postmes et al. 2001).

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[5] Original image reproduced with permission of the rights holder, Emerald Group Publishing Ltd.

Groups typically appear to drive towards consensus about half way through the allotted time for their task (Gersick 1989). Thus, to avoid 'groupthink,' an inherent creative flexibility is crucial if the consensus phase is to be reversed, once it has begun. This will, then, allow alternatives to be evaluated as realities or requirements change (Baruah & Paulus 2011).

Cohesiveness and conflict

A cohesive team can create a positive social climate. This resultant sense of comfort with others can enhance the perception that the activity is creative, whilst reducing actual creative performance (Nemeth & Ormiston 2007). Comfort with others can also arise from the presence of 'agreeable' team members. 'Agreeableness' may be defined as compliant and deferent behavious which some team members employ to avoid conflict. However, this compliance and deference is not considered helpful to the sharing and critiquing of ideas towards creative problem solving. In these instances, where facile and uncritical behaviour described as 'agreeableness' was observed in teams of students on a management course, lower levels of knowledge and skill acquisition were exhibited. Hence, it may be inferred that some level of conflict is required if the team is to avoid premature consensus. This phenomenon is typically described as 'constructive controversy' (Paulus 2000; Ellis et al. 2003; Kaplan et al. 2009; Wong et al. 2009).

The tensional relationship between consensus and conflict may then be a necessary characteristic of successful group creativity. However, in some circumstances, the very act of presenting a creative or novel idea can ignite ingroup conflict. Presented with this conflict, whole group attachments can be strengthened, making the creative source feel separate or part of an 'outgroup' due to the creative proposition being counter to group norms of creativity acceptance (Walton 2003). The effects of the emergence of the project team/creative outgroup may be exacerbated further, especially where each group develops its own cohesiveness and identity. A differential in motivation to invest effort into achieving group goals then results from the emergence of competition between subgroups (Branscombe et al. 2002). This work-based observation of individual tuning towards subgroup identities is consistent with Tajfel's argument that, even at a superficial level, where stereotypes occur - for example between professional disciplines of a multidisciplinary team - differences in goal definition and willingness to engage in the same activity may arise (Tajfel 1978; Tajfel & Turner 1979; Tajfel 1981).

This is consistent with the idea that premature consensus as a negative symptom of cohesiveness may be mitigated by 'minority dissent' (de Dreu & West 2001). Studies of these effects are observed in organisations, where the presence of minority dissent increases creativity and divergent thought, sometimes via presentation of 'counterfactuals,' defined as the consideration of imagined alternatives to past events and outcomes (Wong 2010). However, the introduction of the 'devil's advocate' may not be a sufficient condition for transferring creative thinking to a deliverable innovative products, practices and services. In the Netherlands, studies of postal worker teams observed that the latter may happen only where there are high degrees of participation in decision-making (see Figure 3.7) (de Dreu & West 2001).

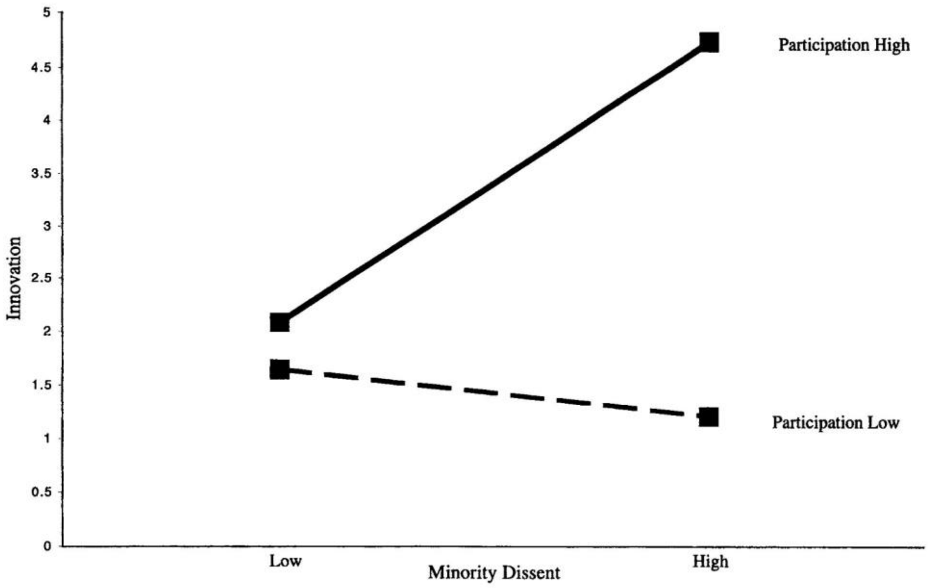


Figure 3.7: Team innovation as a function of minority dissent and participation in decision making (de Dreu & West 2001)[6]

It may be valuable to consider the influence of the minority view in parallel with a social network framework perspective. In studies by Kameda et al. (1997), cognitive centrality was measured as the degree of overlap between information held by a

[6] Image reproduced with permission of the rights holder, American Psychological Association (APA)

member with that of the others. The study revealed that groups were more likely to select the preference held by the most cognitively central member, even if that member held the minority view, correlating social power with decisions taken.

The benefits to creativity offered by 'constructive controversy' may not necessarily apply where negative climates arise as a result of perceptions of uneven workload distribution or 'social loafing.' In these cases, the cognitive information processing skills of encoding, storage, and retrieval, needed for the team to acquire the necessary knowledge and skills required to perform the task or solve the problem can be disrupted (Ellis et al. 2003). Social loafing, the reduced motivation to complete the task in comparison with other members of the group, occurs if the group task is perceived to be not very important (Williams & Karau 1991) or where members do not feel fully accountable for the number or quality of their ideas (Karau & Williams 1993). However, it may be attenuated by high levels of group cohesiveness (Karau & Williams 1997). Social processes can also disrupt cognition in members of groups that are highly motivated towards idea generation. In the "*melée of group discussion" (Kerr & Tindale 2004, p627),* "*production blocking" (op.cit.)* may occur, where individuals' abilities to start or continue a productive train of thought are thwarted (*ibid*.).

Whilst holding the potential for conflict, diversity amongst team members may offer valuable potential for creativity and innovation via the resulting exposure to an array of novel perspectives and a renewed motivation to examine, review, and expand one's own knowledge (Hülsheger et al. 2009; Baruah & Paulus 2011). A more pessimistic view was adopted by Mannix & Neale (2005) who, in relation specifically to background diversity, posited that this can create social divisions with negative performance consequences. They suggested that it is only job-relevant diversity that may promote creativity, and only when the group process is managed carefully. Careful management could be implemented by use of trained facilitators to navigate the complexity of climatic antecedents, inspiring group members to accept responsibility, develop a positive participatory climate, and manage diversity towards effective generation and processing of ideas (Baruah & Paulus 2008; Bolinger et al. 2009; Baruah & Paulus 2011).

Job-relevant diversity, such as the knowledge diversity presented, for example, by a multidisciplinary team, creates 'informational faultlines,' which may act as a moderating variable that can move the desire for creativity into an actual culture of creative performance. These 'faultlines' increase the chance of task conflict and decrease the chance of 'groupthink' within the group (Bezrukova & Uparna 2009). Considering this discussion in the context of multiculturalism theory, Bezrukova & Uparna (*ibid*.), therefore, suggested that, in groups where there is a desire for creative performance, polarisation towards creativity-centred ingroup norms is more likely to occur, resulting in the normalisation of creative action as part of group identity.

'Background diversity' may yet play a role in creative performance when discussed in terms of 'interpersonal congruence.' In a longitudinal study of work groups, creative task performance was observed to be higher when group members saw others in the group as those others saw them, both in terms of personal as well as role characteristics. In some cases, this congruence was achieved within the first 10 minutes of interaction and it had lasting impacts on outcomes four months later (Polzer et al. 2002). Furthermore, congruent relationships between co-members are expected to support performance as the resulting positive feedback behaviour enhance the individual's intrinsic motivation to be creative. However, these findings must be moderated by contextual characterstics such as individual personality or cognitive style (Shalley et al. 2004).

The effects of interpersonal congruence are also found in dyadic alliances present within the team. Dyadic alliances are common in team dynamics as members respond to an inherent need to be paired with other individuals, minimising perceived isolation. This enables individuals to feel more able discursively to interpret team held beliefs, as well as to develop new ideas via processes of trial and error, creating opportunities described as 'truth supported wins' (Ellis et al. 2003). This support may be expanded beyond the dyad to describe 'commonness' as the most attractive attribute when teams are selecting ideas from the pool generated by the group. Groups appear to select 'commonness' over novelty as it is likely that this attribute is more suited to securing consensus (Putman & Paulus 2009).

3.6 Key findings of the social psychology literature review

The review of literature from the social psychology domain has generated three key anchor themes. These are (1) motivation and reward, (2) risk attitudes, and (3) social climate. Within these anchor themes, a series of sub-themes have also been extracted. These are presented in Table 3.2, Table 3.3, and Table 3.4, with their associated literature sources.

Sub-theme	Literature source
Intrinsic motivation	Amabile, 1983; Paulus et al., 1993; Shepperd, 1993; Amabile et al., 1996; McCrae & Costa, 1997; Utman, 1997; Feist, 1999; Tierney et al., 1999; Hakstian & Scratchley, 2000; Paulus, 2000; George & Zhou, 2001; George & Zhou, 2002; Zhou & Shalley, 2003; Shalley et al., 2004
Extrinsic barriers	Klein, 1976; Amabile, 1983; Sundstrom, 1986; Oldham et al., 1995; Amabile et al., 1996; Csikszentmihalyi, 1997; Amabile et al., 2002; George and Zhou, 2002; Amabile et al., 2004; Shalley et al. 2004; Shalley & Gilson, 2004; Parker et al., 2006; Nijstad et al., 2010
Reward structures	Skinner, 1938; Blau, 1964; DeCharms, 1968; Deci, 1971; Lepper et al., 1973; Deci, 1976; Kruglanski, 1978; McGraw, 1978; Amabile et al., 1986; Vallerand and Bissonette, 1992; Amabile et al., 1994; Janssen, 2000; Brief & Weiss, 2002; George & Zhou, 2002; Judge & Piccolo, 2004; Wang et al., 2011
Motivational factors	Ryan & Connell, 1989; Vallerand & Bissonette, 1992; Nijstad et al., 2010
Co-operation and competition	Deutsch, 1949; Pruitt and Rubin, 1986; Erev et al., 1993; Roberts, 1998; De Dreu et al., 2000; Beersma et al., 2003; Beersma and De Dreu, 2005; Hardy & Van Vugt, 2006; Johnson et al., 2006; De Dreu et al. 2008; Nielsen et al., 2008; Bechtoldt et al., 2010; Kruglanski, 2012

Table 3.2: Literature framework of 'motivation and reward' sub-themes, which have potential relevance to the AEC sector

Sub-theme	Literature Source
Collective risk tolerance	Brown, 1965; Bishop & Myers, 1974; Fischoff et al., 1981; Luhmann, 1993; Chicken & Posner, 1998; Kühberger, 1998; Christensen, 2000; Förster, 2001; Csikszentmihalyi, 2002; Caldwell, 2003; Miron et al., 2004; George, 2007; Zhou et al., 2009; Madjar, 2011; Madjar et al., 2011; Best & Charness, 2015
Collective risk responsibility	Fischoff et al., 1981; Luhmann, 1993; Heath and Gonzalez, 1995; Chicken & Posner, 1998
Risky shift	Wallach et al., 1962; Stoner, 1968; Pruitt and Teger, 1969; Cartwright, 1971; Pruitt, 1971; Butler, 1981; Hudgens & Fatkin, 1985; Johnson & Powell, 1994; Powell & Ansic, 1997
Pluralistic-ignorance	Levinger and Schneider, 1969; Chung & Ferriso, 1971; Schwenk, 1984; Miller & Nelson, 2002; Westphal & Bednar, 2005
Relevant arguments	Nordhøy, 1962; Brown, 1965; Albrecht and Hall, 1991 ; Heath & Gonzalez, 1995; Appu & Kumar Sia, 2015; Hvide & Östberg, 2015; McDonald & Westphal, 2003
Leader confidence	Burnstein, 1969; Pruitt and Teger, 1969; Butler, 1981; Heath and Gonzalez, 1995

Table 3.3: Literature framework of 'risk attitudes'' sub-themes, which have potential relevance to the AEC sector

Sub-theme	Literature source
Group cohesiveness (task)	Williams & Karau, 1991; Karau & Williams, 1993; Zaccaro et al., 1995; Paulus & Yang, 2000; Kerr & Tindale, 2004; Paulus & Dzindolet, 2008; Putman & Paulus, 2009; Wong et al., 2009
Group cohesiveness (social)	Kameda et al., 1997; Paulus & Yang, 2000; Polzer et al., 2002; Elllis et al., 2003; Paulus and Dzindolet, 2008; Wong et al., 2009; Baruah & Paulus, 2011
Group cohesiveness (attraction to group)	Sherif, 1936; Schacter, 1951; Zaccaro et al., 1995; Paulus & Yang, 2000; Paulus & Dzindolet, 2008; Wong et al., 2009
Effects of cohesiveness	Sherif, 1936; Schacter, 1951; Rousseau, 1990; Karau & Williams, 1997; Forgas, 2000; Hülsheger et al., 2009; Kaplan et al., 2009
Effects of groupthink	Janis, 1982; Gersick, 1989; Postmes et al., 2001; Bezrukova & Uparna, 2009; Baruah & Paulus, 2015
Psychological safety	Diehl & Stroebe, 1987; Amabile, 1988; Burnside, 1990; Nystrom, 1990; Camacho & Paulus, 1995; Edmondson, 1999; Chatman & Flynn, 2001; Edmondson & Mogelof, 2006; Gibson & Gibbs, 2006; Wiltermuth, 2009; Wong, 2009; Baruah & Paulus, 2011
Effects of conflict	Tajfel, 1978; Tajfel & Turner, 1979; Tajfel, 1981; Paulus, 2000; De Dreu & West, 2001; Ellis et al., 2003; Mannix & Neale, 2005; Branscombe et al., 2002; Walton, 2003; Bezrukova & Uparna, 2009; Hülsheger et al., 2009; Kaplan et al, 2009; Wong et al., 2009; Wong, 2010; Baruah & Paulus, 2011
Effects of team climate	West, 1990; Anderson & West, 1998; Paulus, 2000; Ellis et al., 2003; Zohar & Luria, 2005; Nemeth & Ormiston, 2007; Baruah & Paulus, 2008; Bolinger et al., 2009; González-Romá et al., 2009; Hülsheger et al., 2009; Kaplan et al., 2009; Wiltermuth, 2009; Wong et al., 2009; Nijstad et al., 2010; Baruah & Paulus, 2011
Innovation as a team value	Farmer et al., 2003; Walton, 2003; Goncalo & Staw, 2006; Adarves-Yorno et al., 2007; Hülsheger et al., 2009; Wong et al, 2009; Bechtoldt et al., 2010b
Influence of cultural norms	Lewin, 1935; Lewin, 1936; Sherif, 1936; Lewin, 1954; Asch, 1955; Deutsch and Gerard, 1955; French, 1956; Kelman, 1961; Levine & Moreland, 1990; Hurley, 1995; Read et al., 1997; Forgas, 2000; Postmes et al., 2001; Baron & Kerr, 2003; Walton, 2003; Zohar & Luria, 2005; Goncalo & Staw, 2006; Adarves-Yorno et al., 2007; González-Romá et al., 2009; Kaplan et al., 2009; Hennessey & Amabile, 2010; Reynolds et al., 2010; Burnes and Cooke, 2013
Social tuning	Read et al., 1997; Branscombe et al. 2002; Adarves-Yorno et al., 2007; Bechtoldt et al., 2010
Social comparison theory	Lewin, 1935; Festinger, 1954; Paulus and Dzindolet, 1993; Roy et al., 1996; Madjar et al., 2002; Farmer et al., 2003; Kerr & Tindale, 2004; Paulus & Dzindolet, 2008

Table 3.4: Literature framework of 'social climate' sub-themes, which have potential relevance to the AEC sector

Some themes emerging from this literature review are noticeably absent from the literature framework developed at the end of the last chapter, which reviewed existent literature in the AEC domain. In particular, the negative effects of cohesiveness widely explored in the social psychology literature domain must be reviewed against the weight of AEC industry guidance which emphasises the need for strong ties, without consideration of the variable situational factors which influence their conduciveness to innovation. Additionally, the review of the AEC domain literature has not fully explored intrinsic motivation, a concept that is crucial to engagement with creative activity beyond the discussion of contracted-for economic reward.

Further research is required to establish whether these concepts are indeed relevant to the AEC domain or whether they apply only in non-work settings, or in work settings which are unlike construction practice. Exploratory research is also required to establish which of these constructs are relevant to, or embedded within, the emerging concepts identified in the AEC literature review.

3.7 Summary

The review of social psychology literature presented in this chapter responds to one of the primary objectives of the research. This objective directed the investigation of the social psychology field to establish whether key concepts exist, which can be supplanted wtihin the AEC sector, to deepen and expand our understanding of collective creativity and design teams in practice.

Further research has been conducted to establish whether these concepts are applicable to the AEC domain. The investigation of their applicability is performed according to a research design, which intends to fulfil the aims and objectives of the research, as well as to support generation of a domain-specific framework that can inform and direct future practice, pedagogy and research. This thesis presents the findings of these investigations of applicability, with a resulting domain-specific framework as a defined outcome and contribution to knowledge. The investigations and framework have been conducted and produced by following the research design presented in the next chapter.

4. RESEARCH DESIGN

4.1 Introduction

The review of the social psychology literature highlighted a number of theoretical and observable constructs that may bear relevance to the management and practice of collaborative project teams, with a view to enhancing their creative performance and potential for innovative outcomes. The reviews highlighted that further research is necessary to investigate whether these constructs hold validity within the AEC domain. This thesis fills this gap in the field, with the current chapter providing the associated methodology.

The research design, presented in this chapter, has been prepared to support the research aims and objectives outlined in chapter 1. The research design also responds to the call for a philosophical paradigm shift in AEC research, which will support the generation of new perspectives and knowledge to counter-balance the techno-operational dominance in research and practice. A resulting research strategy is presented, which underpins data collection and analysis, and framework production.

4.2 Philosophical position of the research

Having delimited the domain and framed the subject of study, a series of philosophical assumptions have been established and are used to direct the research design, which includes the studies presented in this thesis.

The exploratory nature of the socio-behavioural aspects of construction practice directs the PhD research towards an interpretative study. An interpretivist perspective is also consistent with the research aim that seeks not to explain human behaviour, but to understand it (Bryman & Bell 2003).

The interpretivist perspective also supports development of a framework which aims to direct industry and professional practice development, as well as the academic research that supports it. Construction, however, as an industrial concept, is expected to and ought to change over time to adapt to market needs, economic and political climates, employee demographics, and sociological contexts. For example, individual mood relating to personal social contexts or an unpredictable political event may cloud or direct professional judgement, design move, or decision in a particular moment. This dynamic and responsive nature of the industry suggests that no order can hold over time, and, further, that this order may vary depending on the specific project, meeting, situation, or wider social environment, or politico-philosophical context. Furthermore, the research accepts that the social constructs may be observed or interpreted in ways that may be different to those which may be observed and analysed at the empirical level (Danermark et al. 2002). The research inquiry, therefore, presumes that the research domain and subject exist in an open system, where the whole cannot reasonably be observed, and where alternative realities and futures cannot be predicted with real certainty.

This predicates the research design towards an epistemological position of critical realism, thus recognising the conditional nature of the results (Bhaskar 1998; Cruickshank 2003). The critical realist position allows – and encourages - the framework to be dialectically reviewed and developed by industry and research, as these futures materialise and new realities are revealed.

4.3 Research strategy

The review of AEC literature raised concern about the sufficiency of domain specific knowledge in relation to the influence of social behaviour on creativity and innovation in the built environment design team. In examining the literature in the social psychology domain, additional theoretical constructs emerged as holding potential relevance for supplantation and re-contextualisation within AEC. In light of these potential additions to AEC knowledge, the primary objectives for the current PhD research seek to investigate the validity of the constructs towards collation of a domain-specific framework. This domain-specific framework will, then. highlight key factors in relation to collaborative creative performance and innovation outcomes, which warrant further research and practical consideration.

With these primary objectives and the epistemological position in mind, the thesis has been divided into a concatenated series of study stages through which the framework themes, content, and relationships have been generated. These are summarised in the remainder of this section and diagrammatically in Figure 4.1.

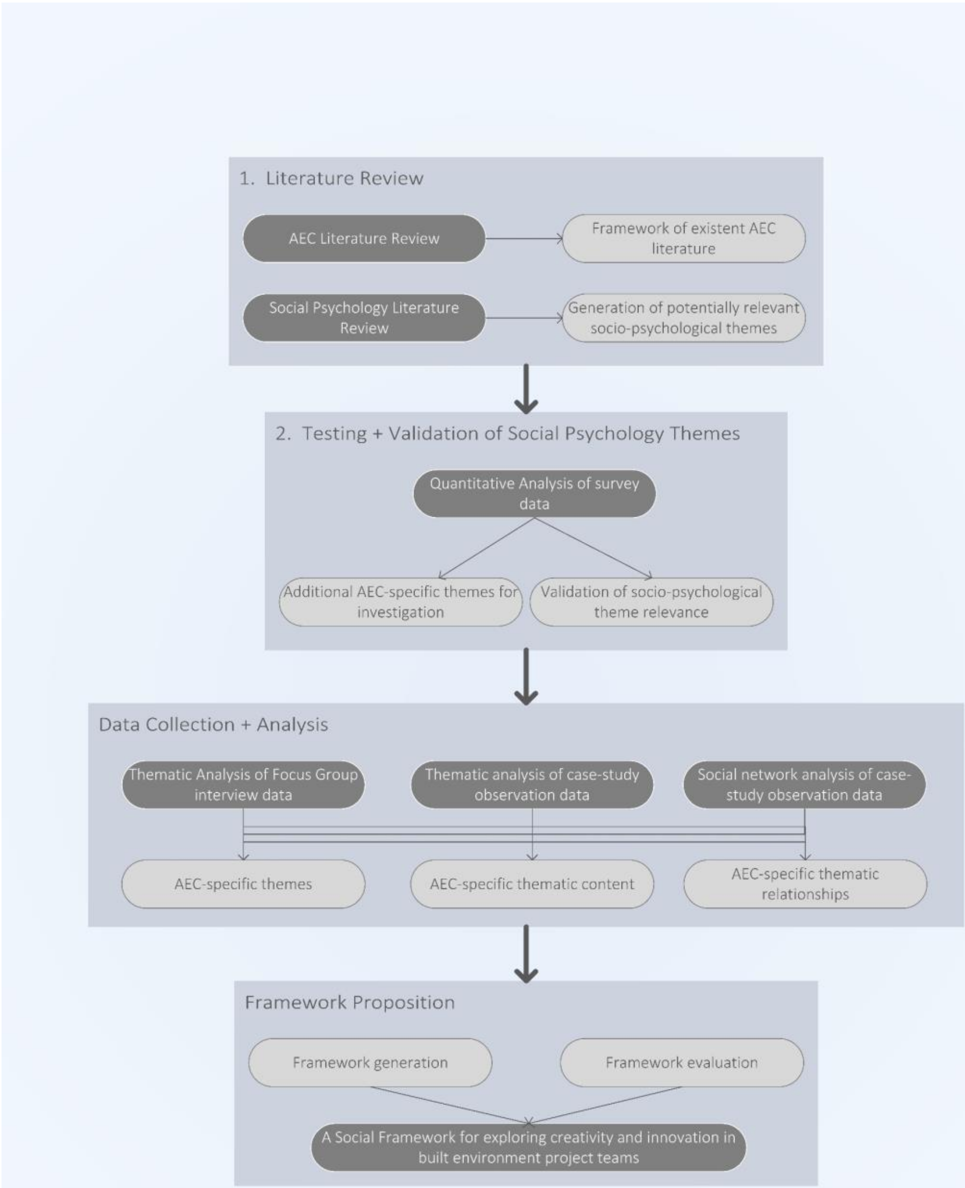


Figure 4.1: Research design summary

These stages also reflect the exploratory nature of the research, which does not seek to verify specific theories or produce generalisable behavioural models for future direct application. The research intention, instead, is to achieve a holistic or systemic picture, gain perception based on actors' understanding, explore multiple interpretations, and to distil from this an ordered framework of knowledge parameters, fulfilling key criteria of exploratory research (Miles et al. 2014).

The four research stages are briefly described below, with more details of each methodology presented at the beginning of the respective chapters.

Stage 1: Survey study

This research stage sought to fulfil the following research objectives:

- Investigate whether the social psychology themes identified as holding potential significance for design team creative performance in the AEC sector were perceived or experienced in professional practice.
- Investigate whether there were any domain specific factors that mediated or appended the social psychology themes identified as holding potential significance for design team creative performance in the AEC sector.

This stage was intended as a broad litmus test of the relevance of the social psychology theoretical constructs in a cross-section of the defined domain of AEC practice. In this passive investigative capacity, the social psychology themes translate as hypotheses, from which a positive or negative relevance could be deduced from analysis of broad industry response. Thus, a positivist and quantitative analysis of respondent data was employed, which would be used to inform the scope, method and direction of the subsequent qualitative research. In light of this approach, a survey method was selected as the most appropriate to confirm or falsify direct experience of the thematic variables across the distributed, exploratory sample.

Stage 2: Focus group study

This research stage sought to fulfil the following research objectives:

- To explore how the socio-behavioural constructs emerging from the literature review and survey manifest themselves in AEC practice.

- To elicit key socio-behavioural themes that influence creativity and innovation in AEC teams.

- To examine the relationships between the socio-behavioural themes that influence creativity and innovation in AEC teams.

Following the quantitative survey analysis, the affirmation, rejection, or adaptation of the thematic constructs were investigated in further depth. This in-depth exploration was necessary to facilitate further inference and sense-making that was not able to be drawn within the constraints of the survey questions. Thus, an interpretivist, qualitative methodology was implemented in the form of focus group study with thematic analysis. The focus group methodology was considered appropriate, not least, as the focus group responses could be maintained within the themes already identified in the literature reviews, but it could also enable participants to raise perspectives and themes that were of particular significance for them. Three focus group interviews, with a total of 74 participants were performed. These were carried out in three separate organisations, which employed practitioners who were directly and contemporaneously engaged in collaborative built environment teams.

Stage 3: Observational study

Although the focus group methodology was supportive of the interpretivist approach to the research, it was expected that the group dynamics within the focus group itself, as well as individual cognition relating to the subject, may have influenced the topics and emphasis in discussion. For example, some individuals may prefer to represent themselves more favourably than their actual performance may warrant. Research stage 3, therefore, maintained the research objectives fulfilled in Stage 2, but sought to explore alternative perceptions of reality.

The focus group (self-reported) data were, therefore, supplemented with data collected via direct observation of a design team in practice. The design team was brought together with the specific purpose of creative thinking and innovation in relation to project process (BIM Level 2 implementation). Observation comprised, not only of a series of face-to-face design team meetings, but also of their interactions via conference calls and use of an online communication site. These environments determined the naturalistic setting for observation. This provided data which, following further thematic analysis, would be additive and complementary to the focus group findings, as well as offering a deepening of insights via comparative analysis of interactions across varying media.

The dataset produced by the observations of the live design team in practice was further analysed using a quantitative method. This method sought to examine the frequencies and patterns of interaction, so that the framework could provide a richer picture of design team interaction. For this purpose, a social network analysis method was used, which applied the principles of graph theory (Doreian 1974; Wasserman 1977) to quantify and visualise directed relationships and communities within the group. Resultant findings from the social network analysis provided an additional perspective from which to view and understand the parallel, qualitative findings.

Stage 4: Generation of the framework

This stage sought to fulfil the following research objectives:

- To arrange the key emergent socio-behavioural themes within a multi-level context reflecting the industry dimensions that influence creative performance and innovation.
- To propose a structural framework based upon the above research which captures, arranges and communicates the key factors and their broad relationships that influence the creative performance and propensity for innovation in built environment design teams

In fulfilling these objectives, a further review of the results of each stage was carried out in the context of a retroductive review of the social psychology and AEC literature. This was achieved by a further thematic review, which sought to rationalise and re-contextualise the emergent themes within an AEC domain-specific context as well as to distil themes and relationships across the multilevel agencies that were recorded. From this, the framework was compiled and generated.

A detailed and programmatic methodology for each research stage is presented in the associated chapter. The survey methodology (stage 1) is discussed in chapter 5. The methodologies for conducting focus groups and case-study observations, with subsequent qualitative data analysis, are discussed in chapters 6 and 7, respectively. Methodology for the quantitative analysis (social network analysis) of the case-study observation is presented in chapter 8.

4.4 Ethical considerations

The research was carried out with due consideration for ethical procedures. Ethical procedures followed the deontological principles of the University of Central Lancashire's ethical policy and guidelines. Ethical issues specific to this study related mainly to corporate and individual privacy issues and necessitated a code of conduct relating to the recording, storage, and dissemination of individual, organisational, and project details. As a result, no individual, project, organisational, or commercial identifiers have been recorded in the thesis. Names have been substituted by codes. Information is embedded within these codes, but only that which is relevant to this specific study, namely professional discipline and project role. Project details are discussed generically and no sensitive project information, such as budgetary data or location has been recorded. Raw data, such as video material and telephone call transcripts have been stored in a password-protected file on the University of Central Lancashire server to prevent unauthorised access. Participants were informed about the nature, scope, and purpose of the research in advance of data collection. All participants were requested to sign consent prior to commencement of data collection and were able to withdraw from the research at any time. They were also provided with contact details of both the researcher and supervisory team, in case any issues should arise.

4.5 Summary

The research design has been prepared to respond to the direct aims of the research via application of a complementary, mixed methods methodological approach. This approach is employed from an epistemological position of critical realism. This position acknowledges the built environment construction team as an entity, which operates within an open system, with experiences subject to multiple interpretations of contemporaneous and future realities. Thus, the framework emerges as a conceptual and dynamic model for use in future research and practice.

In support of the epistemological position and associated methodological approach, the research implemented data collection via survey, focus group interviews, and case-study observation. The survey is subject to quantitative analysis, whilst the content of focus-group interviews is analysed using a qualitative method. The case-study observation datasets are analysed using both quantitative and qualitative methods.

The survey findings were used to inform the scope and method of the subsequent focus group interviews and case-study observations. Hence, they are presented first, in the next chapter.

5. TESTING THE SOCIAL PSYCHOLOGY THEMES IN THE BUILT ENVIRONMENT

5.1 Introduction

This section of the study responded to the following research objectives:

- To investigate whether the social psychology themes identified as holding potential significance for design team creative performance in the AEC sector were perceived or experienced in professional practice; and
- To investigate whether there were any domain specific factors that mediated or appended the social psychology themes identified as holding potential significance for design team creative performance in the AEC sector.

This part of the research required a broad approach to establish whether the social psychology themes identified in the literature review bore relevance to the experience and practice of industry practitioners. The methodological objective of this part of the study was, therefore, to provide an initial validation and qualification of the emergent social psychology themes, prior to engaging in more detailed qualitative research that would direct production of the framework. For this purpose, access was required to a broad cross-section of industry practitioners actively working on a variety of project contexts. Furthermore, the current study was designed to obtain positive or negative affirmation of the social psychology themes identified in the literature review, as well as identify any further domain specific factors. Resulting data would need to be in a format that could be used to support order in the developing conceptual framework, and offer further clarification and direction for the complementary qualitative research stages.

In light of Rosenberg's (1968) framework of properties, dispositions, and actions for social research, these requirements suggested that a survey methodology with subsequent quantitative analysis would be most appropriate (Punch 2003). A survey method of data collection was also likely to facilitate binary or scalar confirmation or falsification of the thematic variables within the exploratory sample.

5.2 Methodology

Survey design

An online questionnaire was designed and created using Bristol Online Surveys (www.survey.bris.ac.uk) as a way to collect data from practitioners across the UK. Each sub-theme identified in the social psychology literature review was given a unique code (see Table 5.1, Table 5.2, and Table 5.3) and translated into a relatable experience which could provide a measurable response. The full question set with associated thematic codes is included in Appendix 1. Questions were designed with the primary objective of recording whether a particular sub-theme or its associated effects were positively occurring within the sector, rather than of extracting a value judgement upon those behaviour in terms of project performance. Questions were also designed to support the broad brush sweep of the characteristics of, and relationships between, these sub-themes within the AEC sector.

Code	Motivation + Reward Sub-Themes
M1	Intrinsic motivation
M2	Extrinsic barriers
M3	Reward structures
M4	Motivational factors
M5	Co-operation and competition

Table 5.1: Sub-themes and associated question coding for the category of 'motivation and reward'

Code	Risk Attitudes Sub-Themes
R1	Collective risk tolerance
R2	Shared risk responsibility
R3	Risky shift
R4	Pluralistic-ignorance
R5	Relevant arguments
R6	Leader confidence

Table 5.2: Sub-themes and associated question coding for the category of 'risk attitudes'

Code	Social Climate Sub-Themes
C1	Group cohesiveness (task)
C2	Group cohesiveness (social)
C3	Group cohesiveness (attraction to group)
C4	Effects of cohesiveness
C5	Effects of groupthink
C6	Psychological safety
C7	Effects of conflict
C8	Effects of team climate
C9	Innovation as a team value
C10	Influence of cultural norms
C11	Social tuning
C12	Social comparison theory

Table 5.3: Sub-themes and associated question coding for the category of 'social climate'

Each sub-theme was translated into a question twice, so that there would be two responses, which could be used to corroborate response validity. Some sub-themes required additional questions, so that the perception or existence of that factor could be sufficiently accounted for. For example, the existence and nature of reward (sub-theme M3) was tested for using the following questions:

Q8: How does the client remunerate your professional services? (Choice response).
Q9: Apart from monetary payment, which factor 'most' influenced you or your company to work on this project? (Choice response).
Q25g: My fellow team members recognise and appreciate my efforts on this project (Likert response).

These questions allowed for the presence of the 'reward' constructed to be tested for its presence as well as its nature. In response to the findings of the associated extant literature (Blau 1964; George & Zhou 2002), the nature of the reward can be identified as either economic or social or both and so the additional question (25g) was included. Some questions held membership of more than one sub-thematic set as their responses were likely to be applicable to two closely related sub-themes. For example, question (8), which asked respondents about categories of reward from working on the project was applicable to both (M3) Reward structures as well as (M4) Motivational factors.

The first section of the survey requested basic demographic information about the respondent, their organisational affiliation, and basic details about the main construction project upon which they were working. The second section asked a series of questions about their experiences of working in that design team. These questions were predominantly based on a 5-point Likert scale, requiring the respondent to score their agreement or disagreement with a given statement. However, resultant data were recoded during analysis to remove the response (*3*) representing '*don't know'* so that statistical analysis of polar positive/negative perception could be performed, where (1) represented '*strongly agree'* and (4) represented '*strongly disagree.*' Whilst the inclusion of the central Likert scale point was not required for data analysis, it did acknowledge the potential for distortion of data towards the positive pole, which some have found can arise if no central point is provided (Guy & Norvell 1977). It is posited that this distortion occurs when, in the absence of a neutral response choice, the respondent's inherent or circumstantial acquiescent response style (Podsakoff et al. 2003) influences them to select a positive answer (Ray 1983; Garland 1991; Krosnick & Presser 2010; Zhang & Savalei 2016).

Sampling strategy

The sample population was determined as all professional practitioners who played a role in the design process in built environment projects, according to the scope of the domain established in Section 1.3 of the thesis. As section 1.3 explains, the boundaries of this domain are indistinct. Its scale is also vast, with 40,000 members belonging to the Royal Institution of British Architects alone (RIBA 2016), though not all of these are expected to be actively practising. The scale of this domain, together with the exploratory nature of the research, therefore, deterred use of a representative sample.

Instead, a snowball approach was utilised, as a way to engage respondents and to derive the most useful data. Snowball sampling, as a form of respondent-driven sampling, is a technique commonly applied where the social group is not easily accessible or not easily defined (Salganik & Heckathorn 2004). In this study, sample accessibility was not straightforward, due to sensitivities relating to commercial privacy. The social group was also not easily defined, as professional networks were not always formally determined.

To commence the snowball method, an initial sample set was determined using a limited, purposive sample group, framed by established interest in interdisciplinary design. This was accessed via the UK-based alumni and contacts of the IDBE (Interdisciplinary Design for the Built Environment) course at the University of Cambridge. Although this initial sample set may be considered to present a degree of response bias towards participants with a pre-existing awareness and acceptance of links between social behaviour and design outcomes (although this is not necessarily the case), the exploratory nature of the research did not warrant a full random probability sample across the AEC industry. In fact, this may have resulted in a lower response rate due to a generalised attachment of low priority to studies of this subject. By focussing on a pre-existing network of interested practitioners, which encourages support to its members (including the researcher, thus also being a sample of convenience), a good response rate and a more informed response were anticipated.

Following completion of the questionnaire, respondents were invited to nominate colleagues within their own project teams and professional networks as additional survey respondents. They were asked to forward the original email or use the weblink provided in-survey. This approach was intended for the purpose of identifying professional clusters via the unique questionnaire code, which would 'travel' with the forwarded questionnaire and be returned with responses. This snowball sampling technique might have offered a greater depth of insight into the research topic, than if a simple, representative, cross-section of the sample population had been sought (Heckathorn 1997; Noy 2008; Goodman 2011).

However, the snowball approach did not yield a sufficient sample of second tier respondents to fulfil the requirements of this aspect of the analysis. So, a further cumulative sampling stage was included by expanding the sample source to the professional institutions associated with the research domain. Members of sector-specific professional institutions are involved in the design of buildings by definition. Similarly, unless a practitioner is a member of the relevant professional institution, they are not deemed competent to design buildings. In this case, the snowball strategy would recommence by deriving a randomised sample from the member lists of those professional insititutions. This sample set was drawn from the publicly available member lists of the professional institutions that are identified as typical members of the project team by the professional regulatory body, the Architects' Registration Board (ARB):

- Royal Institute of British Architects (RIBA)
- Institute of Structural Engineers (IStructE)

- Chartered Institution of Building Services Engineers (CIBSE)
- Chartered Institute of Architectural Technologists (CIAT)
- Royal Institute of Chartered Surveyors (RICS)
- The Landscape Institute (LI)

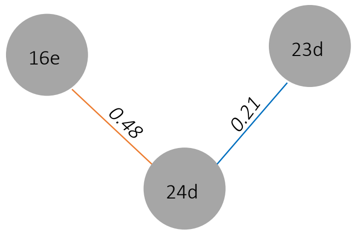
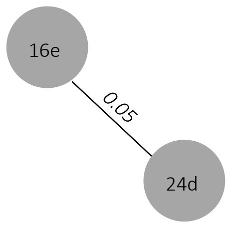
Despite the limited success of the snowball technique, the resulting sample yielded a total of 44 respondents.

Data analysis

Respondent data were subjected to quantitative analysis within the socio-psychological thematic areas. Responses relating to each sub-theme were tested for their internal validity within the question combinations using a Pearson's Correlation to estimate the strength of the relationship and whether the correlation was statistically significant. Questions written as negative statements, in contrast to associated positive statements, were reverse coded prior to analysis. R-values were then categorised according to Cohen's (1992) scale of magnitude of effect sizes, where small correlations were r=>0.10; medium correlations were >0.30; and large correlations were >0.50 (Cohen 1992).

Where correlations between question responses fell in the 'small' category, these questions were discounted. For example, as demonstrated in Table 5.4, for the questions set relating to R1 - collective risk tolerance, question 23d showed only a small correlation (shown in blue) and therefore, resulting responses were excluded from the descriptive statistical analysis.

Where responses demonstrated internal validity, response data from these questions were combined. External validity was then determined by calculating numerical p-values according to their significance at the p=0.05 level (2-tailed). From this dataset, descriptive statistics were generated to confirm whether or not the sub-theme was in fact perceived or experienced in practice. Where there was no significant correlation between questions in a question set, associated responses were analysed for each individual question within the question set.

Internal validity of question set via Pearson's (r) correlation of question responses	Significance of question responses via Pearson's (p) correlation *Only statistically significant relationships are shown*	Descriptive statistics
		n=40 Mean Statistic = 2.29 Standard Deviation=0.49

Blue = low relationship strength (r=>0.10)
Orange = medium relationship strength (r=>0.30)

Table 5.4: Internal validity and significance of responses for (R1) - collective risk tolerance

Particular attention was paid to the range, mean, and standard deviation of responses, with values relating to the Likert scale of responses where '1' indicated 'strongly agree,' '2' indicated 'agree,' '3' indicated 'disagree,' and '4' indicated 'strongly disagree.'

From these descriptive statistics, a mean positive response (*<2.50*) to the presence of a particular sub-theme was taken to indicate a convergence between the subtheme and the practitioner experience. A mean negative response (*>2.50*) was taken as the converse. However, only a lack of respondent awareness can be deduced from this, rather than an absolute lack of industry relevance. For example, a positive response to question 16d, which requested a 5-point Likert response to "*I sometimes meet with team members outside work hours*" would be indicative of social relationships existing within that project team; a negative response to this question could suggest that this aspect of behaviour is absent due to interpersonal issues within the team, that social connectivity is a conscious irrelevance established by that group, or simply that the respondent is not aware of any group social activity. It would not be possible to deduce which would be the most appropriate explanation from the survey responses. Hence, only positive construct relevance could be used to indicate the applicability of that construct to the AEC domain. Negative construct relevance would not necessarily indicate absence of that construct from the AEC domain. Descriptive statistics were also examined for possible inferences, which might support and complement the domain-specific understanding of each construct within that sub-theme, and offer further clarification and direction for the complementary, qualitative research stages.

Results of the statistical analysis are presented within the sub-themes associated with the social psychology themes of motivation and reward, risk attitudes, and social climate, as established in the systematic literature review. Statistical descriptions and observations are drawn within each sub-theme. The results of the statistical analysis are tabulated in full in Appendix 2.

5.3 Survey results: Motivation and reward

The results of the data analysis within the 'motivation and reward' thematic category are presented below. Correlative size and significance between question responses within motivation and reward sub-themes are presented in the matrix in Table 5.5. Resultant positive or negative mean affirmation of each subtheme is then presented, with an associated summary of descriptive statistics in Table 5.6.

M1: Intrinsic motivation

There was no significant correlation between the responses within the question set relating to intrinsic motivational factors (*$r=0.11$ and 0.14*). These factors tested for the presence of social reward, the reward of knowledge, and peer recognition. It was assumed that these factors were too conceptually distant to support a linear relationship. However, they warranted descriptive analysis in their own right.

Respondents appeared split in their intrinsic motivation via social relationships within the design team, as the mean response to questions relating to this sub-theme approximated the central point along the four point response scale (*M=2.59; SD= 0.91*). However, according to the mean distribution of responses (where <2.5 represents positive affirmation and >2.5 represents a negative affirmation), more respondents were in agreement that intrinsic motivation via learning could be derived from the group *(M=1.93; SD=0.47),* and peer recognition *(M=1.90; SD=0.30).*

M2: Extrinsic barriers

There was a significant correlation between the two questions associated with this sub-theme, with the mean response which indicated that conflict or stress was not an element of design team meetings (*Mean=3.14; n=38*).

Associated sub-theme	Q	15b	15d	16d	17d	23c	24b	25a	25b	25d	25g	Mean	Thematic Mean *(sig. correlations only)*
M1: Intrinsic motivation	16d				0.11						0.07	2.59	*No significant correlations*
	17d			0.11							0.14	1.93	
	25g			0.07	0.14							1.90	
M2: Extrinsic barriers	25b									0.57*		3.00	3.14
	25d								0.57*			3.29	
M3: Reward structures	*Correlation not calculated as each response represents distinct and separate factor*												
M4: Motivational factors	*Correlation not calculated as each response represents distinct and separate factor*												
M5: Co-operation and competition	15b		-0.28			-0.29	0.10	-0.10				2.85	2.59
	15d	-0.28				0.60*	0.24	0.33				2.50	
	23c	-0.29	0.60*				-0.04	0.36*				2.70	
	24b	0.10	0.24			-0.04		0.23				3.19	
	25a	-0.10	0.33			0.36*	0.23					2.56	

*Values denote Pearson's (r) correlation, with *significance where p<0.05 (2 tailed). Values highlighted according to Cohen's (1988) scale of magnitude of effect size:*

small: >0.10 medium: >0.30 large: >0.50

Table 5.5: Correlation matrix of sub-theme question responses relating to 'motivation and reward'

M3: Reward structures

Most respondents were remunerated for their work via their own separate fee agreement with the client, whilst only 4.9% were remunerated as a team. When looking solely at the procurement of individual team members, this would suggest a practitioner predisposition to pro-self engagement with the project. However, there are also other rewarding factors at play, beyond financial reward. The highest form of reward, other than formal remuneration, was identified amongst respondents as the chance to work on a high-profile project *(24%, n=10),* with the remainder ranked as follows:

- the chance to develop skills *(17%, n=7)*
- solely income opportunity *(17%, n=7)*
- other *(17%, n=7),* with other reasons defined as servicing an existing client, being the client and thus initiating the project, and personal career development
- develop organisational experience *(15%, n=6)*
- the opportunity to expand client network *(10%, n=4)*

M4: Motivational factors

In analysis of the responses for this question set, it was interesting to note that mean responses positively and negatively affirmed the propensity for practitioner motivation by the social environment *(M=2.59; SD=0.91).* A similar distribution was observed in relation to motivation elevation by the opportunity to be inspired by a colleague *(M=2.60; SD=0.60),* although there was a small tendency toward the negative in this case.

M5: Co-operation and competition

Three of the questions within this category demonstrated a significant correlation. Analysis of responses to the individual questions suggested that respondents had a tendency against the idea that the design needed to reflect their own personal ethos and approach (*M=2.85; SD=0.69*), although there was a strong predominance towards procurement relationships between individual organisations, rather than as a team entity. There was also a strong tendency to believe that consensus is not necessary for decision-making (*M=3.19; SD=0.47*).

Positively affirmed sub-themes *Negatively affirmed sub-themes*

Code *[individual queston]*	**Sub-Theme**	**Number of responses** *(n)*	**Mean** *(values relate to 4 point Likert scale where 1=Strongly Agree; 2=Agree; 3=Disagree; 4=Strongly Disagree)*	**Standard deviation**
M1*[Q16d]*	Intrinsic motivation *(social motivation)*	39	2.59	0.91
M1*[Q17d]*	Intrinsic motivation *(learning from colleagues)*	41	1.93	0.47
M1*[Q25g]*	Intrinsic motivation *(peer recognition & appreciation)*	31	1.90	0.30
M2	Extrinsic barriers	38	3.14	0.53
M3[Q8]	Reward structures *(economic reward)*	41	*Text choice variables (remuneration)* 95.1% remunerated individually 4.9% remunerated as a team	
M3*[Q9]*	Reward structures *(non-economic reward)*	41	*Text choice variables (other reward)* 24.4% High profile project 17.1% Maintain profile 17.1% Solely income related 17.1% Other 14.6% Experience and knowledge 9.8% Expand client network	
M3*[Q25g]*	Reward structures *(peer recognition & appreciation)*	34	*Text choice variables (Appreciation within team)* 100% consider their efforts to be appreciated within the project team.	
M4[Q8]	Motivational factors *(economic reward)*	41	*Text choice variables (remuneration)* 95.1% remunerated individually 4.9% remunerated as a team	
M4*[Q9]*	Motivational factors *(non-economic reward)*	41	*Text choice variables (other reward)* 24.4% High profile project 17.1% Maintain profile 17.1% Solely income related 17.1% Other 14.6% Experience and knowledge 9.8% Expand client network	

Table 5.6: Descriptive statistics for sub-themes within 'motivation and reward' thematic category (continued overleaf)

Positively affirmed sub-themes *Negatively affirmed sub-themes*

Code *[individual queston]*	**Sub-Theme**	**Number of responses** *(n)*	**Mean** *(values relate to 4 point Likert scale where 1=Strongly Agree; 2=Agree; 3=Disagree; 4=Strongly Disagree)*	**Standard deviation**
M4*[Q25g]*	Motivational factors *(peer recognition & appreciation)*	34	*Text choice variables (Appreciation within team)* 100% consider their efforts to be appreciated within the project team.	
M4*[Q16d]*	Motivational factors *(social motivation)*	39	2.59	0.91
M4*[Q17c]*	Motivational factors *(inspiration from creative peer)*	35	2.60	0.60
M5*[Q8]*	Co-operation & competition *(economic reward)*	41	*Text choice variables (remuneration)* 95.1% remunerated individually 4.9% remunerated as a team	
M5*[Q15b]*	Co-operation & competition *(value of self to project)*	41	2.85	0.69
M5*[Q15d]*	Co-operation & competition *(design team equality)*	38	2.50	0.86
M5*[Q23c]*	Co-operation & competition *(value of consensus)*	33	2.70	0.68
M5*[Q24b]*	Co-operation & competition *(value of consensus)*	36	3.19	0.47
M5*[Q25a]*	Co-operation & competition *(individualism within project team)*	36	2.56	0.69

Table 5.6 continued

5.4 Survey Results: Risk attitudes

The results of the data analysis within the 'risk attitudes' thematic category are presented below. Correlative size and significance between question responses within risk attitudes sub-themes are presented in the matrix in

Table 5.7. Resultant positive or negative mean affirmation of each subtheme is then presented, with an associated summary of descriptive statistics in Table 5.8.

R1: Collective risk tolerance

Respondents tended to perceive that risk is shared and tolerated as a team (*M=2.29; SD=0.49*).

R2: Collective risk responsibility

Respondents had a tendency to feel that design teams will share responsibility for the risks that are taken (*M=2.28; SD=0.52*).

R3: Risky shift

There was no significant correlation between questions in this category. However, responses tended to suggest that, whilst design team members did not tend to think that the point of design was to create something new and different (*M=2.75; SD=0.78*), they tended to be prepared to take risks in design (*M=2.16; SD=0.65*). Only 2 *(n=36)* respondents who did not identify themselves as risk-takers were in a team where members who were perceived to be risk takers were present. Both these respondents said that they would take a risk in the team environment. All other respondents who did not identify themselves as risk-takers were not in groups where they perceived risk-takers to be present.

Associated sub-theme	Q	15a	15c	15e	15g	16b	16e	17b	18c	23d	24a	24c	24d	25c	Mean	Thematic Mean *(sig. correlations only)*
R1: Shared risk tolerance	16e									0.08			0.48*		2.35	2.29
	23d						0.08						0.21		1.66	
	24d						0.48*			0.21					2.18	
R2: Shared risk responsibility	16b											0.36*	0.48*		2.58	2.28
	24c					0.36*							0.22		2.05	
	24d					0.48*						0.22			2.18	
R3: Risky shifts	15a			0.06	0.09										2.75	*No significant correlations*
	15e	0.06			0.02										2.14	
	15g	0.09		0.02											2.16	
R4: Familiarity	15c										0.02				2.01	*No significant correlations*
	24a		0.02												2.06	
R5: Pluralistic ignorance	*Omitted from data analysis as questions considered too tenuous a test*															
R6: Relevant argument	17b								0.57*		0.07			0.02	2.62	2.64
	18c							0.57*			0.16			-0.12	2.67	
	24a							0.07	0.16					-	1.90	1.98
	25c							0.02	-0.12		-				2.06	
R7: Leader confidence	*Omitted from data analysis as questions considered too tenuous a test*															

*Values denote Pearson's (r) correlation, with *significance where p<0.05 (2 tailed). Values highlighted according to Cohen's (1988) scale of magnitude of effect size:*

small: >0.10 medium: >0.30 large: >0.50

Table 5.7: Correlation matrix of question responses relating to 'risk attitudes' theme

R4: Pluralistic ignorance

There was no significant correlation between the responses for this sub-theme and raw data were insufficient to describe positively or negatively the scope and nature of the sub-theme within the sample.

R5: Relevant arguments

A significant correlation was presented between the propensity of design team members to take risks and the risk propensity of the team leadership *($p=0.00$).* There was also a significant negative correlation between the level of discussion of ideas and whether an individual felt that they had gone with a solution with which they weren't entirely comfortable *($p=0.03$).* However, there were insufficient data confidently to support indication of the manifestation of relevant-argument theory in the design team.

R6: Leader confidence

There was no significant correlation between the responses for this sub-theme and there were insufficient data to explore it further.

Positively affirmed sub-themes *Negatively affirmed sub-themes*

Code *[individual queston]*	**Sub-Theme**	**Number of responses** *(n)*	**Mean** *(values relate to 4 point Likert scale where 1=Strongly Agree; 2=Agree; 3=Disagree; 4=Strongly Disagree)*	**Standard deviation**
R1	Collective risk tolerance	40	2.29	0.49
R2	Collective risk responsibility	41	2.28	0.52
R3*[Q15a]*	Risky shift *(inherence of novelty in design)*	40	2.75	0.78
R3*[Q15e]*	Risky shift *(risk aversion generally)*	36	2.14	0.76
R3[Q15g]	Risky shift *(risk aversion in design)*	37	2.16	0.65
R4	Pluralistic ignorance	Examination of the survey questions relating to this sub-theme resulted in them being subsequently deemed unsatisfactory in their potential for determining the presence of this aspect and so were omitted from the data analysis.		
R5*[Q17b]*	Relevant arguments *(support seeking for risk strategies - generally)*	37	2.62	0.64
R5*[Q18c]*	Relevant arguments *(support seeking for risk strategies – leadership)*	33	2.67	0.74
R5*[Q24a]*	Relevant arguments *(support seeking for new ideas)*	39	1.90	0.50
R5*[Q25c]*	Relevant arguments *(social influence on support giving)*	36	2.06	0.67
R6	Leader confidence	Examination of the survey questions relating to this sub-theme resulted in them being subsequently deemed unsatisfactory in their potential for determining the presence of this aspect and so were omitted from the data analysis.		

Table 5.8: Descriptive statistics for sub-themes within 'risk attitudes' thematic category

5.5 Survey results: Social climate

The results of the data analysis within the 'risk attitudes' thematic category are presented below. Correlative size and significance between question responses within social climate sub-themes are presented in the matrix in Table 5.9 and Table 5.10 Resultant positive or negative mean affirmation of each subtheme is then presented, with an associated summary of descriptive statistics in Table 5.11.

C1: Group cohesiveness (task)

A mean average of 2.14 (*n=41*) implied that respondents tend to experience group cohesiveness in relation to their task.

C2: Group cohesiveness (social)

Responses were divided in their experiences of social cohesion in the team, with a tendency towards a lack of social cohesiveness (*M=2.51; SD=0.43*).

C3: Group cohesiveness (attraction to the group)

Respondents had a slight tendency to experience cohesiveness in terms of their attraction to the group (*M=2.15; SD-0.46*).

C4: Effects of group cohesion

Respondents tend to experience the effects of group cohesiveness (*M=1.99; SD=0.42*).

Associated sub-theme	Q	16a	16d	17e	18a	18b	18d	23a	23e	24e	25c	25e	25f	Mean	Thematic Mean *(sig. correlations only)*
C1: Group cohesiveness (task)	16a						0.11	0.62*				0.19	0.17	2.08	2.14
	18d	0.11						0.18				0.00	-0.04	3.18	
	23a	0.62					0.18					0.39	0.38	2.00	
	25e	0.19					0.00	0.39					0.90	2.76	
	25f	0.17					-0.04	0.38*				0.90*		2.71	
C2: Group cohesiveness (social)	16d				0.60*	0.34*			0.59*					2.59	2.51
	18a		0.60*			0.78*			0.54*					2.11	
	18b		0.34*		0.78*				0.41*					2.08	
	23e		0.59*		0.54*	0.41*								2.36	
C3: Group cohesiveness (attraction to the group)	17e								0.41*					1.95	2.15
	23e			0.41*										2.36	
C4: Effects of cohesiveness	17e							0.37*						1.95	1.99
	23a			0.37*										2.00	
C5: Effects of groupthink	24e										0.26			2.30	No significant correlation
	25c									0.26				2.94	

*Values denote Pearson's (r) correlation, with *significance where p<0.05 (2 tailed). Values highlighted according to Cohen's (1988) scale of magnitude of effect size:*

small: >0.10 medium: >0.30 large: >0.50

Table 5.9: Correlation matrix of question responses relating to 'social climate'' theme (sub-themes C1-C5)

Associated sub-theme	Q	15f	16a	16c	17a	17c	17d	23b	23d	24e	25b	25c	25d	25e	25f	Mean	Thematic Mean *(sig. correlations only)*
C6: Psychological safety	17d							-0.04	0.08			-0.32	0.10			1.93	1.81
	23b						-0.04		0.65*			0.39*	0.09			1.83	
	23d						0.08	0.65*				0.28	0.11			1.66	
	25c						-0.32	0.39*	0.28				0.51*			2.94	
	25d						0.10	0.09	0.11			0.51*				3.29	
C7: Effects of conflict	25b												0.57*	0.55*	0.52*	3.00	2.94
	25d										0.57*			0.61*	0.63*	3.29	
	25e										0.55*		0.61*		0.90*	2.76	
	25f										0.52*		0.63*	0.90*		2.71	
C8: Effects of team climate	16a							0.33								2.08	*No significant correlation*
	23b		0.33													1.83	
C9: Innovation as a team value	15f									0.12						1.78	*No significant correlation*
	24e	0.12														2.70	
C10: Influence of cultural norms	16c				0.89*											2.29	2.31
	17a			0.89*												2.28	
C11: Social tuning	*Omitted from data analysis as questions considered too tenuous a test*																
C12: Social comparison	17c						0.31									2.60	*No significant correlation*
	17d					0.31										1.93	

*Values denote Pearson's (r) correlation, with *significance where p<0.05 (2 tailed). Values highlighted according to Cohen's (1988) scale of magnitude of effect size:*

small: >0.10 medium: >0.30 large: >0.50

Table 5.10: Correlation matrix of question responses relating to 'social climate' theme (sub-themes C6-C12)

C5: Effects of 'groupthink'

Respondents had a slight tendency to observe that their team did not fully explore alternatives (*M=2.30; SD=0.79*), whilst also slightly tending to disagree that they personally agreed to go with design solutions with which they were not entirely comfortable (*M=2.94; SD=0.67*).

C6: Psychological safety

Responses suggested quite strongly that the design team offers an environment which is psychologically safe (*M=1.81; SD=0.43*).

C7: Effects of conflict

Respondents tended to disagree that they experienced the effects of conflict within the design team (*M=2.94; SD=0.54*).

C8: Effects of team climate

A positive view of team climate was presented with a general sense of shared ownership of the project (M=2.08; SD=0.60) and a strong tendency towards experiences of positive affect states during design team meetings (M=1.83; SD: 0.51).

C9: Innovation as a team value

There was a strong suggestion that innovation and creativity are perceived as relevant to the project (M=1.78; SD=0.58) and that innovation is held as a team value (75%; n=37). However, results suggested that there is only a slight tendency for design teams to search out the alternatives which might lead them to creative solutions (M=2.30; SD=0.70).

C10: Influence of cultural norms

Respondents demonstrated a slight tendency to acknowledge the presence of cultural norms and values within the design team (*M=2.31; SD=0.61*).

C11: Social tuning

There were insufficient data returned for this question set to be able to explore this sub-theme further.

C12: Social comparison

Responses to individual questions within this question set tended to suggest that design team members had a very slight tendency to disagree that they could be inspired by other creative members of the team (*M=2.60; SD=0.60*). However, they expressed stronger agreement for the idea that they can learn from their colleagues on the project team (*M=1.93; SD=0.47*).

Positively affirmed sub-themes

Negatively affirmed sub-themes

Code *[individual queston]*	**Sub-Theme**	**Number of responses (*n*)**	**Mean** *(values relate to 4 point Likert scale where 1=Strongly Agree; 2=Agree; 3=Disagree; 4=Strongly Disagree)*	**Standard deviation**
C1	Group cohesiveness (task)	41	2.14	0.49
C2	Group cohesiveness (social)	41	2.51	0.43
C3	Group cohesiveness (attraction to the group)	41	2.15	0.46
C4	Effects of cohesiveness	40	1.99	0.42
C5*[Q24e]*	Effects of groupthink *(insufficient exploration of alternatives)*	30	2.30	0.70
C5*[Q25c]*	Effects of groupthink *(social influence on support giving)*	36	2.94	0.67
C6	Psychological safety	40	1.81	0.43
C7	Effects of conflict	39	2.94	0.54
C8*[Q16a]*	Effects of team climate *(shared ownership)*	36	2.08	0.60

Table 5.11: Descriptive statistics for sub-themes within 'social climate' thematic category (continued overleaf)

Positively affirmed sub-themes *Negatively affirmed sub-themes*

Code *[individual queston]*	**Sub-Theme**	**Number of responses** *(n)*	**Mean** *(values relate to 4 point Likert scale where 1=Strongly Agree; 2=Agree; 3=Disagree; 4=Strongly Disagree)*	**Standard deviation**
C8*[Q23b]*	Effects of team climate *(positive affect state)*	36	1.83	0.51
C9*[Q15f]*	Innovation as a team value *(relevance of creativity/innovation)*	37	1.78	0.58
C9*[Q24e]*	Innovation as a team value *(insufficient exploration of alternatives)*	30	2.30	0.70
C9*[Q19]*	Innovation as a team value *(team values)*	*(Ranked variables)* 75% of respondents identified innovation as a team value		
C10	Influence of cultural norms	32	2.31	0.61
C11	Social tuning	Examination of the survey questions relating to this sub-theme were subsequently deemed unsatisfactory in their potential for determining the presence of this aspect and so were omitted from the data analysis.		
C12*[Q17c]*	Social comparison *(creative peer)*	35	2.60	0.60
C12*[Q17d]*	Social comparison *(peer knowledge/ability)*	41	1.93	0.47

Table 5.11 continued

5.6 Testing for disciplinary difference

Data analysis method

Prompted by a number of studies of interdisciplinary difference and conflict in design teams (Spence et al. 2001; Badke-Schaub et al. 2009; Emmitt 2010), additional analysis was conducted to explore the disciplinary distribution of responses depending on discipline background. Self-reported discipline affiliations were divided into three groups (defined by accepted divisions in industry and demonstrated by standard multidisciplinary company and educational organisation). The three distinct discipline groups were adopted as shown in Table 5.12.

Study Discipline Groups	*Architecture/Design*	*Engineering*	*Management/Financial*
Professional roles	▪ Architects ▪ Architectural Technicians ▪ Landscape Architects ▪ Urban Designers	▪ Building Services Engineer ▪ Civil Engineer ▪ Highways Engineer ▪ Mechanical & Electrical Engineer ▪ Structural Engineer	▪ Construction Project Manager ▪ Construction Manager ▪ Design/Project Manager ▪ Property Surveyor ▪ Quantity Surveyor
	n=13	*n=18*	*n=12*

Table 5.12: Discipline groups and associated professional roles

Construction Site Manager	Construction Manager
Fire Engineer	Building Services Engineer
Sustainability Consultant	*Not recoded as further detail could not establish whether from architectural/engineering/management background.*
Solicitor	Quantity Surveyor

Figure 5.1: Disciplines identified as 'other' and associated recoded disciplines

Where respondents coded their discipline as '*other*,' their manually entered discipline was coded to the closest related discipline based on likely educational background and nature of practice, as shown in Figure 5.1. One of the respondents had not supplied sufficient detail from which to infer their background or nature of practice, so this person was excluded from the sample. This reduced the sample size from *n=44* to *n=43*.

Percentages of each discipline group's agreement/disagreement with question statements were then visually represented in bar chart format, facilitating analysis in the first instance by looking for patterns of response in terms of differences and commonalities between groups. Each discipline group was further examined to see whether a group's responses were significantly different to those of the remainder of the group. This was investigated by comparing the responses from one of the discipline groups with the combined responses of the remaining two groups. For example, the frequency of the management/financial group's positive and negative responses to a question relating to the compatibility of working alone and creativity was compared with the frequency of positive and negative responses of the combined responses of the remaining two groups (Architecture/Design and Engineering). This generated a 2x2 matrix of categorical variables (Table 5.13) from which to calculate the non-random probability.

	Management/Financial	Combined responses of remaining 2 groups (Architecture/Design + Engineering)
Positive Response	9	16
Negative Response	1	10

Table 5.13: 2x2 matrix of disciplinary response data for survey question 15c: "Working alone is not conducive to creativity." (Likert scale response).

A further two matrices were produced for the remaining two groups. This created similar data for the architecture group (compared with the combined responses of the management/financial and engineering groups) and the engineering group (compared with the combined responses of the architecture/design and management/financial groups). In this way, a series of three 2x2 matrices were produced for each question that generated a Likert scale response.

However, the exploratory survey yielded a relatively small sample which could not be termed 'random,' and so standard parametric tests were considered to be inappropriate (Connelly 2016). Given the nature of the small sample and the possibilities for grouping disciplines as two dichotomous datasets (discipline + 'other two'), this dataset predicated towards analysis using the Fisher's Exact Test Of Independence (Fisher's Exact Test). Fisher's Exact Test calculates the significance of statistical comparisons of independent categorical data. It is considered particularly useful for small samples, because it identifies exactly the difference from the null hypothesis, compared with the approximations of other methods (Inman 1994; Biddle & Morris 2011; Coolican 2013). The chi-square test is better recommended for relatively larger samples than those obtained for this study (Connelly 2016) as it is sensitive to sample size, potentially producing unstable results following calculation using extremely large, or extremely small frequencies (Frankfort-Nachmias & Leon-Guerrero 2011). A one-way ANOVA is frequently used for comparing variables across three or more groups (Martin & Bridgmon 2012; Coolican 2013). However, this investigation sought to make a pairwise comparison of one discipline group in relation to the remainder of the sample population. A paired t-test also offers a parametric method for comparing two groups. However, the t-test requires comparison of difference means, rather than of the absolute variables contained within the 2x2 matrix, which represented a binary scale of positive/negative response (Frankfort-Nachmias & Leon-Guerrero 2011; Coolican 2013). Thus, the significance of any difference in responses was calculated and reported according to the Fisher's Exact Test.

Statistically significant comparisons between discipline groups within individual question responses are presented below.

Results of disciplinary difference analysis

This section presents statistically significant differences ($p<0.05$) between a given discipline group and the remainder of the sample, within question responses. Significance was determined following organisation of the data into the three discipline groups and subsequent application of Fisher's Exact Test. A number of statistically significant results emerged.

Working alone and creativity

Statistically significant differences between the discipline groups were demonstrated when considering preferences for social interaction to support creativity. Most members of the management/financial and the engineering groups concurred that working alone was not conducive to creativity (*survey question 15c*), but this was not the case for the architecture and design group, as shown in Figure 5.2.

Management & Financial: 90% agree / 10% disagree

Engineering: 75% agree / 25% disagree

Architecture & Design: 40% agree / 60% disagree

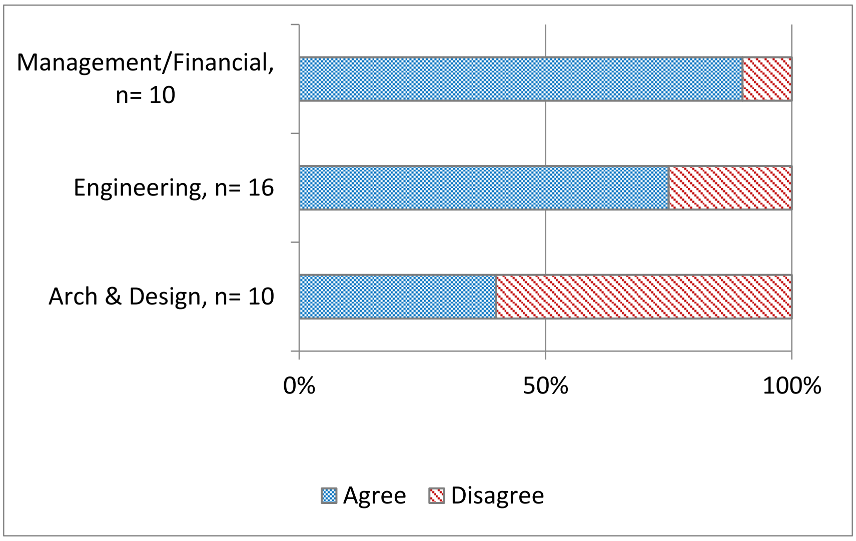


Figure 5.2: Bar chart for disciplinary groups in relation to Q15c - working alone is not conducive to creativity

Table 5.14 shows the results of testing the null hypothesis that there is no difference between a given discipline group and the remainder of the sample, calculated using Fisher's Exact Test.

	E + AD	MF + AD	MF + E
Management/Financial (MF)	0.13		
Engineering (E)		0.72	
Architecture & Design (AD)			0.04

Table 5.14: Disciplinary differences in response to Q15c - working alone is not conducive to creativity (p-values, with significance at <0.05 level highlighted in yellow)

Where $p<0.05$ (highlighted in yellow), the null hypothesis that there is no difference between the two discipline groups is rejected, in relation to perceptions of working alone as supportive of creativity. For this question, it was found that the Architecture and Design group responded significantly differently to the remainder of the sample set.

Clear norms and values

Further disciplinary differences occurred in relation to the perception about whether the design team they currently worked in had a very clear set of norms and values (*survey question 16c*). Again, the architecture and design group disagreed with the other two discipline groups, as shown in Figure 5.3.

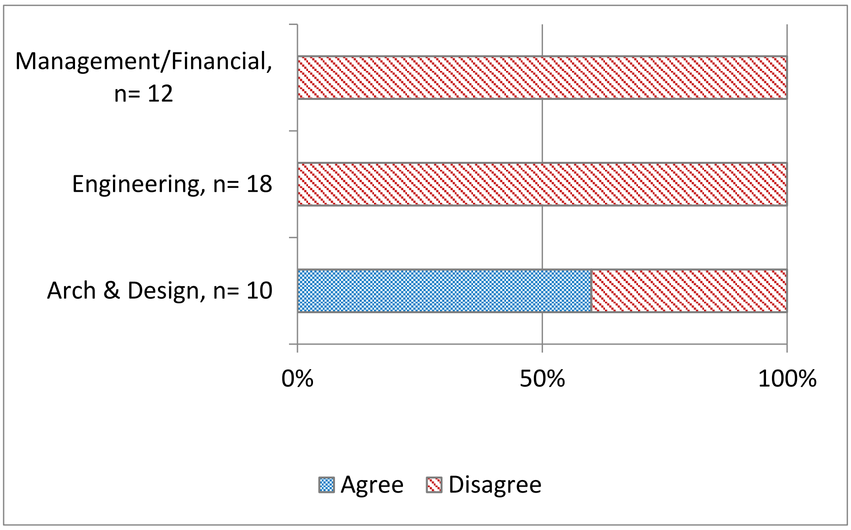


Figure 5.3: Bar chart for disciplinary groups in relation to Q16c - the group has a very clear set of norms and values

Table 5.15 shows the results of testing the null hypothesis that there is no difference between a given discipline group and the remainder of the sample, calculated using Fisher's Exact Test.

	E + AD	MF + AD	MF + E
Management/Financial (MF)	0.16		
Engineering (E)		0.02	
Architecture & Design (AD)			0.00

Table 5.15: Disciplinary differences in response to Q16c - the group has a very clear set of norms and values (p-values, with significance at <0.05 level highlighted in yellow)

These results suggest that there are some significant differences in the way that discipline groups perceive the presence of clear norms and values in the design team.

Risk as a fundamental part of design

When conceiving risk as a positive and fundamental aspect of design (*survey question 16e*), the architecture and design group suggested a more pro-risk approach in comparison to their colleagues, as shown in Figure 5.4.

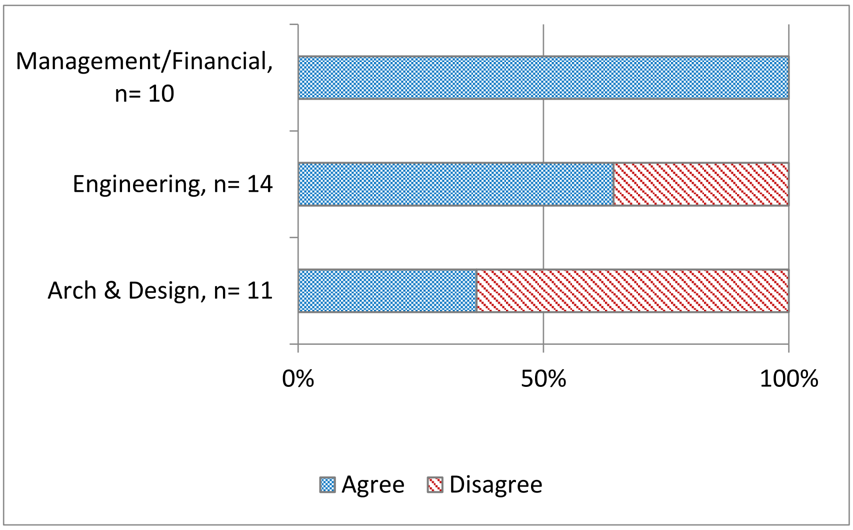


Figure 5.4: Bar chart for disciplinary groups in relation to Q16e - we embrace risk: it's a fundamental part of design

Table 5.16 shows the results of Fisher's Exact Test, used to identify significant differences between a given discipline group and the remainder of the sample.

	E + AD	MF + AD	MF + E
Management/Financial (MF)	0.01		
Engineering (E)		1	
Architecture & Design (AD)			0.02

Table 5.16: Disciplinary differences in response to Q16e - we embrace risk: it's a fundamental part of design (p-values, with significance at <0.05 level highlighted in yellow)

These results suggest that there are some significant differences in the way that discipline groups consider risk to be a fundamental part of design, with the architecture and design group included as holding different views.

Risk-takers in the team

Most architects also did not consider that there were colleagues in the project team who were prepared to take big risks (*survey question 17b*), whilst respondents from the management/financial and engineering groups tended towards the opposite view, as shown in Figure 5.5.

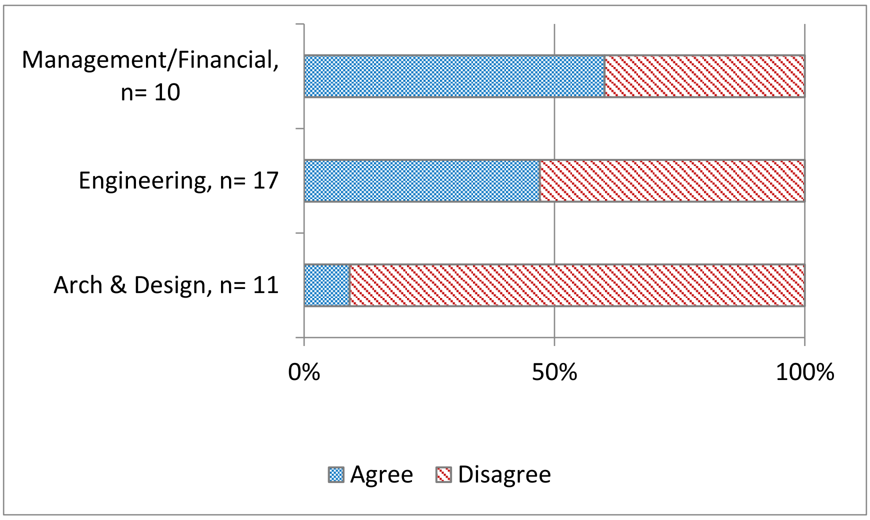


Figure 5.5: Bar chart for disciplinary groups in relation to Q17b - there are some people who are prepared to take big risks in this team

Table 5.17 shows results of testing the significance of differences in responses between a given discipline group and the remainder of the sample, calculated using Fisher's Exact Test.

	E + AD	MF + AD	MF + E
Management/Financial (MF)	0.14		
Engineering (E)		0.51	
Architecture & Design (AD)			0.03

Table 5.17: Disciplinary differences in response to Q17b - there are some people who are prepared to take big risks in this team (p-values, with significance at <0.05 level highlighted in yellow)

These results also suggest that the architecture and design group hold different views to those in the remainder of the sample, in relation to perceptions about whether there were big risk-takers in the team.

Meeting with team members outside work hours

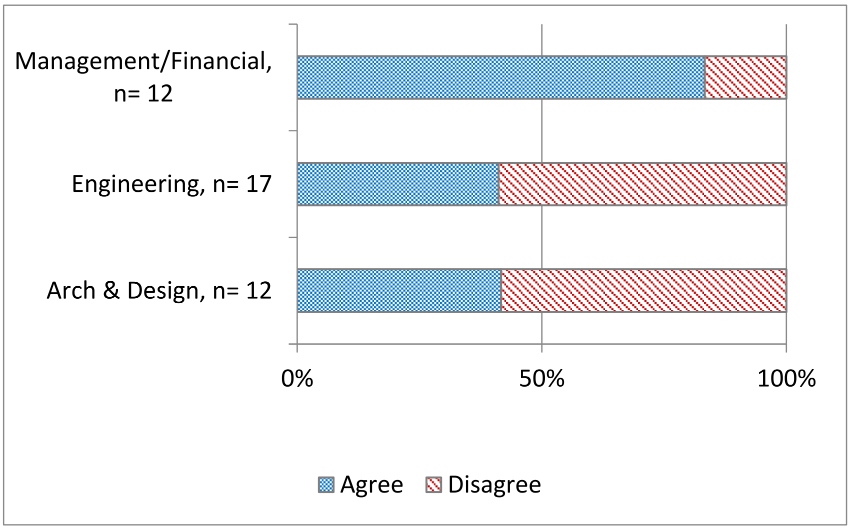


Figure 5.6: Bar chart for disciplinary groups in relation to Q16d - I sometimes meet with team members outside work hours

However, in relation to the propensity for individuals from the design team to meet outside work hours (*survey question 16d*), it was the management and financial group who were least likely to be involved in such social relationships, as shown in Figure 5.6. Table 5.18 shows the results of Fisher's Exact Test in relation to a given discipline group and the remainder of the sample.

	E + AD	MF + AD	MF + E
Management/Financial (MF)	0.03		
Engineering (E)		0.21	
Architecture & Design (AD)			0.32

Table 5.18: Disciplinary differences in response to Q16d - I sometimes meet with team members outside work hours (p-values, with significance at <0.05 level highlighted in yellow)

These results suggest that, in this case, it is the management and financial discipline group who are less likely to meet with design team members outside working hours.

5.7 Discussion of survey findings

Thematic analysis of the social psychology literature suggested that the field has the potential to offer a significant theoretical resource, and highlighted specific areas that currently remain under-explored within the AEC sector. Following analysis of the exploratory survey data, it may be inferred that many of the sub-themes within the thematic categories of motivation and reward, risk attitudes, and social climate are, indeed, present within the AEC sector and, thus, warrant further research to explore the scope and nature of this applicability. The presence of the sub-themes is discussed below within these three overarching categories.

Motivation and reward

Responses to the survey indicated that intrinsic motivation was present in respondents' design team involvement. However, this related only to peer recognition and peer learning. Intrinsic motivation derived from social relationships within the design team appears to be a variable factor in respondent experiences. The social context was given a lower priority as a motivational factor in comparison with, for example, peer recognition. Also, respondents did not tend to feel motivated by the presence of an inspirational colleague. Whether the minimal social facet of the design team is a satisfactory state and not necessary for enhanced creative performance in the AEC domain, is a subject for complementary exploration within the research.

Respondents also did not report extrinsic barriers to be an issue that inhibits their design team performance. However, the presence of both economic and non-economic extrinsic rewards were reported as relevant. Contrary to some of the AEC literature (Murray & Langford 2003, Love et al. 2011, Elmualim & Gilder 2014, Loosemore 2014), neither conflict nor stress were significant features of design team meetings.

The 'co-operation and competition' sub-theme was present only with regard to economic reward, which was predominantly an arrangement with individual organisations, suggesting the possibility that a pro-self culture may be entrenched within design teams. However, respondents did not record similar pro-self motivations when considering their own individual motivations. They did not, for example, tend to feel the need to impress their own approach or identity upon the project. This may suggest that individual motivations are at odds with procurement trends. However, nor did participants report pro-team characteristics, such as valuing the need for consensus. The chance to work on a high-profile project was offered as the most common, non-economic motivation to participate in the design team. That opportunity may be an organisational goal, but it is more likely that respondents were mindful of their own personal professional development in this respect. This combination of economic and non-economic motivational factors, the variability of the influence of social relationships upon motivation, and the lack of a consensus driven approach to decision-making may suggest that design team members are intrinsically driven more by personal professional development than the shared experience of the current project.

Risk attitudes

Analysis of the survey data suggested that there was a degree of 'sharedness' relating to the setting of risk tolerance levels and allocation of risk responsibilities present in design teams. When considering the manifestation of the 'risky shift' in the setting of these risk tolerance levels, a picture of a generally risk averse design team emerged. Design team members did not confirm the inherence of the pursuit of novelty within their design process and tended to be risk averse in and out of the design process. This suggests that risk tolerance levels within the design team are likely to be low, but without acknowledgement of the presence of a higher risk taker there are insufficient data to establish whether the 'risky shift' plays out in practice.

When gaining support for new ideas, the effects of social influence appeared to play a role, as the proponent of the idea sought support from the group and members responded to this. This suggests that the relevant arguments sub-theme had a presence in the design team's collective approval of the inherently risky new idea. This was not the case for other risk strategies where participants did not acknowledge the presence of a relevant arguments phenomenon.

Social climate

Respondents tended to feel a sense of cohesiveness within their group and experience its effects. However, whilst that tendency was clear in relation to their task and their enthusiasm for membership, respondents were divided in their responses relating to social cohesiveness. This is consistent with the findings within the ‘motivation and reward’ thematic category, which highlighted social relationships as a lesser intrinsic motivation than other factors.

Respondents felt that their design teams do not always consider all the alternatives and that they were liable to agree to design solutions with which they were not always entirely comfortable. This may indicate the presence of the negative side of cohesive groups – ‘groupthink,’ as described by Janis (1982) and Postmes et al. (2001).

Those who responded to the survey reported a generally positive climate within their design teams. They did not tend to experience conflict. They also tended to experience states of positive affect and felt quite strongly that the design team offers a psychologically safe environment, within a sense of shared project ownership. If these antecedents to innovation are present, this may indicate that the social climates of built environment design teams tend are conducive to the introduction and adoption of new ideas (Amabile 1988; West 1990; Burnside 1990; Nystrom 1990; Edmondson 1999; Chatman & Flynn 2001; Edmondson & Mogelof 2006; Gibson & Gibbs 2006; Hülsheger et al. 2009).

The respondents maintained a strong tendency towards holding innovation and creativity as values, both individually as well as collectively in the design team. However, they tended to hold the view that their teams had not sufficiently searched out the alternatives that might lead them to these creative solutions. When considering these responses in light of those within the ‘risk attitudes’ category, it may be suggested that design teams appear to aspire towards innovation and creativity but do not demonstrate the capacity or propensity to take the individual and collective risks necessary to instigate or deliver them. In addition to this risk aversion, respondents tended to disagree that they could be inspired to be creative by another creative member of the design team. Respondents were more likely, though, to learn from their colleagues.

Disciplinary differences

The additional analysis of the way that different discipline groups responded to the survey questions indicated some potentially intriguing findings which require further exploration in the remaining research stages.

It was observed that, where members of a discipline group differed significantly in their responses from the remainder of the respondents, this was more commonly members of the architecture and design group. This may justified by the anecdotal descriptions of the architect, such as in Ayn Rand's Fountainhead (Rand 2007 (First published 1936); Hosey 2014) or as creative auteur (Cocco & Szaniecki 2015; Koolhaas 2016). However, further exploration is required to establish whether this creative contingent within the design team forms a distinct 'outgroup.' If this is reported or observed, this may imply that whilst innovation is accepted as a team value, creative thinking may be subsequently excluded from overall group norms and behaviour, and ultimately from group output as innovation. This may support the finding that individuals are not inspired to be creative by other creative individuals in the group.

The hypothetical existence of the creative outgroup is given further weight by analysing differences between the responses of practitioners who are typically considered sources of creativity and those of the rest of the sample. For example, architects and designers were at variance in their responses relating to attitudes to risk. Whilst they did not perceive themselves to be the risk-takers, the survey findings suggest that they did not consider that there were other risk-takers in the group. Their colleagues tended to contradict this perception and so a possible deduction may be that the architects and designers are, themselves, the risk-takers.

Similarly, the management and financial group was least likely to find lone working conducive to creativity contrary to the architects and designers, who tended to prefer to carry out creative thinking alone. This may suggest that architects form a 'creative outgroup' which other members of the design team need to access, but are limited from doing so by the social dynamics of the team. With reference to the social psychology literature, it may be possible for the 'creative outgroup' to hold differing norms and values to those of the 'ingroup.' (Tajfel 1978; Tajfel & Turner 1979; Tajfel 1981; Boen & Vanbeselaere 2001; Walton 2003). This proposition may be supported by the survey findings because the architects and designers tended to be unclear about the design team's norms and values in stark contrast to their colleagues.

If there is, indeed, the presence of a 'creative outgroup', that, together with the possible findings of risk aversion and limited social context, may be important domain-specific factors regarding barriers to creativity and innovation within built environment design teams. It is, therefore, important to nominate the creative outgroup as a sub-theme in its own right, within the social climate category. This new sub-theme, as an outcome of the survey findings, will be investigated further within the case-study observation and focus group stages of the research.

5.8 Summary and implications for the complementary research stages

Verification and qualification of survey findings

The survey stage of the study responded to its objective as a broad industry 'litmus test' of the presence and relevance of the social psychology themes within AEC practice. Analysis served to explore the broad nature of these themes and the relationships between them. Quantitative analysis confirmed the degree to which each sub-theme was manifested in the experiences of the exploratory sample. However, there were three instances where this was not possible.

For some sub-themes, reflective examination of associated responses indicated that the question design had not been sufficiently adequate to provide a useful measure of sub-theme experience. These sub-themes were (R4) Pluralistic ignorance, (R6) Leader confidence, and (C11) Social tuning. This does not necessarily imply that the particular sub-theme does not hold relevance within the AEC domain. Rather, it indicates that these sub-themes require further exploration using alternative research methods in the complementary and qualitative research stages. These sub-themes are, therefore, further investigated by analysing the responses of focus group participants, as well as through observation of a live design team in practice.

Furthermore, the quantitative analysis supported only a broad brush test of whether or not the sub-themes were experienced in practice. Given, the small exploratory sample, results are not sufficiently robust to be able to verify them with high levels of confidence. In addition, the data also do not provide qualitative information which may be used to draw detailed inferences regarding the domain specific nature of the sub-themes and the relationships between them. Verification and qualification of the survey findings will, therefore, remain a key objective of the complementary research stages.

Areas for further exploration

Within sub-themes, the survey findings also raised a number of questions which require further exploration. This exploration will be carried out in the complementary research stages. These emerging areas for further exploration were as follows:

- The nature of social relationships within the design team and their influence on creative performance.
- The differing motivations according to individual, team, and organisation.
- The presence of 'risky shifts' in design team decision making in the presence of a higher risk-taker.
- The presence of a 'creative outgroup.'

5.9 Implications for the framework

Based on the survey findings, the following social psychology themes, which were found to have a presence in AEC practice, were affirmed as candidates for application as elements within the proposed framework (Table 5.19).

Following generation of survey findings, it was vital, however, that these candidate framework elements, as well as the negatively affirmed sub-themes were examined more closely for relevance, depth, and detail, and developed further in the qualitative stages of research. These negatively affirmed sub-themes include intrinsic motivation, extrinsic barriers, motivational factors, co-operation and competition, risky shift, pluralistic ignorance, relevant arguments, leader confidence, social cohesiveness, groupthink, conflict, social tuning, and social comparison). The additional theme of the 'creative outgroup' which emerged from the analysis of survey responses also requires such consideration. These subsequent qualitative stages of research are documented in the following three chapters, with the next chapter reporting the methodology, results and findings of the focus group interviews.

Code	Sub-Theme	Domain specific details and qualification
M1	*Intrinsic motivation*	Relating to peer recognition and peer learning. Limited relevance of social context.
M2	*Extrinsic barriers*	None reported to hinder creative performance. Team conflict not perceived to have significant effects.
M3	*Reward structures*	Economic and non-economic rewards.
M4	*Motivational factors*	Social motivation vs. task-based motivation Economic vs. non-economic factors Team vs. organisational influence
M5	*Co-operation and competition*	Pro-self procurement culture. Pro-self-development individual culture. Limited pro-team culture.
R1	*Collective risk tolerance*	Shared risk tolerance levels
R2	*Collective risk responsibility*	Shared risk responsibilities
R3	*Risky shift*	Low risk tolerance levels Lack of high risk-takers Low propensity for the pursuit of the novel
R5	*Relevant arguments*	Effects of social influence on support seeking for new ideas rather than general risk strategies

Table 5.19: Summary of sub-themes with potential application to AEC domain-specific framework (continued overleaf)

Code	Sub-Theme	Domain specific details and qualification
C1	*Group cohesiveness (task)*	Strong group cohesiveness in relation to task
C3	*Group cohesiveness (attraction to group)*	Sense of membership
C4	*Effects of cohesiveness*	Social cohesiveness toward task
C5	*Effects of groupthink*	Lack of consideration of all alternatives. Social influence regarding agreement of solutions
C6	*Psychological safety*	Sense of psychological safety within the design team
C8	*Effects of team climate*	Positive affect states Shared project ownership
C9	*Innovation as a team value*	Individual and collective valuing of innovation. Possible lack of supporting processes towards innovation.
C10	*Influence of cultural norms*	Low risk capacities and propensities
C12	*Social comparison*	Comparison via knowledge rather than creativity
D1	*The creative outgroup*	Derogation of risk-taking and creativity acceptance via outgroup/ingroup norms.

Table 5.19 continued

6. THEMATIC PERSPECTIVES IN PRACTICE

6.1 Introduction

This research stage fulfilled the following objectives of the research:

- To explore how the socio-behavioural constructs emerging from the literature review and survey manifest themselves in AEC practice.
- To elicit key socio-behavioural themes that influence creativity and innovation in AEC teams.
- To examine the relationships between the socio-behavioural themes that influence creativity and innovation in AEC teams.

This research stage, therefore, intended to examine the social psychology themes and survey findings for AEC-relevance, depth, and detail. An interpretivist, qualitative approach was implemented using focus group study as a suitable method for exploratory study of the subject matter (Coule 2013). The qualitative data generated by the focus groups were explored using thematic analysis to facilitate deeper investigation of the constructs affirmed by the survey findings. It also enabled focus group participants to raise their own perspectives or social themes that held particular significance for creative thinking and innovative performance in their own experience.

6.2 Data collection

Study participants

The exploratory survey design had included an optional, final question which requested an email address should participants wish to be involved in future research. From the database of respondents who completed this question, each was contacted about the possibility of conducting focus group research within their company setting. Following direct contact, willing respondents then negotiated access to their own organisational setting on the researcher's behalf. Where organisations were also willing, the respondent and researcher jointly co-ordinated a seminar within that company. The survey respondent remained the key contact point for the researcher.

This process resulted in three focus groups (Table 6.1). The number of participants within each focus group varied. The number of participants within each focus group is reflective of the associated company size, thus representing a comparable proportion of employees within each organisation. Whilst company names are omitted from the thesis to protect commercial privacy in accordance with approved ethical procedures, the offices visited included a large multidisciplinary company based in the south-west of England and two medium sized practices based in the north-west of England. All practices were involved in projects of all scales across their regions, although the larger company (Focus Group 1) and one of the medium-sized companies (Focus Group 3) operated nationally. The largest company (Focus Group 1) was also involved in a variety of international projects. In each case, focus group seminars were attended by participants from all levels of the company hierarchy who were in a variety of project roles. In totality, the focus groups comprised a multidisciplinary group of 74 participants from across the UK.

Social psychology theme	Number of participants
Focus Group 1	45
Focus Group 2	18
Focus Group 3	11
TOTAL:	**74**

Table 6.1: Numbers of focus group participants

Format

The format of the focus group sessions was designed to fulfil three objectives:

- To explore and identify significant issues;
- To generate broadly conversational data for analysis; and
- To evaluate findings in the eyes of the people that the research is about.

(Howitt 2010)

The focus groups were run in the format of a continuing professional development (CPD) seminar, each lasting a minimum of one hour. For the first 20 minutes, the researcher presented the tentative findings of the exploratory survey. During this presentation, care was taken to highlight the three social psychology themes[1] and a brief description was given of the sub-themes that may influence creative thinking and innovation in design teams. In addition, whilst the notion of the 'creative outgroup' was not posited, the presentation reported differences in survey responses between the discipline groups.

The presentation was then summarised by a series of questions that were used to open up the discussion within the focus group. The final slide of the presentation displaying the questions is shown in Figure 6.1.

[1] (1) motivation and reward, (2) risk attitudes, and (3) social climate

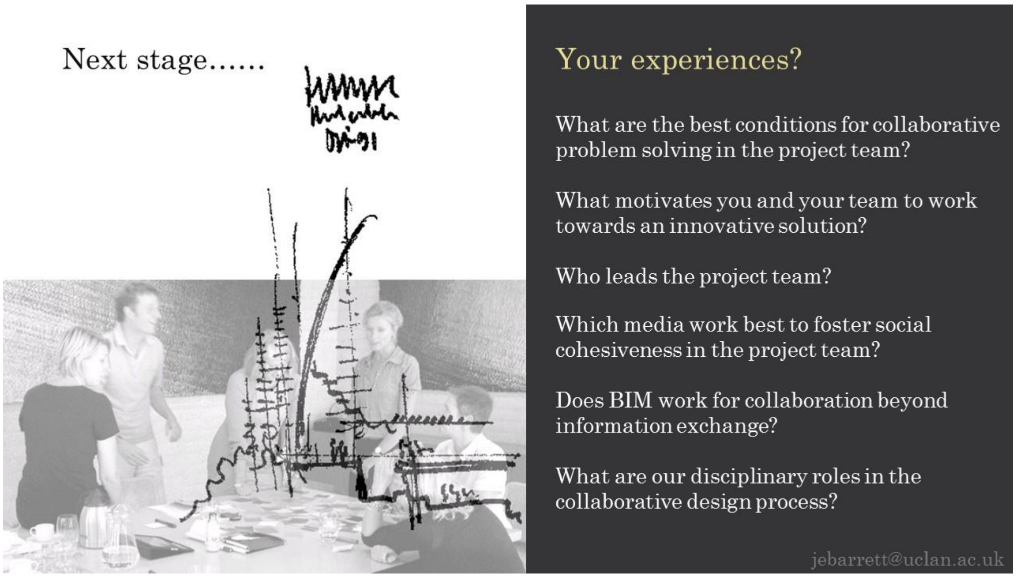


Figure 6.1: Final presentation slide showing facilitative questions for focus group discussion

These questions were framed to participants as key points where the study required knowledge and experience beyond the theoretical data (Morgan 1996). During subsequent discussion, the researcher maintained a facilitation role to ensure efficient running of the session and to minimise conversational drift (Fern 2001; Berger 2002). This facilitation role also necessitated avoidance of expression of the researcher's personal opinion and judgement so as to maintain a detached position, thus allowing participants to express their views freely (Fern 2001; Stewart et al. 2007; Howitt 2010). This facilitative approach was informed by a number of studies which used focus groups as a method of data collection in workplace settings (Lindfors et al. 2012; Wibeck 2012; Hensmans 2015; Morken et al. 2015; Solebello et al. 2016).

Recording method

For purposes of recall during future analysis, the discussions were recorded on a digital voice recorder and transferred to an mp3 format on a secure hard drive prior to thematic analysis. The recorder was placed centrally in the room and tested prior to the focus group session to ensure that all voices could be heard on the subsequent recording.

6.3 Thematic analysis methodology

First appearing in psychological journals in 1943, thematic analysis offers a methodology for investigation into the content of interaction using detailed textual material (Howitt 2010). It was selected for this study for its applicability as a qualitative analysis methodology that could support discovery, analysis, and reporting of repeated patterns of meaning within the dataset (Braun & Clarke 2006). It was also selected because it provides a descriptive method of investigating motivations, meaning, and experience, rather than a theory building approach, in concordance with the epistemological position of the research. It also supports the exploratory purpose of the study as the thematic analysis method has frequently been used for searching out broad themes, rather than focusing on fine detail (Howitt 2010).

Comparable methods, such as Conversational Analysis (CA), are often employed to examine the fine detail in the transactional medium of conversation. Whilst it is a widely used methodology, Conversational Analysis was considered inappropriate for this study, because it focuses on the nature of social relationships between participants. This study, however, focusses on detailed study of the nature of relationships external to the focus groups, rather than those occurring within the session (Atkinson & Heritage 1984). Nor is the study seeking to examine contingent repertoires emerging from observed discourse, as is the objective of Discourse Analysis (DA) (Silverman 2011). Instead, the study objective, namely to analyse key themes emerging from participants' 'real world' experiences collected via group interview data, directs analysis towards a thematic approach (Silverman 2011).

Analytical process

The audio files collected during the focus group sessions were imported into nVivo, version 11 Pro (QSR International). Within the software, each file was named according to focus group session number (Table 6.1). Applying qualitative research methodological guidance (Braun & Clarke 2006; Howitt & Cramer 2014; Miles et al. 2014), the following steps were then followed in performing the thematic analysis: (1) transcription and immersion; (2) initial theme-driven coding; (3) data assignment; (4) AEC-specific data-driven coding; and (5) review and definition of domain-specific themes.

These steps are visualised in Figure 6.2 and described in detail below.

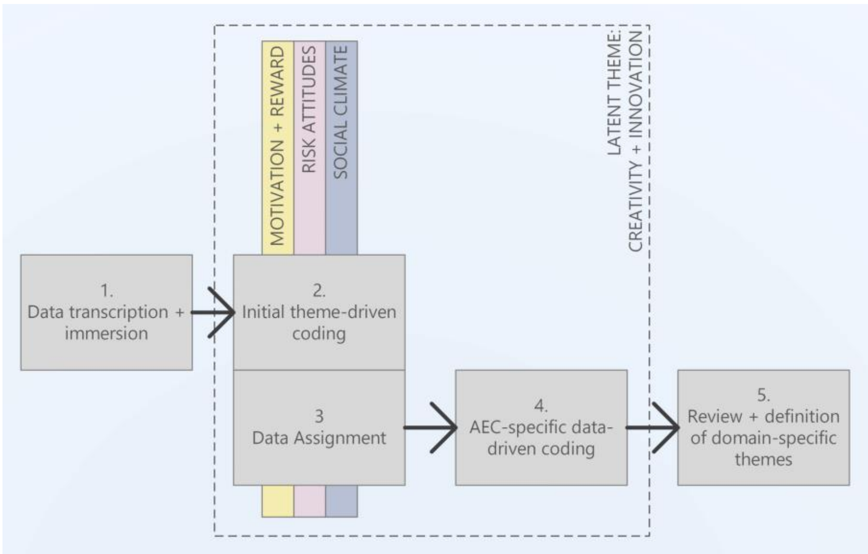


Figure 6.2: Derivation of AEC-specific themes via thematic analysis - methodology

Stage 1: Transcription and immersion

The audio files imported into the nVivo software were fully transcribed by myself. This facilitated ease of searching in the software. More importantly, the process of transcription was also an interpretative act because it provided the opportunity for active data immersion beyond the mechanical act of transferring audio content to paper (Braun & Clarke 2006). Following transcription, further immersion was gained via active re-reading of and re-listening to data files to ascertain and note any repeated patterns or ideas that could be interpreted as significant to the dynamics of creative thinking and innovative performance in the design team.

Stage 2. Initial theme-driven coding

Braun and Clarke (2006) posit that there are two forms of thematic analysis. The first is a deductive testing of pre-existing theoretical concerns whilst the second is driven by the data and supports an inductive method of research. This study requires the use of both approaches, because it tests the relevance of the pre-existing social psychology theory whilst performing an exploratory role in the AEC domain where pre-existing theory is limited.

In testing the relevance of the pre-existing social psychology theory, the overarching themes of motivation and reward, risk attitudes, and social climate identified during the social psychology literature review in relation to creativity and innovation were recorded as initial parent units of analysis. The sub-themes associated with each overarching theme were subsequently created within these to establish a unit hierarchy against which extracts from the source data could be systematically associated according to their relevance. This initial code hierarchy, defined by the outcomes of the social psychology literature review and survey findings, determined the ‘anchor themes’ for use in subsequent analysis in accordance with recommended research practice (Howitt & Cramer 2014).

Data were attributed to individual hypothesis codes using a variety of methods:

- *Descriptive coding:*
  Identifying topics relating to the theme.
- *In vivo coding:*
  Capture of participant language to summarise the theme.
- *Values coding:*
  Participant attribution of importance, attitude or belief in relation to a theme.

- *Causation coding:*
  Participants' causal beliefs in relation to the research topic.

(Miles et al. 2014)

Stage 3: Data assignment

Source data were then examined and interpreted for positive association with these anchor themes. In response to the research methodological guidance (Boyatzis 1998; Braun & Clarke 2006), data were explored semantically as well as interpretatively. The semantic analysis process associated what was explicitly said with a particular sub-theme. The interpretative approach went beyond the content to infer the underlying dynamics and issues at play in relation to the 'latent' theme (Braun & Clarke 2006) of creativity and innovation. This combined approach was deemed valid for this study, although the semantic approach tended to be more prevalent as a result of the restrained, task-based, professional group environment.

Stage 4: AEC-specific data-driven coding

A switch from theme-driven coding to a data-driven coding approach was then implemented. This involved abstraction away from the pure data toward the generation of further levels within the code hierarchy, which were identified via thorough heuristic analysis of the data within each sub-theme in the context of the research objectives. These additional codes were generated via identification of prevalent patterns and interesting concepts across the datasets. This supported the naturalistic goal by investigating and articulating meaning in action, rather than constructing new meaning from the narrative (Silverman 2011). Prevalence was established, not necessarily based on quantifiable measurement, but for its significance in relation to the research objectives (Braun & Clarke 2006). Emerging patterns of prevalence and items of significance in relation to the research objectives were then recorded as additional units of analysis according to the meaning inferred and using terms which specifically and accurately described them within the context of AEC. This process, using the same data attribution method as for stage 2 (Miles et al. 2014), was continued until the data could not be divided into further themes without descending into such specific detail that would be unnecessary for the exploratory purpose of the study (Braun & Clarke 2006). The data were reviewed to collate all extracts relevant to a particular theme and produce an initial map of candidate themes. AEC-specific sub-themes generated within each thematic set were then explored for their prevalence in terms of aggregated coded references.

Stage 5: Review and definition of domain specific themes

Once the creation of the AEC specific themes was complete, each unit was classified according to the anchor themes. This prepared the new themes for review and reorganisation without loss of their original socio-psychological affiliation. The initial map of candidate themes was then further reviewed for commonality using Miles et al.'s (2014) four interrelated inductive summarisers:

- *"Categories or themes*
- *Causes/explanations*
- *Relationships among people*
- *Theoretical constructs"*

(Miles et al. 2014, p.87)

These candidate themes were scrutinised, grouped, and refined for subject orientation and association irrespective of the socio-psychological categorisation. Data within the themes were examined for their internal homogeneity (data within the themes cohered meaningfully) and external heterogeneity (clear and identifiable distinctions existed between the themes) (Braun & Clarke 2006). This reflexive process continued until themes were coherently organised and an overall narrative could be reported that provided a satisfactorily accurate representation of the data. The thematic map of AEC-specific themes and sub-themes is presented in section 6.4

(*Results of the thematic analysis*) and section 6.5 (*Thematic discussion of focus group narratives*).

6.4 Results of the thematic analysis

The thematic analysis showed that the AEC practitioners experienced a variety of factors in relation to innovation and creativity in multidisciplinary design teams. This evidence can be categorised within the social psychology anchor themes of motivation and reward, risk attitudes, and social climate. Within these anchor themes, a number of AEC-specific sub-themes were identified. These sub-themes not only record and summarise the experiences of the focus group participants, but also highlight a number of issues which would warrant further research, but are not prevalent in construction literature. These sub-themes are listed in Tables 6.2, 6.3, and 6.4. Where themes were found across each of the focus group sessions, this prevalence is highlighted in yellow.

	FOCUS GROUPS		
Anchor Theme: MOTIVATION + REWARD	1	2	3
Company culture as project innovation driver	■	■	■
Low fee/budget limits potential	■		■
Company profit goal conflicts with innovative performance		■	■
Company rewards polarised to team rewards	■		
Clarity of role understanding	■		
Engineering subservience to architect	■	■	■
Specialist disciplines peripheral to process	■		■
Timing of appointment factor in ability to collaborate	■	■	■
Specialists procured by core disciplines, not collaboratively	■		
Motivation derived from getting credit for work done	■		■
Motivation derived from peer feedback	■		
Willingness to share information promotes learning	■		
Generational propensity for collaboration		■	
Individual comfort in technological solutions for collaboration	■		
Individual dedication to collaborative innovation	■		
Motivation derived from collective success	■		
Association with inspiring people as motivation to collaborate	■		
Motivation via documented progress	■		
Lack of time as barrier to motivation	■		■
Lack of time inhibits potential for innovation	■		■
Non-contribution by team members as barrier to motivation			■
Clarity of client vision	■	■	■
Innovation goals obfuscated by procurement complexity			■
Procurement processes inhibit scope for innovation			■

Table 6.2: Thematic outcomes of focus group discussions in relation to the 'motivation and reward' anchor theme (prevalent themes highlighted)

	FOCUS GROUPS		
Anchor Theme: RISK ATTITUDES	1	2	3
Consensus used to manage risk of effects of output	■		
Group risk propensity established to determine vision			■
Client risk propensity			■

Table 6.3: Thematic outcomes of focus group discussions in relation to the 'risk attitudes' anchor theme (no prevalent themes)

	FOCUS GROUPS		
Anchor Theme: SOCIAL CLIMATE	1	2	3
Ability for companies to develop brief	■		■
Correlation of member dominance with proximity of client	■	■	
Ability to contribute ideas limited by company hierarchies	■	■	■
Team collaboration norms dependent on company norms	■	■	■
Alliances formed based on experience			■
Corporate profit goal and process innovation goal conflict		■	
Barrier to collaboration – lack of client proximity		■	■
Clarity of client-team communication of vision		■	
Criticism of engineering engagement in team			■
Engineering subservience to architect	■	■	■
Interdisciplinary common language aids collaboration			■
Timing of appointment as factor in ability to collaborate	■	■	■
Fragmentation to preserve cohesiveness	■	■	■
Role clarity determined by clarity of guidance			■
Architect as dominant vision holder	■	■	■
Disciplinary land grab of project roles			■
Frustrations with project managers	■		■
Conflict caused by client distance from non-dominant roles		■	
Reticence to challenge client and brief		■	■
Ability to accommodate change			■
The importance of constructive challenge		■	
Abilities and expectations engendered in education	■		■
Benefits of direct interaction		■	
Team success derived from shared learning experience	■		■
Appropriate selection of communication media		■	■
Collaboration fostered by co-location of individuals	■		
Competence outweighs behaviour			■

Table 6.4: Thematic outcomes of focus group discussions in relation to the 'social climate' anchor theme (prevalent themes highlighted). Continued overleaf...

	FOCUS GROUPS		
Anchor Theme: SOCIAL CLIMATE	1	2	3
Differing individual goals causes conflict	■		■
Dominant members establish psychological safety		■	
Effort of face to face interaction reaps rewards		■	■
False consensus created via dominant 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 dynamic			■
Need for respect			■
Norms of meeting organisation and agenda setting		■	
Personal characteristics for innovative collaboration			■
Role of banter as social lubricant			■
Role of banter to determine individual identity			■
Shared mental model of the successful outcome	■		
Subscribing to cohesion gives reward in focus and progress	■		
Confusion caused by process complexity	■		
Dominant members as filter to team membership			■
Longevity of relationships			■
Individual preferences towards introversion/extraversion	■	■	
Social interaction outside design team meetings	■	■	
Importance of recognition for innovation via publicity		■	
Quantitative measures of innovation, not just aesthetics	■		
Disciplinary partitioning across industry			■
Need for design process facilitator	■		
Role definition compromised by lack of clarity in guidance			■
Team design response to project scale and complexity	■		■
Value of diversity within procured teams	■		

Table 6.4 continued

Through the process of reflexive analysis, these sub-themes were further grouped toward internal homogeneity and external heterogeneity. Internal homogeneity refers to data within each theme, which should cohere meaningfully. External heterogeneity refers to the clear and identifiable distinctions that can be made between the themes (Patton 1990; Braun & Clarke 2006). This resulted in the following AEC-specific categories: Procurement; feedback and recognition; time and workload; intra-team behaviour; client; creative outgroup; professionalism versus profit; innovation drivers; practice guidance; interdisciplinary knowledge; professional identity; and the social team.

These AEC-specific themes and associated sub-themes are presented as thematic maps in Figure 6.3.

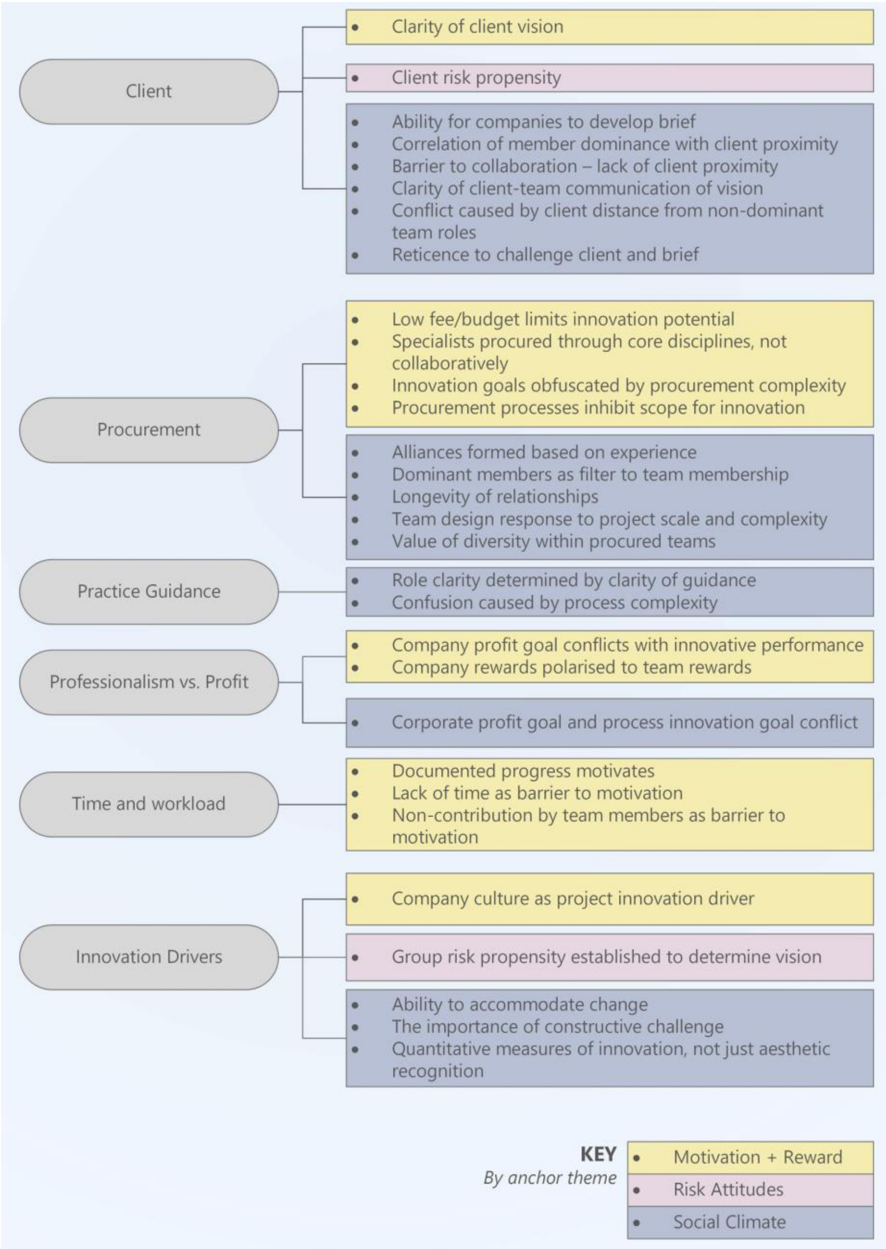


Figure 6.3: AEC-specific thematic map from focus group discussions (continued overleaf)

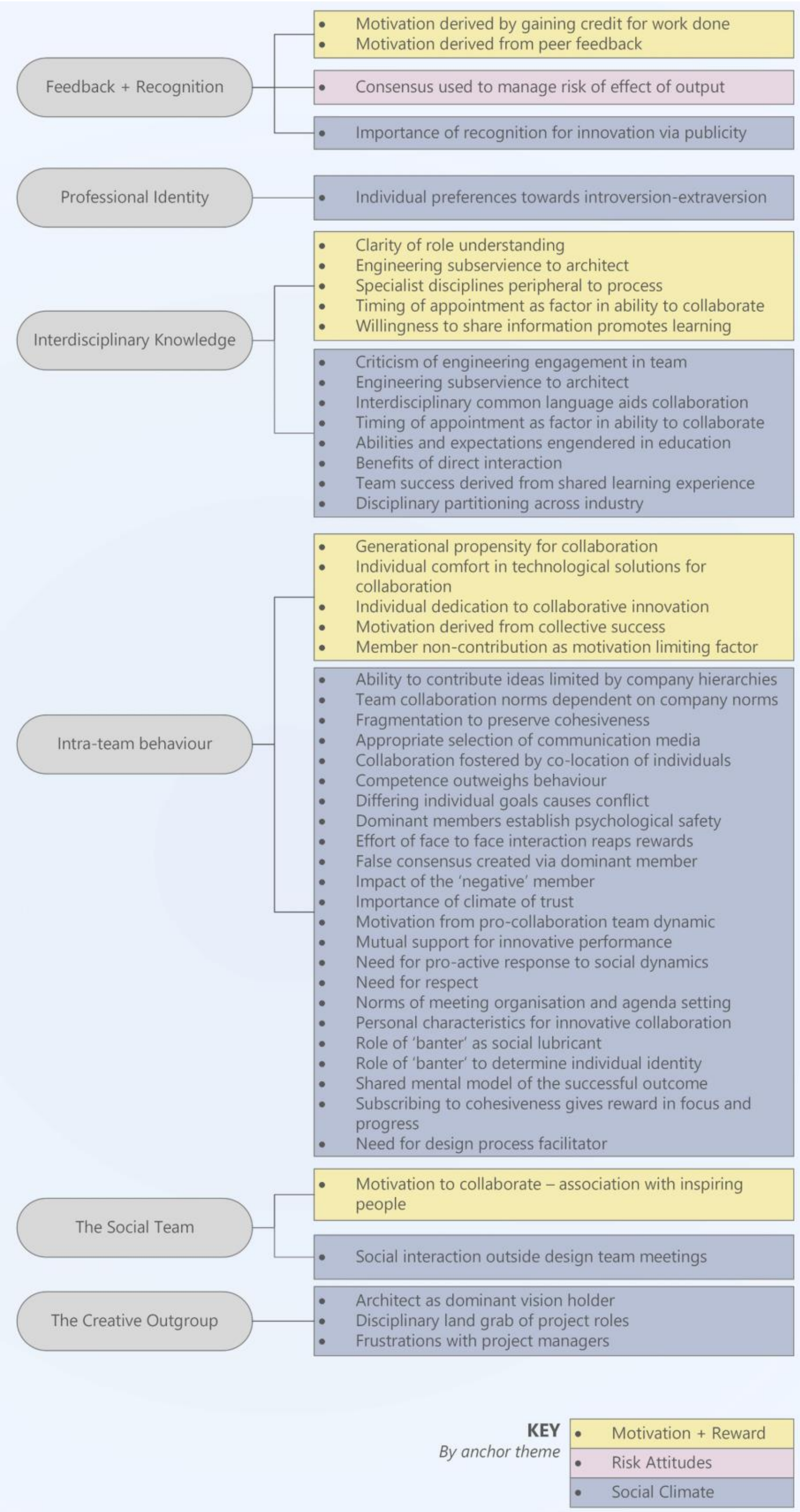


Figure 6.3 continued

6.5 Thematic discussion of focus group narratives

Focus group narratives, which directed inference, interpretation, and subsequent formulation of the domain-specific themes, are described below, with quotations taken directly from transcripts. Narratives are described within each of the emerging domain-specific, data-driven (stage 4) themes of client, procurement, practice guidance, professionalism vs. profit, time and workload, innovation drivers, feedback and recognition, professional identity, interdisciplinary knowledge, intra-team behaviour, the social team, and the creative outgroup. Within these themes, narratives are described according to the sub-themes highlighted via initial, theme-driven (stage 2) coding according to the social psychology anchor themes of motivation and reward, risk attitudes, and social climate (see also Figure 6.3).

Client

All three focus groups highlighted the value of a client who is able clearly and effectively to communicate the project vision. Participants expressed the view that they can struggle to understand a client's vision where the project team structure prevents them from direct contact, for example, where the lead consultant (traditionally the architect) acts as the point of contact for the team.

> *I'm working on [project name] at the moment and the brief is just to redevelop the building. The client doesn't know exactly what they want and part of him wants a museum, but he's not quite sure, so. But we're involved in the brief stage, which we don't always get to be involved in, so it's been good coz we've been going to all the meetings and our views are being taken into account, where it might just usually be the architect or the client to talk about it.*
>
> *Focus Group 2*

However, non-architect participants also indicated that they would value expression of the client's vision in non-architectural terms. For engineers, client vision expression beyond the spatial requirements and aesthetics, such as consideration of environmental performance can be supportive of interdisciplinary project success.

> *I was thinking about, we're talking just about the architects. And we're, and the vision, and the vision is separate. And the agenda is with the client. And the best example of working collaboratively for me was when we were working for [client name], coz there was a very clear vision from the client. And the other thing about the vision, the vision wasn't just about the architecture. We should be now in a position where the vision of buildings and building success should be measured on more than just the aesthetics. The environmental performance, the engineering measurables really come into this. So, we should be able to shift the vision and contribute to a vision that isn't just one facilitating the architectural vision. It's one of actually setting the engineering vision.*

Focus Group 1

An understanding of the scope for innovation is also gained from the ability of consultants to infer the risk attitudes of the client.

> *And if you do get a client that's got a sense of vision, that's strong. You can work with that. I think if you've got a very risk averse client, you can be quite confined by that limitation.*

Focus Group 3

Participants recognised that such communication would be dependent upon the presence of a well-informed client. However, a causality dilemma is experienced because consultants have been appointed, presumably, to inform the client. This presents an issue for the timing of appointment. If *all* disciplines are empowered to inform the client, shape the brief, and correctly interpret the client's vision, participants considered that a design team environment more conducive to collaboration would ensue. Disciplinary dominance is, thus, established via proximity of team members to the client, which is expressed within a hierarchical social climate within the design team.

> *…the architects go in and make a bunch of decisions with the client and they'll come in, and there's a bit of a scheme design, where it gets thrown around a bit. But it's nice to be involved in that process, but we don't normally get paid to be involved, coz it's perceived that their involvement is very valuable. So, it's, but we should probably be involved in that.*
>
> *Focus Group 2*

Thus, pre-Stage 0 involvement is suggested for all disciplines, as a means towards a collaborative relationship with clients and colleagues, rather than one that is subservient or facilitative.

> *So, bringing the client into the collaboration process, as well, like being involved sooner than Stage 0 Concept Definition[2] process, it's clear that the client's been thinking about the project, but in terms of coming up with some very strong preconceived ideas based on their own thinking, being an educated client in their market and knowing what they want, but not understanding some of the impacts of their decisions.*
>
> *Focus Group 2*

The converse approach to client relationships appears also to be true, in that failure to maintain a collaborative approach to vision-setting and appraisal throughout the design process can compromise design outcomes.

> *You could easily say what are the key failure factors? If you don't do these, perhaps that's the way to think of it, then the project's at risk.*

[2] RIBA Plan of Work, 2013

> *Bringing the client back into the project, clarifying what he or she wants, what their building's going to be used for.*
>
> *Focus Group 2*

Where collaborative client relationships do exist, it was widely expressed that there exists a cultural reticence within the industry to challenge client expectations where it could produce a better outcome.

> *There seems to be an attitude that even you can't bring added value and there's a reluctance to bring that up with the client, and even if it's not going to necessarily add economic problems, it could add, it could actually reduce it. There seems to be a reluctance to suggest that quite often.*
>
> *Focus Group 2*

It might be suggested that this opinion is associated with less experienced practitioners. However, this cultural reticence appears to be independent of hierarchy or experience as the following was expressed by a very experienced and senior architect and his view was confirmed by his team.

> - *You accept all these deadlines that the client gives us or the contractor gives us instead of saying, 'hang about a minute, we can do this proper if you give us another month.' You'd be surprised. I think some would take it. But we all sit there and go okay.*
>
> - *And you end up compromising the design.*
>
> - *Yeah, you end up compromising coz you haven't got time to fully do it.*
>
> *Focus Group 3*

Procurement

When considering the impact of the way clients procure their design team, focus group participants highlighted a number of aspects that they experienced as barriers to project innovation potential. A common theme was the issue presented by a low fee. Participants felt that clients expect extra support from practitioners without the appropriate contingent fee which erodes motivation toward innovation, supporting the findings of social psychology studies concerning 'contingent reward' (Janssen 2000; Judge & Piccolo 2004; Wang et al. 2011).

> *The best condition [for innovation] has got to be a client who's willing to spend the money they want and invest in the team. Coz so many jobs will start off by someone saying, I want clarification for this site. I think it's about people doing jobs that they're getting paid for.*
>
> *Focus Group 3*

Specialist disciplines felt less empowered to negotiate fees, as they tended to be procured via other core disciplines within the team. Here, they negotiated a fee with the project manager from that core discipline, rather than directly with the client. Thus, the specialists (e.g. asset managers and urban planners) in Focus Group 1 felt that scope for their contribution to collective design activity was constrained.

> *We don't fund our project leaders in a collaborative way. They come from a core discipline and they get funded from the core discipline, and really, you know, we should be paying these people collaboratively from all disciplines, and that way they'd be behaving in a more collaborative way.*
>
> *Focus Group 1*

This reflected the diverse multidisciplinary nature of the company structure behind Focus Group 1. However, less diverse offices also experienced complexity in methods of procuring a collaborative design team, which they felt obfuscated their creative goals.

> *'Cause there's so many ways of procuring a project these days. Everybody's got their own ideas of which are the best. You mentioned partnering. To a point it worked but it seems to have died a death and gone away now.*
>
> *Focus Group 3*

This complexity further exacerbates the sense of a diminishing creative role from the architect's perspective, and consequently represents a growing state of demoralisation amongst the profession, which is unlikely to be conducive to innovative performance.

> *- And that's where procurement kicks in. We seem to be doing more D&B*[3] *now, more D&B than we ever did you know the traditional role seems to be getting less and less, so particularly with all the [client name] work that we do. It's being able to hang on to that creative role that you had under the direction of a project manager, that we're working for a contractor who'll have a team of estimators, who'll be under the contractor's aim.*
>
> *- Which is completely different to the design team. That's the problem as well.*
>
> *- It is, yeah, yeah.*
>
> *Focus Group 3*

Participants, thus, felt that they were more likely to seek long-term alliances that they could trust, rather than to explore new relationships.

> *Years of experience and learning tell you who are the best people to work with. The one's that let you down, you don't use them again. So, you know, it takes years to actually know who you can actually*

[3] Design and Build (Generic procurement route where contractor is responsible for design or aspects of design. Architects may be appointed by the contractor to complete the design work.)

> *trust to help you deliver that very complicated project and it only comes through experience.*
>
> *Focus Group 3*

However, it was noted that that predication towards long term alliances limited decisions relating to design team membership to individuals benefit from longevity in their careers. These individuals are more likely to be dominant and senior within company hierarchies, as exemplified by this architectural director:

> *For me, when I'm assembling a team, I'd like to assemble a team that the skill set is a given. But the personalities that I can work with are really important coz then you get the best out of people, and if that, I know the engineers, let's say the QS's[4] will work well with my staff and I think that's really the personality side of it, of running a project, is so important, and that's why I must admit, that's why I work with those companies I know, who I know I work well working with.*
>
> *Focus Group 3*

Reliance upon long-term alliances may also evolve teams toward homogeneity in the resistance to change inherent in this particular strategy. However, it was noted that a diverse team is valued for its support for innovation and creativity (Polzer et al. 2002; Baruah & Paulus 2009; Bezrukova & Uparna 2009; Hülsheger et al. 2009).

> *Diversity, actually I think I love it, you know, coz you get really different perceptions you know male, female, all different backgrounds and it really supports innovation and creativity.*
>
> *Focus Group 1*

It was generally felt that the strong ties of long-term alliances could be relied upon to yield rewards in architectural projects, as described by Hülsheger's (2009) work. However, it was considered that, whilst these alliances might be helpful in larger

[4] Quantity Surveyors

projects, a much more strategic approach was required in these cases, to co-ordinate connections between the numerous work packages and associated disciplines.

> *I was working on a project out in [project location] where the client was very hands on and he pretty much employed everybody not quite at lowest cost, but the fee was, I'm going to come and package up every small bit of it if it's more efficient to do so, rather than employ someone to do everything. He looked at the infra-structure engineers and said, 'well, I'm going to ask you to do water, power, and highways, but I'm going to get someone else to do the transport planning. I'm going to get someone else to do…' Well, we did the lakes and waterways, so almost like public realm type design, and he was quite hands on. We had to do a lot of collaboration to get the work, coz, obviously, the lakes, we've got to get from somebody doing the water design, so we didn't even know how big a waterway we got to do. It was all collaboration, but, actually, it worked very well. I just think that if you, well, it's my personal theory, but if you looked at the scale of the project, I think you would find that the larger scale, when you talk about the strategic level jobs, you'd end up with those parties and they're, and whether it's forced or not, I think there has to be more collaboration to achieve the same standardised level of success as you do for a building project.*
>
> *Focus Group 1*

Practice guidance

Since the evolution of procurement methods and project team structures in response to post-Latham (1994) and Egan (1998) industry reform, participants felt that the clarity of role definition in design teams had been compromised, limiting the potential for influencing innovative outcomes.

> *If it was a design manager or contractor, I don't think they would be interested in design quality. They're just process. All they're interested in is a certain process that they want to go through, but we're also, whilst I want design excellence, I'm also getting pressure, certainly, from the [client name] that that's the budget. That's the budget. We can't go any further than that and it's trying to balance the two, and that's the difficulty sometimes. When you want to do something really creative...*
>
> *Focus Group 3*

This lack of creative influence is further exacerbated by the perceived increased complexity of process-driven projects, presenting significant challenge to designers.

> *This one this was extremely painful. It was our only process-bound client and one of the biggest projects we've done in terms of floor plan and in terms of fee value, and one of the toughest.*
>
> *Focus Group 1*

Professionalism versus profit

Many participants expressed the concern that project team innovation goals could be stifled, or even contradicted, by organisational profit goals. Within companies, conflicts of perspectives are apparent between those responsible for in-house profit-led goals and those responsible for design team innovation values and delivery in projects.

> *There is a suggestion there are forces at work in our company that want to simply drive up profits and one way of doing that is to do less work. So, I imagine that's where that's come from, coz we're being pushed to go from 7% this year, to increased profit next year, coz we're capable of doing that, and it's a shame on that particular example. I'm sure it's true erm and it's a current around the*

> *company. Don't give up firing in the good ideas because you never know when those will be taken up and they will have broken through. You shouldn't be reduced to just turning the handle.*
>
> *Focus Group 2*

Where a design team member may be subjected to these profit-led company pressures, other design team members observe that this can inhibit collaborative working.

> *Yeah, it's getting them to buy in. To some people it's just fee. It's just a fee.*
>
> *Focus Group 3*

Participants describe these contradictory pressures as polar opposites in relation to incentivisation towards either profit-led or design innovation goals.

> *Yeah it's all about rewards. There seems to be two poles here I think.*
>
> *Focus Group 1*

Time and workload

Where low fees are in place on projects, the resultant time for creative thinking and innovation delivery are reported as barriers to design team motivation.

> *Time was one of our shortcomings. We knew it was going to be a long slog, but we didn't have a very good fee and we had to put a lot of effort into that.*
>
> *Focus Group 1*

This barrier to motivation toward innovation is further challenged when there is a perception of an imbalance of effort amongst the team.

> *And it only takes one person, doesn't it? If you're working on a design team and one person isn't putting the effort in, that the rest of the team is, it really throws the whole thing down.*
>
> *Focus Group 3*

Conversely, when design teams are able to see that they are being collectively effective, they feel more able to work through the process.

> *It's interesting to hear how people feel that they need to feel a need to be effective when you collaborate. And when you've said what you need to say and you get feedback, and you need to say it again through the process until you get that understanding on what you've said.*
>
> *Focus Group 1*

Innovation drivers

In addition to profit vs. innovation goals entrenched within their companies, all focus groups were clear in their perceptions that their respective company cultures exerted an influence on the culture of the various design teams with which they were involved. Constructive alignment of these cultures amongst design team members was perceived to generate relationships that were positive and more conducive to creative thinking, whereas culture clashes were more likely to lead to difficulties in reaching their creative goals.

> *We've been through the mill on it and come out the other side still smiling. But the challenge here was to feed this unmoveable massive microdetailed thing with information despite our culture being full of ideas and fast moving, and collaborative, and creative - that's the word I'm looking for. It was a clash of cultures and we had to make it*

> *work and I think after nearly 6 years, I think in September, it'll maybe work.*

Focus Group 1

> *It's not just collaboration with other consultants, it's collaboration with us as well. [Participant name] is right. I do accept what you're saying. It's something that we could build on.*

Focus Group 3

Risk attitudes, as a further aspect of these cultures, are also seen as relevant to design outcomes. It is further suggested that member risk propensity should be established at the outset of the design process as a way to determine explicitly how innovation may be valued and delivered during the project.

> *If you had a vision, if you could set out, like a collaborative vision of the answer to the project that everyone bought into, it may help to sort of help to set those priorities where...To me people are very risk averse. Some people are more willing to take risks. So, if you establish that matrix of what goes where, where do people fit, then? That you almost need to establish that group, that that project dynamic as something to buy into, with a vision that you can actually begin to deliver.*

Focus Group 3

Similarly, 'change' is also considered a cultural aspect which can influence innovation potential, which can become more elusive in long-term alliances.

> *- And on the other hand, you can get too comfortable, and you can say, 'bloody hell, I've been doing this for the last 2 years, and these guys are doing this.'*
>
> *- Yeah, complacency can set in and you want the innovation at the time. So, you're right there's two sides to that.*

Focus Group 3

This participant observation is a direct echo of the supporting social psychology literature, which suggests that the 'strong ties' of very cohesive teams, such as those found in alliances with longevity, can prove detrimental to innovation and solution-finding (Miron et al. 2004; Hülsheger et al. 2009; Zhou et al. 2009). Participants also observed that an idea of change might involve a cultural shift in enabling constructive challenge of established methods or protocols.

> *Another one that's very vital in meetings is erm, is asking the stupid question, is asking why. Somebody will say, 'okay we're gonna do this' and you can, I often, 'I don't really grasp why we're doing that. Can you explain to me why are we doing it that way?' And obviously there isn't a good reason.*

Focus Group 2

Constructive changes to traditional approaches for measuring project success are also cited as methods for driving innovation. Where project success will be measured by quantitative results in addition to aesthetic outputs, improved synthetic thinking is perceived to occur.

> *….linking back to what [name] says if you're measuring building performance and you suddenly have in the rules, things in terms of engineering, environment, sustainability criteria, especially if you've got specified targets to hit such as legal, BREEAM[5] prerequisites and stuff……how can we get this together to get a building that works and satisfies whatever? And I think [company name] are great.*

Focus Group 1

[5] Building Research Establishment's (BRE) Environmental Assessment Method http://www.breeam.com/

Feedback and recognition

Design team motivation appears to be particularly fuelled by the receipt of credit for creative contribution, suggesting a need for conscious seeking and giving of such feedback during collaborative design.

> *And when you've said what you need to say, and you get feedback, and you need to say it again through the process until you get that understanding on what you've said. I think that's really, really key, to come away from a meeting or workshop knowing that you both worked through it. That really helps collaboration, but that takes time and there's a skill involved in that.*
>
> *Focus Group 1*

This is valued whether received from client or team peers.

> *…we kicked this 3d thing out of the box. Do you remember that day? And we'd been working, well I'd been, for a year and a half, to get this roof truss to not look like a structural item but to, like, mix it with the facades, and to incorporate it in some way. And it turned out something like this is a near finished model erm and [name] just did the old 'erm mmmmm yes, it's okay, it's fine it worked.' Just gave a Gallic shrug, yeah. But it was a great, you know [name] was almost red with pleasure. I've got a photograph of it somewhere.*
>
> *Focus Group 1*

Participants implied that this feedback is not only useful to fuel motivation, but can be valuable in managing the risk of failure. To this end, participants suggested that information sharing and associated feedback can be useful in developing a consensus towards the resulting design. However, this can only be achieved through controlled and purposive information distribution.

> *…what we've found about how to control information, so it transfers to your partners in the team really, really effectively, and it has to be*

> *really clear. There's no point just throwing information at each other coz that just effectively comes down on you.*
>
> *Focus Group 1*

The importance of feedback and recognition extends beyond the design team to industry approval. The perception of a design process directed towards such approval rather than optimal solution for the client exists amongst engineering participants who assume that architects "*will want the shiny piece to put on their website*" (*Focus Group 2*).

Professional identity

Whilst organisational collaborative culture was identified as a critical success factor in innovation, it was also acknowledged by participants, that individual differences can also influence the degree to which collaboration may become a characteristic of the project design process. In particular, stereotypical differences were perceived between architects and engineers. These were both self-described as well as reported via the observations of others.

> *And you know, you've got to take the time to do it. To take your head out from the calculations and go off, and go round the team to talk to them and collaborate effectively.*
>
> *Focus Group 1*

Engineers were generally perceived to hold preferences for introverted problem solutions, which participants felt inhibited them from engaging in externally facing activities such as collaborative thinking. Architects were generally perceived to be more extrovert, with preferences for project goals that favour external recognition.

> *Coz you know I think the architect will want a proper fee based on, they will want to go for the new building. They naturally are*

> *optimistic and outward looking people. They will want the shiny piece to put on their website.*
>
> *Focus Group 2*

Interdisciplinary knowledge

When discussing collaboration towards innovative output, participants expressed the view that their ability to contribute to the body of interdisciplinary knowledge fuelled their motivation toward the shared outcome of the team. However, certain factors presented limitations. For example, where disciplinary roles are absent, a lack of member flexibility to accommodate their absence is considered obstructive and can prove detrimental to team motivation in relation to their collaborative venture.

> *Well you can say right, actually, I don't know. I'm not a transport planner. But if you can say, well, actually, there is a way. But you can solve this. But I'm going to help you drive a process towards a solution. I don't know if that's facilitation or collaboration. But you know, if you're seen to do that, then it's not really good for morale in the long run.*
>
> *Focus Group 1*

However, where that flexibility becomes a facilitative subservience, this can also detrimentally affect motivation. This was a view that was widely expressed amongst engineers when discussing their relationships with their architectural colleagues.

> *Well, facilitative means that they wanna do, they wanna hang something on skyhooks and we say how high do you want it to be? We'll bend over backwards to do it.*
>
> *Focus Group 1*

> - *Do you find though that at [company name]? We find that here are the things that will help you make it work. I'm just trying to get some ideas. Did they deduce that this was something you were getting despondent at?*
>
> - *Yes they did. They didn't trust us.*
>
> - *Because you were trying to be collaborative!*

Focus Group 1

Whilst engineers tended to feel subservient to architects, specialist disciplines felt even further demoralised as they tended to feel subservient to the engineers and thus peripheral to interpretation of the shared and imagined building.

> *You've got the core, you know, main disciplines. You got structural engineers on the MEP[6]. I think some specialists kind of feel subservient to them and trying to get a mental model of what's…*

Focus Group 1

A relationship appears to exist between this sense of subservience and timing of project involvement. Where disciplines are commissioned late in the design process, then motivation toward collaboration and perceived influence on innovation potential is minimised. This appears to be a particular issue for architect-engineer relationships, but it is also applicable to cost planners who may need to present feasibility constraints well after the shared mental model of the building has been constructed.

> - *But that's not getting the other consultants on board soon enough. But they're not always being paid at that point.*
>
> - *So you make assumptions based on experience.*

Focus Group 3

[6] Mechanical, Electrical, Plumbing

> *I think a lot of the projects that have gone wrong recently that I've worked on they've always overrun. They've always been over budget and you don't work out what your project is until you get your cost planner involved at Stage 4 or 3[7], and you're a year down the road, and you've cooked some dreams up, but you have to go back and redesign it.*
>
> *Focus Group 2*

Where consultants feel that they are empowered by project structure and culture to contribute to the project vision, a performative role of mutual learning toward interdisciplinary synthesis is perceived to generate positive results.

> *[Architect name] are a bit like that. We work well. We work what we feel is collaborative,e because he's very, very interested in what we have to say, coz they're learning everything and then they're making their moves.*
>
> *Focus Group 1*

Thus, developing an interdisciplinary common language is perceived to be integral to this process of learning which in turn, allows innovation to be conceived and projects to be deemed successful.

> *It's about a common language, isn't it, across the whole construction, as opposed to this this bit of design, and almost treating in complete isolation, rather than taking into account anything else around it. It's intrinsic to it to, you know, to a collaborative innovative scheme, but it's not the only part of it, and it needs everyone else to get it to work.*
>
> *Focus Group 3*

However, this language of synthetic thinking is considered something that is generally omitted from professional courses.

[7] RIBA Plan of Work, 2013

> *But it can come back round to education, because if we're not suitably educated in, say, structural engineering, we find that hard to challenge what he's saying, and that's the only way you can do it.*
>
> *Focus Group 3*

The professional distinctiveness engendered within higher educational courses is perceived to be further extended in industry, where the work of associated professional bodies is not considered to be supportive of interdisciplinary synthesis.

> *I don't think the professional bodies support collaboration. They individualise it within your own sector.*
>
> *Focus Group 3*

This requires practitioners to be sufficiently self-motivated to learn this capability "*on the job*" (Focus Group 1).

> *Your course must have been unique, I think, coz I don't think I got taught any of that stuff at university. I absolutely learnt it all on the job and, yes, collaboration might be common sense, but it's common sense if you're a common person, and not all of our people are common. They're quite uncommon and, you know, I think it is something that you can benefit from some learning.*
>
> *Focus Group 1*

Participants also acknowledged that interdisciplinary, synthetic thinking requires direct interaction between consultants, rather than via a project manager.

> *Another thing that doesn't work so well is when you've got project management in the middle, which is very usual many times. But sometimes, it can stifle innovation, coz you have to go and explain everything and they go to explain it to someone else. But you need this connection with people who actually work on the project.*

Focus Group 2

Intra-team behaviour

Participants noted that there were different team member propensities for pro-collaboration behaviour. Whilst design team members would universally "*have to accept that it's going to take an effort*" (*Focus Group 1*), there was a perception amongst older members that new entrants to the profession were more motivated to collaborate toward innovation.

> *There's a balance between experience and innovation, and ideas. You guys have a lot of good ideas, I'm sure, and good ideas. We are too battle-hardened and rule out that thinking, and that's a shame.*
>
> *Focus Group 2*

This difference in perceived generational propensity to collaborate and drive toward innovation appears to be counteracted by company hierarchies, which implicitly impose a barrier to collaboration and idea generation for more junior members. This can be imposed by expectations that more senior members will carry out more of the interactional tasks.

> *I think often, if only the senior person goes to the meeting, the brief work is actually done by somebody else. If the person who's actually doing the work goes to the meeting, is the person who is actually doing the work? On a project I was recently working on, if we'd only met each other, had a chat, when we go back to offices we could ring each other. So, you have to go back through the chain to just ask a really simple question - just go straight to them.*
>
> *Focus Group 2*

Alternatively, barriers to collaborative behaviour for junior staff can be imposed by the responsibilities of senior staff toward company brand protection, which can inhibit the adoption of new ideas.

> *The guys that design the buildings here today have a great relationship and they will work collaboratively. And then there's an internal review process where the higher up they are, then in terms of protecting the brand, they're doing that.*
>
> *Focus Group 1*

This scenario is further exacerbated by the paradoxical situation where more junior staff may bring a fresh view to solution finding, but lack the experience or confidence to interject.

> *Sometimes you need to push yourself into the meetings that senior staff are talking in coz there's this mystique about older, more experienced people knowing about what they're talking about. Sometimes, the intuitive gut instinct is a valid one.*
>
> *Focus Group 2*

In a project team environment, where a particular subgroup establishes itself as more dominant, junior staff feel even less psychologically safe to interject, creating a dynamic where interruption or constructive challenge is absent from normative behaviour for those outside the dominant subgroup.

> - *So, I suppose you had some kind of planning meeting with some objectives?*
>
> - *Yeah.*
>
> - *But this individual group clearly wanted to be in control and not have anyone rise to it. That's not uncommon.*
>
> *Focus Group 2*

Participants then felt that, in these cases, innovation was likely to be stifled, as skill sets were effectively excluded from the group, creating a false guise of consensus.

> *I think it's quite funny how, sometimes, teams are put together by somebody who clearly needs all the skills in that team, but they don't listen to them, which is what happened there. It's the sum of parts? No, it's the sum of one part.*
>
> *Focus Group 2*

Company norms of collaboration and innovation can also influence similar norms in operation in the design team. For example, where a company fosters such norms between disciplines within the office, individuals find it easier to foster the same in the project team environment.

> *And on the microscale, even this office, we've got different disciplines spread all over the place and I see people, well I'm quite happy to blast up and down the stairs ten or twelve times a day, get my calories burned.*
>
> *Focus Group 2*

All focus groups recognised the potential of building upon in-house collaboration capabilities within their own offices, as a complementary aspect of design team interaction.

> *It's not just collaboration with other consultants, it's collaboration with us as well. [Participant name] is right. I do accept what you're saying, it's something that we could build on, but not just what you're trying to achieve, not just belittle, that's rubbish. That's not the idea, but we need to do something.*
>
> *Focus Group 3*

Furthermore, it was perceived that individual comfort with technological methods for collaboration and information sharing varied amongst employees, though this comfort was not always helpful where it became the primary and dominant focus of attention.

> *There are people here who'll have their favourite area and feel very comfortable in Revit[8] modelling, and are in the habit of exchanging information very fast. So, it's very important to us. I think too we need to look at how we're behaving with each other on your projects. I know many of you are beavering away most of the working night, but make that work collaborative. Make sure it's a means to an end.*
>
> *Focus Group 1*

However, it was generally agreed that over-reliance arising from comfort with communication technologies can inhibit effective collaboration or idea generation. Practitioners within focus groups therefore emphasised the need consciously to select the appropriate medium for interaction and creative purposes. For example, participants tended to be in agreement that text-based online interactions were generally ill suited to the persuasive purpose of idea transfer.

> *You can also be more persuasive on a call just in terms of, you know, in like five minutes.*
>
> *Focus Group 2*

> *A lot of what's done as well, it's just putting people's mind at ease, isn't it? You just wanna let somebody know that you've got it. It's alright. It's sorted. You're putting people's mind at ease. It's much easier to deal with people after the phone call when you say look, I understand why you're worried about this, but don't.*
>
> *Focus Group 2*

Instead, ideas were considered best communicated via face to face interaction, especially where drawings were used as communal vehicles of intention.

> *I listened to how our former senior partner, [name], he used to sit in a, he'd actually have the confidence to sketch out his ideas on a piece*

[8] 3-dimensional CAD modelling software for BIM workflow and collaboration

> *of paper. It was a pretty poor sketch, in front of you, in front of people. To have the confidence to do that. Not everyone can do that and to sketch in front of the client as well. That's quite a skill, that. You very rarely see that now. You try to talk it. You try to communicate it through a more rigid CAD drawing or do a powerpoint, but actually, to do that physically and like you said, the social interaction of doing that in front of somebody, they get the message but much better.*
>
> *Focus Group 3*

> *I think when the engineer then grabs the sketch and adds to it, that kind of interaction is really healthy in the design process, and at [company name] we're pretty good at that.*
>
> *Focus Group 3*

As a result, the effort of face to face interaction is rewarded by shared understanding, personal investment, and ultimately group cohesiveness.

> *…it's only when you've articulated that and gone through it, and used those prompts, and actually built on the information. It needs to be face to face for me. There's nothing like hearing it first hand from the designer. You also get to hear their enthusiasm for it, which you can't bind into a drawing.*
>
> *Focus Group 3*

Some participants went further by positing that co-location of project teams offers benefits in efficiency and process innovation.

> *….coz we did all the MEP[9] work in 3d and used NavisWorks[10] to co-design at the end and see what all the inside spaces would be like. This was a star for collaborative working coz this was where co-location works and the whole team within about 6 months of starting co-located in an office......[company name] were co-located with us here in this office and we delivered the project on time that worked pretty well, but that seemed to be one where co-location worked.*
>
> *Focus Group 2*

Face to face interaction appears to play a role in building a social climate of trust, where individuals can trust each other to maintain, buy into, or even enhance their own vision of the successful project. However, this can take time to achieve.

> *We'll throw our own stuff into the mix we're not just here to work on what you think you're going to deliver. It's a creative environment and we're part of it. Erm and they looked at me and - this is strange - but after a few weeks of working but [name] and [name] and [name], they each knew there was great value there and they built up this great trust, and they began to play with us.*
>
> *Focus Group 1*

Thus, a climate of trust and respect can facilitate transfer of project vision, as well as empowering colleagues to become involved in decisions to which they would not normally contribute.

> *I was involved in a meeting last week with erm a couple of guys from [place] and the project is kicking off. It was quite nice to have an input, coz it's not my forte, electrical work, but it was good to have an*

[9] Mechanical Electrical Plumbing
[10] 3d modelling and real-time review software package

> *input. And it felt quite nice to be taken seriously, to have that trust to be able to say this or this.*
>
> *Focus Group 2*

> *They need to respect you.*
>
> *Focus Group 3*

'Banter' was widely discussed as a way that team members cultivate a shared climate of trust, as well as developing common bonds, from which to develop the professional relationship.

> *Banter's quite important, you know, to relax everybody. You know, to put everybody at ease.*
>
> *Focus Group 3*

> *It's having a shared interest, you know, you talk about football, you have a banter about football. It's having a shared sense of common beliefs or something that everyone can buy into, can come to a common point to discuss.*
>
> *Focus Group 3*

The sense of 'sharedness' established through informal interaction can then transfer to the discussion and evolution shared imagined vision of the successful project (Goldschmidt & Eshel 2009; Lloyd 2009; Luck 2009; McDonnell & Lloyd 2014), toward which all members can collaboratively work.

> *- I understand we're all different, but I also understand that we need to be piecing everyone together. We've all got personalities. It's trying to define, you know, what we see as success right from the start and then trying to work together to deliver that.*
>
> *- A joint vision of success at the outset.*
>
> *Focus Group 1*

Although participants were quite categorical in favouring face to face interaction for discussion beyond simple information transfer, it was also noted that poor quality face to face interaction can be detrimental to collaboration and the team's propensity for innovation. In some cases, the physical environment, combined with the dominance of certain members and the dynamics they impose, can actually cause physical and emotional discomfort amongst the group, where members do not even feel able to move, let alone contribute their ideas.

> *The room that I was in was really stuffy, really horrible. There was definitely one or two people who kept droning on and like it seemed like we had a programme for our actual meeting, but it seemed that 1 or 2 items took up so much time and there weren't sort of scheduled breaks. Like it just went on for two hours. Then, when the person who was talking wanted a break, you know, then it was great. Like I needed to go and, you know, get a coffee, and I got up and sort of like went to the coffee machine in the room, but even like that action made me feel a little bit, like, uncomfortable, and I don't think that was really good.*
>
> *Focus Group 2*

Other participants reported involvement in design team meetings where a lack of introductions at the outset prevented members from knowing the identity, discipline, or perspective of those with whom they were to collaborate.

> *I don't think it was a really well-planned meeting. I think, you know, sometimes to just get up and do some formal introductions even coz you come in and you're, like, so that person's talking, that I don't know who they are, so it's hardly like…*
>
> *Focus Group 2*

Similarly, it was noted that the meeting agendas should reflect and facilitate the project goals, especially where innovative outcomes are intended. Experiences suggested that meetings tended toward simple reporting of information, rather than offering opportunities for informal interaction, which may be better suited to the synthesis and development of ideas.

> *I think in multidisciplinary meetings, they only really work if there's, if you have an agenda - that's item one, discuss scope. Item two, review report. If you can engineer that agenda, such that you have a bit of group talk that you were going to do a bit, you know, stagger a bit of group, not talking, but doing, and maybe talking things but not just uploading an agenda. It's just hardcore going through documents. I think there is obviously the task of whoever sets the agenda and if they want to ensure a collaborative meeting, they can design an agenda that is conducive to that.*
>
> *Focus Group 2*

Views of inappropriate management of meetings in the context of the project's goals for innovation were widely expressed amongst participants, which resulted in one subgroup within Focus Group 1 calling for development of the professional role of design process facilitator.

> *I've found [architects] to be very uncollaborative and very 'we want you to do this now' and it makes you wonder, are these the best people to lead the collaborative process? And then I think, well, who would that be? And there are project managers in our industry and you can get great ones and not so great ones, but I generally find that they're paperwork people and they're not helping the collaborative process, and wouldn't it be better if we found a new breed of people who were actually trained in collaboration, and getting people to work together?*
>
> *Focus Group 1*

In addition to the management of design team meetings, the capabilities of individuals to persuade and engage their colleagues are considered to be critical to the success of face to face interactions.

> *The charisma and integrity you need to communicate an idea, you can't teach that. It's almost like you've got that or you haven't got that.*
>
> *Focus Group 3*

> *You can try and build up people's confidence and the ability to stand up and talk, but that, the ability to try and be clear, precise, and if you don't have that confidence that can back you up.*
>
> *Focus Group 3*

The degree to which an individual is comfortable in collaboration is perceived to influence their ability to be collaborative. However, their motivation to do so may be limited where they perceive that another team member does not fulfil their side of this informal contract.

> *He says the right words, but he never produces the information, and that's the flip side of it, where it just becomes frustrating.*
>
> *Focus Group 3*

In this case, the individual who is perceived to be 'loafing' (Erev et al. 1993; Karau & Williams 1993; Ellis et al. 2003; de Dreu et al. 2008) communicates with design team members, but does not deliver on his word, prompting scorn from his colleagues. The impact of the "*negative*"(Focus Group 3) member of the group is reported to have far reaching and tangible effects.

> *One person can actually change the atmosphere of a design team meeting. It can be very harmful and you can tangibly feel that sometimes in design team meetings.*
>
> *Focus Group 3*

This is not perceived to be true in the opposite case. Where an individual delivers and is admired for their competency, communication difficulties are accommodated.

Competency can outweigh some of the more objectionable characteristics though. If you know it you can adapt to that.

Focus Group 3

However, when the effort in collaboration proves productive, this sustains motivation toward the project goal.

I think that's really, really key to come away from a meeting or workshop knowing that you both worked through it.

Focus Group 1

However, if project goals are at odds or remain unresolved, then this may induce conflict amongst the team.

Yeah it's getting them to buy in. To some people it's just fee. It's just a fee.

Focus Group 3

Nevertheless, participants suggested that a pro-active response to competency or commitment challenges within the group is not embedded within project cultures, despite their clear effects on process or outcome.

- *If there's a perceived lack of respect for the project whether that's time commitment or whatever and you perceive that person isn't putting in the same effort that everybody else is, and it feels that that person is maybe the weak one.*

- *And nobody's willing to stand up and say that to that person, how do you deal with that?*

- *We tend to go, you just go and accept it.*

- *Oh, such a body's coming to this meeting, we go 'oh right.'*

> *- And you start to adapt yourself for that person which isn't the right way to go about it. We should deal with it, with their line manager or whatever, to say 'this is a negative to the process. I'd like to discuss this with you.' We might have to change personnel but it's detrimental to the process.*
>
> *Focus Group 3*

Focus group participants also indicated that project goals relating to process and outcome were influenced by differential company cultures, which may need time to synthesise towards a unified project goal.

> *We've been through the mill on it and come out the other side still smiling, but the challenge here was to feed this unmoveable massive microdetailed thing with information, despite our culture being full of ideas and fast moving, and collaborative, and creative - that's the word I'm looking for. It was a clash of cultures and we had to make it work and I think after nearly 6 years I think, in September, it'll maybe work.*
>
> *Focus Group 1*

A collaborative approach is required to facilitate this synthesis. This requires specific abilities and a pro-team motivation to mobilise potential.

> *It's not dominating them. You want to tease the best out of them.*
>
> *Focus Group 3*

Nevertheless, it is difficult to achieve this dynamic in larger schemes, where the project requires individuals in larger numbers than those conducive to group cohesiveness. Where groups become too large, peripheral or specialist disciplines are prevented from engaging due to the difficulty in sustaining attention.

> *I think the size of the meeting can change it quite a lot coz if there's too many people in the room you have an agenda that not everyone can say something about. And you might actually miss the bit on the*

> *agenda that you wanted to say something about, coz you've got to sit through hours of it. We all work on different bits of the project so not everything is relevant to everybody. So, I think if we actually split into smaller groups, we might have a discussion that's much more productive rather than have to sit through 3 hours of droning.*
>
> *Focus Group 2*

The social team.

The project team was described by participants as a predominantly professional entity, as would be appropriate to the workplace context. However, some participants described the design team as a social entity, in that its interaction was not necessarily limited to formal, task-focussed exchange. In these cases, it was recognised that conscious organisation of social interaction towards social cohesiveness promoted performance effectiveness.

> *I think just getting everyone who's going to be involved in the project in a completely non-work environment, so that everyone can actually meet each other is a big, just a good start, coz simply by just turning up to a meeting, realising that you're going to be tested on your technical ability by people you don't even really know the name of, coz you haven't been introduced to them, is a good way.*
>
> *Focus Group 2*

Such interaction organisation was characterised by a prevalence of face-to-face meeting, hierarchical equity, disciplinary equity, and opportunities for non-task-based discussion.

> - *On one I've really enjoyed is where we've viewed each other as the design team, well most of us on the design team were on a level playing field really, and it's the form and function that went in hand in hand. So, it was a really good rich dialogue right from the start.*

- Were you all socially connected? Did you all go out for beers and stuff as well?

- That was something I was gonna say, actually. We did do that. There was. At the end of each stage, you'd go out for a a pub lunch, you know, or something, or and that really.

- Can I ask what the balance of face to face meeting or remote meeting was?

- It was virtually all face to face.

Focus Group 1

Individuals also gained motivation from their association with inspiring team members, which contributed to their positive attitude to their job.

We work with some great people. We're really lucky.

Focus Group 1

These alliances with inspiring people were also considered to be directly linked to propensity for innovation.

It's an inspirational design team that gets the innovation done.

Focus Group 1

The creative outgroup

The focus group discussions appeared to affirm the existence of the 'creative outgroup,' which was recorded in the survey findings. A degree of resentment appears to have been established within participants' design teams due, in the main, to the architect being the primary guardian of the project vision. This guardianship appears to have emerged through tradition, but is maintained by the architect's tendency to have a proximate client relationship. This relationship supports views of non-architectural disciplines, which hold that the architect is likely to have more time to deliver a perceivably better outcome due to the more specialised nature of the engagement of other disciplines as subconsultants.

> *I think another thing is that there's a strong focus on the deliverable in your own contract, and you make sure you deliver what you are contracted to deliver within timeframes, within constraints. Whereas architects can take the time they need to do what they need to do. They can take the time to breathe, whereas we have to do it all in the space of 2 weeks.*
>
> *Focus Group 1*

Non-architectural participants also held the view that architecture tends to attract individuals who are less likely to engage in collaborative activity.

> *I think it's interesting the personality profile for people, you know like the Briggs Myer's[11] thing. If you did that, you'd find a correlation between collaboration and people, and their character, and personality. And I think the obvious thing is, you know, architects generally believe that the project, the design, is their vision and you've got to try and deliver it, in a way. I think as well, the types of characters and personalities that are led to doing architecture are part of it too.*
>
> *Focus Group 1*

This view, to a degree, is confirmed by an architect who expresses that he perceives the creative vision to emanate from his discipline, with collaboration conceived as a process of persuasion of other disciplines to align with architects' expectations.

[11] Myer's Briggs (MBTi) Personality Type Inventory

> *- Is that where creativity and collaboration is separated? Creativity is handed on. You do your sketch and it doesn't, actually, go beyond that point of handing over. As you say, you take their word as*
>
> *- You take their word that that's the only way it's possible to do it.*
>
> *- Coz you're not educated enough to challenge it from their discipline.*
>
> *- As a creative, it would bug you and you just muddle through and try and come up with your own solution. But then it's just persuading them.*
>
> *Focus Group 3*

The architectural role of creative guardianship also engenders a reciprocal resentment of management disciplines, which are considered to circumvent creativity in favour of process efficiency and delivery, as accorded by the post-Latham (1994) and Egan (1998) creation of their roles.

> *- I would say the architect predominantly holds the aspiration for creativity. If it was a design manager or contractor, I don't think they would be interested in design quality. They're just process. All they're interested in is a certain process that they want to go through but we're also, whilst I want design excellence, I'm also getting pressure, certainly, from the [client name] that that's the budget. That's the budget. We can't go any further than that and it's trying to balance the two, and that's the difficulty sometimes. When you want to do something really creative...*
>
> *- Shouldn't that push innovation though?*
>
> *- Yeah, but not if you're on a deadline.*
>
> *Focus Group 3*

This appears to highlight emerging group delineation between those who seek to pursue creative outcomes and those who are focussed upon delivery.

> *They just suddenly appeared one day didn't they, project managers, like from nowhere. It always used to be us. No joke, the project manager from a number of meetings said 'yeah, thanks for coming and [name], over to you.' Yeah. So, he basically said, 'I'll take the money, designers go away and do it!'*
>
> *Focus Group 3*

6.6 Discussion

The social psychology anchor themes, which were deduced from the survey findings to have potential application to the AEC-domain (Table 5.9), were presented to focus group participants to direct thinking and discussion. Participants' responses to these sub-themes were subsequently recoded to generate AEC-specific sub-themes. These new themes are discussed below, with reference to the originating anchor themes.

Motivation and reward

Intrinsic motivation, maintains its relevance to the study. It is implied in the conflicting facets of 'professionalism versus profit.' Here, the conflicting intrinsic motivation to deliver an innovative outcome and contribute to industry improvement is at odds with the extrinsic need to deliver profit on behalf of the employer. Similarly, 'intrinsic motivation' is implied within the new 'professional identity' theme, which establishes intrinsic, disciplinary self-identity as a determinant of thinking styles and preferences for introversion or extraversion in collaborative practice.

Extrinsic barriers were reported in relation to issues of 'time and workload.' This was originally implied in the social psychology literature review that generated the original theme. However, 'extrinsic barriers' were also experienced by focus group participants within the new theme of 'interdisciplinary knowledge.' The content within this thematic category suggested that the degeneration of the collaborative relationship to one of subservience to the perceived project leader can also have significant detrimental impacts on motivation and performance. Conversely, successful collaborative interdisciplinary learning in the design team is reported to be a significant motivational factor.

The social psychology themes which highlighted reward structures, and the dual tendencies toward co-operation and competition, are directly relevant to the emergent 'procurement' AEC theme. However, the confirmation of the value of non-financial reward by focus group participants, directed generation of the 'feedback and recognition' theme.

Risk attitudes

The 'sharedness' of the project vision established within the 'motivation and reward' theme was connected to themes in the 'risk attitudes' category. In sharing a vision of the future building, participants also expressed that the collective propensity for risk in a project should also be shared at the outset. This was considered to facilitate better collective creativity. This suggestion is reflective of the theoretical constructs in the social psychology literature, which generated themes of collective risk tolerance and collective risk responsibility.

Social climate

The social climate of the group, categorised within the social psychology originating themes as 'cohesiveness' was generally recognised as conducive to creativity and innovation within the design team. These are described within the AEC theme of 'intra-team behaviour.' Cohesiveness in the AEC sector was widely considered to be influenced by communication medium selection, which was highlighted as critical to the successful transmission of design ideas and intentions. The recurrent issue of the 'shared vision' of the project was interpreted as a manifestation of teams' cohesiveness – or the desire to be so – in relation to group task cohesiveness.

A multiplicity of relationships within the group were reported to influence psychological safety, the absence of which was reported to be particularly stifling of collaborative creativity. The behaviour of the client and of the perceived project leaders, and the longevity of relationships were reported to be of significance in this regard. Group hierarchies were also considered influential on perception of psychological safety in relation to the likelihood that novel ideas would be presented.

Norms of interaction, including communication medium choices, and behavioural protocols operating in meetings, were recognised by participants. Some cultural norms, such as whether or not constructive challenge was acceptable, were reported to inhibit the development of a social climate for innovation. More positively, social comparison, was observed, in some cases, to promote creative thinking, as individuals pushed themselves towards better performance in the company of people they perceived to be 'inspiring.'

The possibility of the additional theme of the creative outgroup, established in response to the survey findings, was also affirmed by focus group participants. As a result, it is maintained as an AEC-specific theme towards inclusion in the framework.

6.7 Summary and implications for the framework

This chapter has presented the findings of the thematic analysis of data produced during the focus group interviews. The thematic analysis highlighted an array of AEC-specific content within the social psychology sub-themes of motivation and reward, risk attitudes, and social climate. This content, emerging from the focus group discussions is, however, insufficient to describe causalities and correlations in detail. However, the following key themes were identified as warranting further exploration:

1. Client
2. Procurement

3. Practice guidance
4. Professionalism vs. profit
5. Time and workload
6. Innovation drivers
7. Feedback and recognition
8. Professional identity
9. Interdisciplinary knowledge
10. Intra-team behaviour
11. The social team
12. The creative outgroup

These themes will be discussed in parallel with those generated by the case-study observation, and collated within the framework proposition in chapter 10. A case-study observation of a design team in practice has also been conducted as a parallel study to validate and expand upon the self-reported experiences contained within the findings presented in this chapter.

In addition to the self-reported nature of the findings presented in this chapter, a further limitation of this section of the research relates to its exploratory nature. The self-reported experiences of the participant sample were considered suitable for the exploratory nature of the research, but it is emphasised that the emergent themes and discussion points are not presented as generalisable findings. Such findings would need to be produced following an alternative research design, which would need to be implemented beyond the scope of the PhD, and in response to the emerging framework.

7. OBSERVING THE SOCIAL PSYCHOLOGY THEMES IN PRACTICE: A QUALITATIVE APPROACH

7.1 Introduction

Whilst the focus group study examined self-reported experiences of the socio-behavioural themes in practice, the nature of these self-reports may be considered subjective. Research methodologies have long recorded subjectivity and bias within self-report measures in psychology (Austin et al. 1998; Fan et al. 2006; Navarro-González et al. 2016), as well as other fields such as management (Sharma & Shakeel 2015), health (Bound 1991), and economic (Siminski & Yerokhin 2012) sectors.

The current research stage intends to complement the self-reported findings of the focus group study via direct observation of a design team in practice. This research stage, therefore, shares the following objectives of the preceding focus group study:

- To explore how the socio-behavioural constructs emerging from the literature review and survey manifest themselves in AEC practice.
- To elicit key socio-behavioural themes that influence creativity and innovation in AEC teams.
- To examine the relationships between the socio-behavioural themes that influence creativity and innovation in AEC teams.

Whilst observations of participants in live environments are not without their own inherent biases, subsequent comparative analysis of both data collection methods was expected to highlight thematic prevalence across both data sets. This chapter, therefore, presents the methodology, results, and narrative findings of a complementary study to the focus groups, which strengthen and append those findings.

7.2 Observation methodology

Some social psychologists are emphatic in their call for more direct observation of actual behaviour (Knee et al. 2005) to counteract the growing reliance upon self-reporting measures (Baumeister et al. 2007). Observation, as one of the most basic methods of psychological study can be applied as a method for data collection, from which to infer new meanings in relation to the social world (Howitt 2010; Banister 2011; Silverman 2011). Its benefits include, not only its performative capabilities in the real-world context, but also methods by which behaviour, artefacts, and events can be systematically described (Marshall & Rossman 2011). These are employed in a myriad of significant studies of social interaction from Bales's (1950) analysis of group interaction to the development of perspectives relating to childhood aggression (Hartup 1974). These studies analyse the recorded data which may include verbal and non-verbal gestures quantitively, qualitatively, or using a mixed methods approach in order to interpret meaning or construct theory (Henwood 2004; Silverman 2011). Recorded observation allows for the checking of accuracy or distortion in self-reported findings, as well as the chance to observe situations as objectively as is possible within the scope of the study and the limitations of the method (DeWalt & DeWalt 2002; Marshall & Rossman 2011).

The importance of using naturally occurring interactions has been emphasised in studies of social interaction, in contrast with the experimental 'contrived' scenarios implemented for many psychological research studies (Atkinson & Heritage 1984; Silverman 2011). Collection of naturally occurring data was considered most appropriate for this study as it would lend itself well to the exploratory interpretivist approach, without requiring hypothesis-testing, which would be more applicable to a positivist, experimental research design (Atkinson & Heritage 1984).

Data could have been collected by participant research, where the observer becomes fully immersed in the activity or culture to be studied, so that the phenomenological experience can be actively investigated (Wisker 2001; DeWalt & DeWalt 2002; Silverman 2011). Total immersion was not considered appropriate for this study due to the potential intrusion and obstruction to the professional activity, as well as potential inadvertent manipulation of its outcomes (Wisker 2001).

Non-participation involves passive observation of the participants with complete separation between the observer and participant(s), for example behind a one-way mirror (Anderson 1939) or unobtrusively from a distance (Qualter & Munn 2005). In addition, a non-participatory approach would allow simultaneous team dynamics to be observed, recorded and analysed.

Participatory positioning at either polar extreme of total immersion or separation was not deemed suitable for the current study. Firstly, the nature of the project context and purpose required a positive and trusting relationship with the design team to be nurtured. This was due to the commercial sensitivity of the case-study project and the wishes of the design team to maintain commercial protection of any innovative outputs. This necessary trust was more likely to be cultivated via a non-covert researcher involvement. Secondly, manipulation of the social dynamics would need to be avoided. Whyte (1979) encompasses even minimally overt researcher presence over an extended period of time to be participatory. Hence, in the interests of continued involvement; a naturalistic environment; and data immersion to support inductive analysis, a semi-participatory role was selected in response to Whyte's minimalistic definition. In the interests of accuracy; exploration of 'normal' behaviour; objectivity; and ease of data collection, direct semi-participatory observation in a naturalistic setting was therefore selected as the preferred methodology for this stage of the research.

This method of observation raised concern regarding collection of skewed data, because participants may change their behaviour as a result of researcher presence (Lincoln & Guba 1985), a phenomenon known as the Hawthorne effect (Diaper & Diaper 1990). In this instance, the Pygmalion or Rosenthal effect (Rosenthal & Babad 1985) may also be valid as the observer presence may suggest to participants that they will need to fulfil high expectations in relation to collaborative teamwork skills. However, the need to maintain a long-term relationship was in itself both a trade-off for the potential bias as well as the mechanism for its minimisation. This is because the prolonged engagement with the design team created trust and understanding of mutual endeavours, nurturing relaxed, more natural behaviour on the part of the participant. It also increased understanding of behavioural nuance on the part of the researcher. The longevity of the relationship, thus, helped to reduce potential distortion by both subject and researcher.

During face-to face meetings, the researcher sat separately from the design team and conversation was avoided unless directly invited from the group. During conference calls, the researcher acknowledged presence at the commencement of the call, but refrained from conversation thereafter. Similarly, the researcher did not contribute to online discussion unless she was specifically requested to do so. Where the researcher was engaged in conversation, this was limited to making arrangements for forthcoming face to face meetings or informal, non-project relevant conversation following a meeting's end.

Study participants

A case-study project was identified as the subject for the observational study. The project was a national test case for investigating the standards and practice of BIM Level 2 process on a virtual construction project. The project was funded by Innovate UK to develop best practice guidance and deliver a tool for BIM Level 2 project management. Their success in delivery of the subsequent innovation was evidenced by their becoming finalists at the 2017 Building Awards in the BIM Initiative of the Year category. Hence, the project team were brought together with the explicit purpose of creative thinking and innovation delivery and maintained this defined purpose throughout the life of the project. This suggested that the case-study would be predisposed to creativity and innovation and so, influence of the social psychology sub-themes should be more readily observed.

The design brief itself comprised the following elements (though site specific information has been removed in accordance with ethical procedures):

1. Development of 'self-build on a shoestring' residential units.
2. Mixed use development to provide new retail space and Grade A office space.
3. Public realm area adjacent to the river.

(Case Study Client 2015)

Design team members had been partly self-selected from the client's own network and in part directly approached for involvement based on disciplinary knowledge and skills required to successfully deliver the outcome. Not all design team members interacted regularly or frequently with the group. However, a total of 19 design team members were recorded. Their names were removed at the point of data analysis in accordance with ethical procedures and they were given unique codes (Table 7.1) according to their discipline affiliation using the same groupings applied during the survey study. Disciplinary affiliation was determined using judgement based upon self-reported job role, professional institution membership and degree or higher degree title. These three pieces of information were collected prior to observation via short questionnaire and consent form. Numerical identifiers were also included in the order that they participated in the observation. The resultant coded identifiers are used to distinguish between speakers in the discussion of thematic outcomes in sections 7.5-8.

Multimedia interaction

Formal team interaction occurred through a variety of methods. Given their dispersed geographical locations across the UK, the team agreed early in the process to minimise face to face meeting so as to minimise cost. Between meetings, they interacted via regular conference call and also using a member-only online discussion website on a continual basis. Individual members of the team sometimes spoke directly with each other outside these formal channels.

The observational study selected only the formal channels of team interaction for data collection as these were open to all team members. This allowed a comprehensive and inclusive picture of team dynamics to be recorded. Recording of only the formal team interactions also served to minimise observer intrusion into the project.

Study Discipline Groups	*Architecture/Design*	*Engineering*	*Management/Financial*
Participant codes	A1 A2 A3	E1 E2 E3 E4 E5 E6 E7 E8 E9 E10	M1 M2 M3 M4 M5 M6
	n=3	*n=10*	*n=6*

Table 7.1: Observation participation identification codes

Recording methods

The three varying interaction methods required three different recording methods. Face to face meetings were recording using three cameras fixed to tripods. Each camera and tripod was located in the room so as to maximise visual capture of the verbal and non-verbal expressions of each member present. Cameras were set to record at the programmed start of the meeting and recording was stopped once the team had agreed its finish. The audio-video file from each camera was then transferred in mp4 format into the data analysis software.

Conference calls were accessed via unique telephone number and access code issued within the hour prior to the programmed start. Prior to the start of the call, the telephone was set for audio through its speaker and this was recorded using a digital voice recorder. The resulting audio file was then saved as an mp3 file for use in transcription and subsequent analysis.

Conversations held on the discussion website were organised into ‘channels’ according to the subject being discussed. Each channel was copied into a text file on a regular basis. This text comprised data containing conversational content, as well as the name of the individual making the statement, and the time that he or she made it.

The three interaction media and their associated recording methods resulted in a hierarchy of data richness afforded by each. The richness of the data that could be used for analysis was dependent on the scope of expression that could be recorded, whether as words only, verbal expression, and non-verbal expression (Table 7.2)

		Interaction format		
Observation media	*Recording format*	**Words only**	**Verbal expression**	**Non-verbal expression**
Online forum	Text file	■		
Conference call	Audio recording	■	■	
Face to face meeting	Video recording	■	■	■

data richness

Table 7.2: Interaction media and data richness

Observation timeframe

The project was initiated during September, 2015 and is ongoing at the time of thesis submission. The project programme was established in accordance with the Royal Institute of British Architects' Plan of Work (2013) as is the standard method of working in the construction industry. The project intended to run until the end of the design phase and prior to commencement of the pre-contract phase resulting in the following programme (Table 7.3):

RIBA Work Stage	*Description*	*Completion Date*
Stage 0	Strategic definition	14th October 2015
Stage 1	Preparation + brief	10th November 2015
Stage 2	Concept design	8th December 2015
Stage 3	Developed design	5th January 2016
Stage 4	Technical design	2nd February 2016

Table 7.3: Case-study project initial programme (Case Study Client 2015)

This programme would have been synchronous with the data collection phase of the PhD programme so that all design stages could be accommodated in the analysis. However, several factors influenced significant delay to this programme. For example, one key factor in programme slippage appeared to be the team's shifting focus from design delivery towards dissemination of their 'learnings.' This transferred a significant amount of attention and time away from design and process progress towards preparation of presentational material and publication. It is indeed possible that some of these factors may have been influenced by the social themes of motivation and reward, risk attitudes, and social climate, and these will be discussed later in the chapter in relation to the study findings.

It was not possible to observe the team throughout the full design phase, due to the delay to the case-study project programme. As a result, the team were observed until the concept design phase (RIBA Stage 2) between October 2015 and May 2016. Within this timeframe, a significant amount of data was collected across the three media contexts, as described in Table 7.4. This provided theoretical saturation in relation to the early design phase. However, theoretical saturation across the whole design phase could be achieved via a more longitudinal study.

Media	*RIBA Stage*	*ID*[1]	*Date*	*Duration (hh:mm)*
Face to face meeting	Stage 0	F1	10/11/15	03:13
	Stage 1+2	F2	24/06/16	04:16
Conference call	Stage0	C1	30/10/15	02:21
	Stage 0	C2	05/01/16	00:54
	Stage 0+1	C3	18/01/16	00:23
	Stage 1	C4	29/04/16	00:44
	Stage 1	C5	05/06/16	00:36
	Stage 1+2	C6	10/06/16	00:32
Online forum	Stage 0,1,2	OF	October-June	Continuous

Table 7.4: Observation schedule

Observation was carried out, therefore, for a total of 12 hours and 59 minutes, with parallel continuous recording of online conversation for a period of 4 months.

[1] These source IDs are noted as references in the thematic discussion of observation findings. For ease of cross-reference, they are expanded in full as footnotes on the relevant pages, as follow:
F1: Face to face meeting 1
F2: Face to face meeting 2
C1: Conference call 1
C2: Conference call 2
C3: Conference call 3
C4: Conference call 4
C5: Conference call 5
C6: Conference call 6
OF: Online forum

7.3 Thematic analysis methodology

The same thematic analysis methodology used for the analysis of focus group data was also used to analyse the observational data. This was, in the first instance, to facilitate comparability across findings so that prevalence and significance could be determined across methods of interpretation and result formats. Additionally, application of the same qualitative analysis methodology was considered appropriate given the common objectives of both studies.

The emerging focus group data were captured via audio file, which was subsequently transcribed. In the case of the observational study, audio transcriptions were supplemented by additional and richer data formats. These included the video files recorded by the cameras during the observations. These were also imported into nVivo, version 11 Pro (QSR International). Within the software, each file was named according to observation date and ID (Table 7.4) and organised in folders according to media type.

In parallel to the focus group analysis, the following steps (described in detail in section 6.3) were also followed in performing the thematic analysis:

1. Transcription and immersion
2. Initial theme-driven coding
3. Data assignment
4. AEC specific data-driven coding
5. Review and definition of domain specific themes

The results of the thematic analysis are presented in the next section. The narrative descriptions and thematic maps of resultant AEC-specific themes are presented in section 7.5.

7.4 Results of the thematic analysis

The thematic analysis found an array of data from each media type that could be categorised within the social psychology anchor themes of motivation and reward, risk attitudes, and social climate. Within each anchor theme, the prevalence of aggregated source references to AEC-specific sub-themes was noted. Within the 'motivation and reward' anchor theme, the highest five prevalent AEC-specific constructs were as follows:

1. Motivation derived from positive external recognition.
   (19 references)

2. Conflict between professional role to improve industry and profit-led goals.
   (13 references)

3. Motivation derived from quality of output and collective success.
   (13 references)

4. Engagement derived from possible future successes.
   (11 references)

5. Demotivation due to lack of prioritisation of compliance to standards.
   (10 references)

In relation to attitudes to risk, the highest five prevalent AEC-specific constructs were as follows:

1. Risk to team potential profit by expanding stakeholder engagement.
   (16 references)

2. Risk of potential negative views external to the team.
   (14 references)

3. Commercial privacy conflicts with industry sharing.
   (13 references)

4. Risk of conflict with industry agencies.
   (12 references)

5. Corporate risk conflicts with industry improvement.
   (12 references)

In relation to social climate, the highest five prevalent AEC-specific constructs were as follows:

1. Dominant members filter external engagement.
   (12 references)

2. BIM process partitions disciplines inhibiting overlap.
   (11 references)

3. Disciplinary partitioning within industry.
   (11 references)

4. Confusion caused by process complexity.
   (10 references)

5. Individual conflict caused by conflicting guidance.
   (10 references)

In performing step 5 of the thematic analysis, the review and definition of domain specific themes, an ordering pattern of significance emerged. Examination of the subject headings described within the anchor themes above highlighted the multilevel nature of the actions and expressions of the individual. These combined multilevel actions and expressions were likely to either be dissonant or harmonious with the group, as a whole. This reflected the theoretical context (Brown 1929; Lewin 1935; Lewin 1936; Lewin & Lippitt 1938; Lewin 1954; Read et al. 1997; Chicken & Posner 1998; Loosemore & Chin 2000; Baiden et al. 2003; Pryke 2004; Zohar & Luria 2005; Hennessey & Amabile 2010; Reynolds et al. 2010; Burnes & Cooke 2013; Cash et al. 2015; Morrell 2015; Poirier et al. 2016; van Amstel et al. 2016) as well as the findings from the focus group study.

Study of the candidate codes, therefore, generated in the thematic analysis facilitated an ordering according to the nature and level of agency according to which an individual will act when operating in a design team. These levels of agency were:

1. Individuals as agents of the construction *industry*

2. Individuals as agents of their professional *disciplinary* affiliation

3. Individuals as agents of their *company*, by whom they are employed

4. *Individuals* as agents of themselves, accommodating their own preferences and motivations.

Thus, social behaviour of design team members can be determined as a gestalt agency comprising these levels. Thematic maps relating to the four levels of agency are presented in Figures 7.1-7.4. and discussed in detail in Sections 7.5-7.8.

When exploring the data in relation to the individual's perceptive experience as a representation of the construction industry (Figure 7.1), a prevalence of themes is apparent within the motivation and reward anchor theme, and especially in relation to the role of industry in supporting and facilitating recognition and feedback for the innovative outcomes of projects.

When exploring the data in relation to the individual's perceptive experience as a representation of his or her discipline (Figure 7.1), a prevalence of themes is apparent within the social climate anchor theme, and especially in relation to the synthesis of interdisciplinary knowledge toward an innovative outcome. Although not strictly contained within the analysis of the three anchor themes, a competitive aspect to disciplinarity was observed with an implied derogation of the architectural discipline in project process as well as friendly conversation.

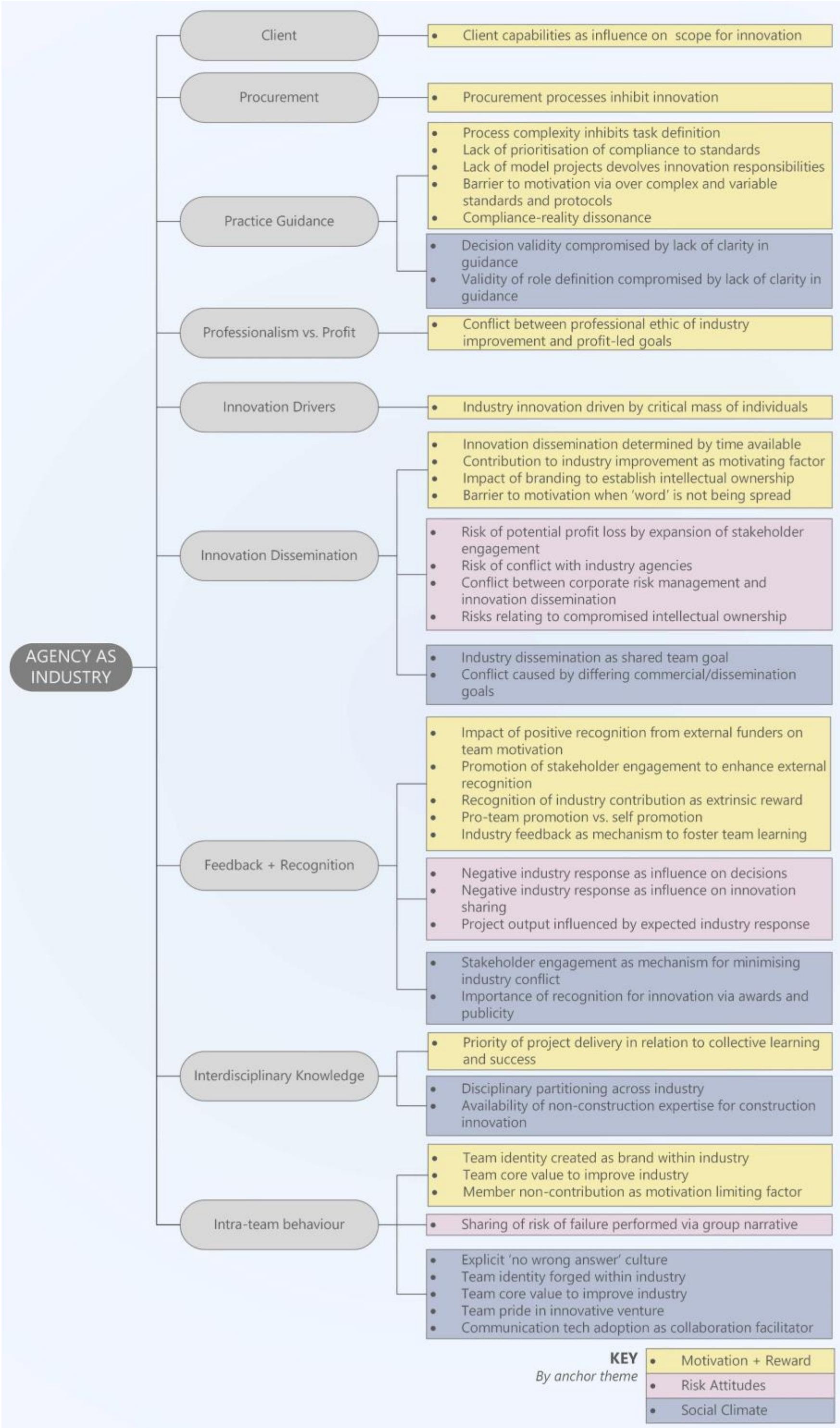


Figure 7.1: Thematic map - agency as industry

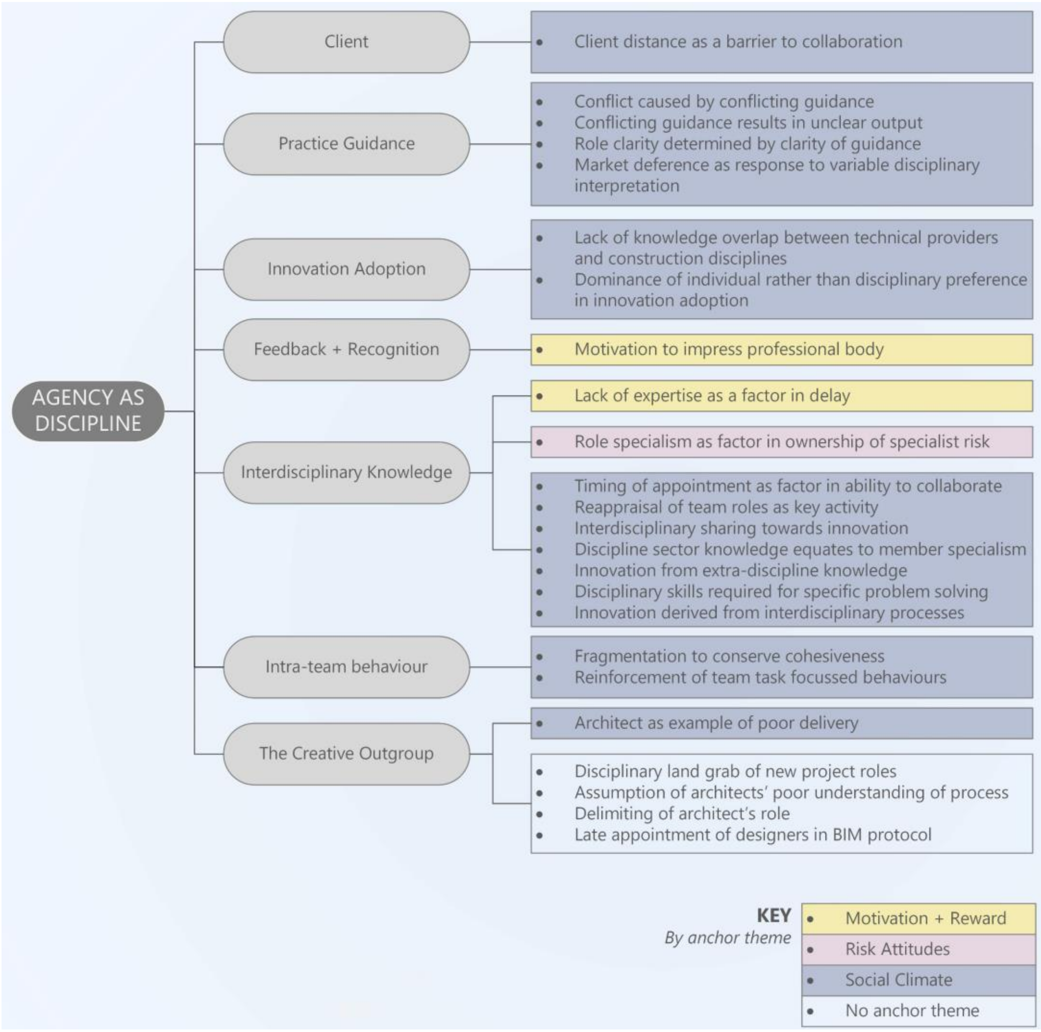


Figure 7.2: Thematic map - agency as discipline

Figure 7.3 suggests a lesser variety of themes employed by an individual as an agent of their company than for the other three levels of agency. The company appears to influence individual's action within the design team, predominantly with regard to their motivation and incentives to collaborate as well as providing sufficient scope for creative endeavour within their workload capacity.

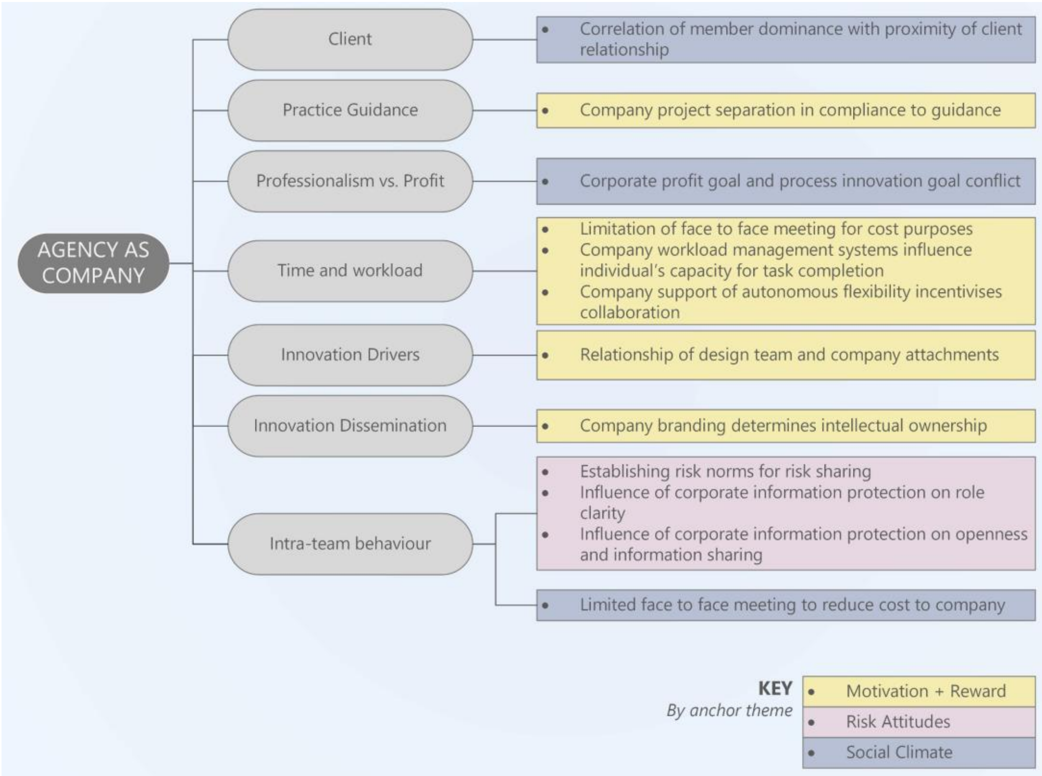


Figure 7.3: Thematic map - agency as company

It is not necessarily surprising that more themes were attributed to agency at individual level than to the other three (Figure 7.4). Within the gestalt, interactionist perspective of the analysis, the 'individual' is defined as the predispositional characteristics or temperament that interact with the situation to stimulate observable behaviour (Reynolds et al. 2010). Self-categorisation distinguishes individual identity as separate to affiliated groups, such as the 'team,' 'industry', 'discipline' or 'company.' (Tajfel & Turner 1979; Haslam et al. 1997; Reynolds et al. 2010). It may be suggested, therefore, that this difference in agency categorisation may induce differences in perceptive responses to external stimuli based upon the primacy of the self and the more readily retrievable self-schemata when active in the interaction space during social cognition (Markus 1977; Gaertner et al. 1999). Thus, the role of individual agency may be inferred as having a stronger influence on the motivation of teams to collaborate towards innovation.

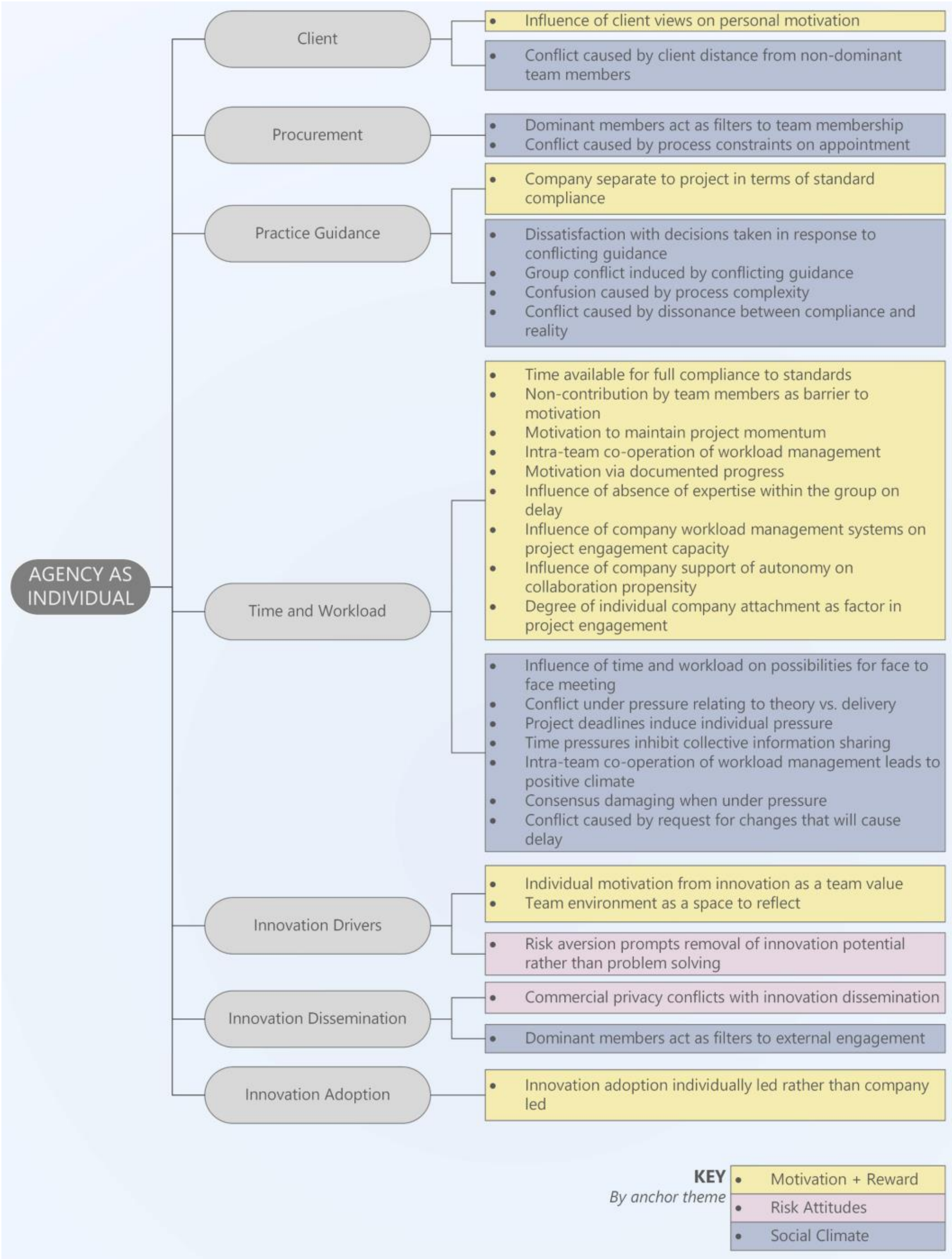


Figure 7.4: Thematic map - agency as individual [continued overleaf]

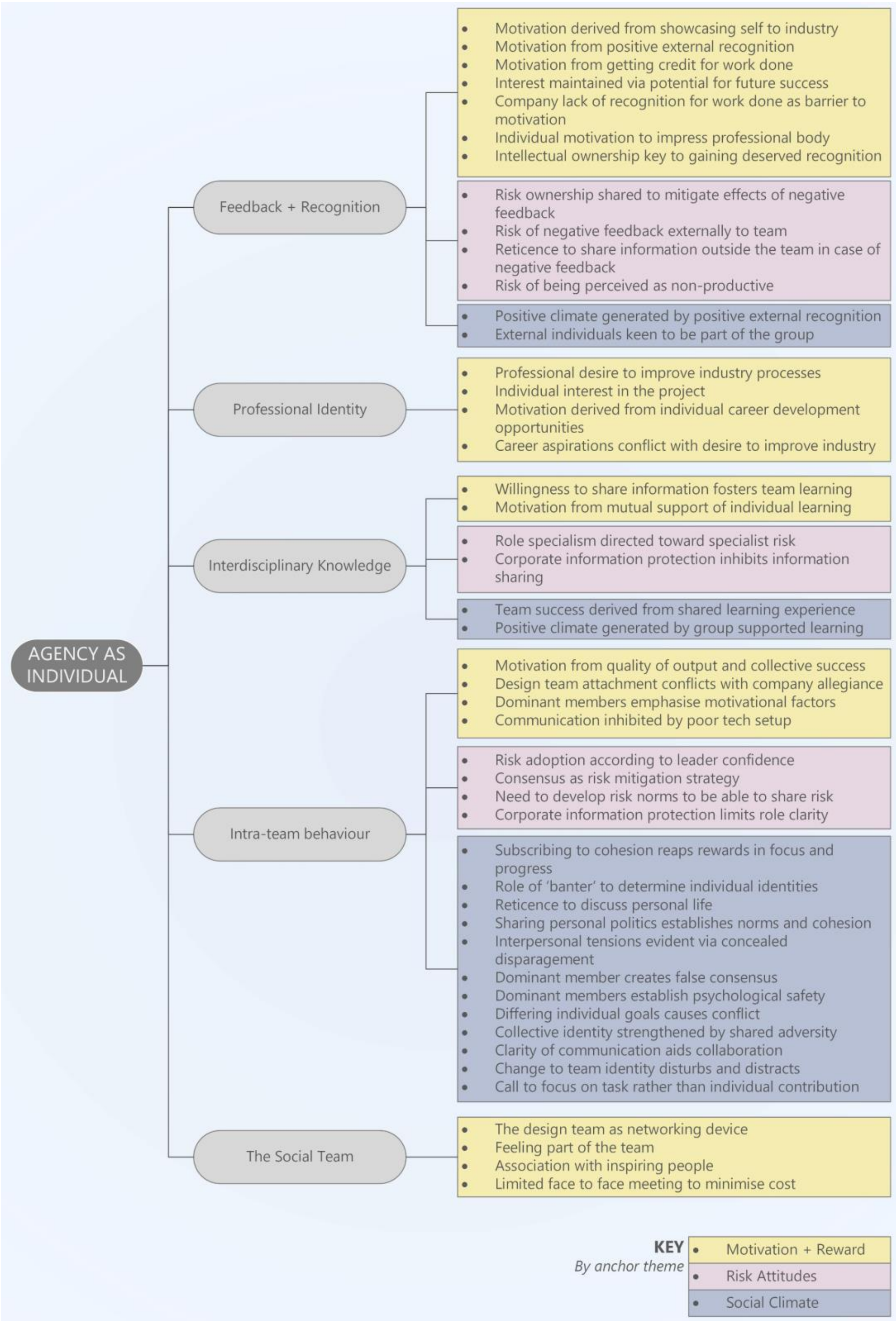


Figure 7.4: Thematic map - agency as individual [continued overleaf]

7.5 Thematic discussion of industry-level agency

The AEC specific themes derived from the analysis of the anchor themes are discussed in sections 7.5-7.8. In the discussion, measures have been taken to protect commercial and individual privacy of participants in accordance with approved ethical procedures (Section 4.4). These measures include expression of names of individuals as the identifying codes set out in Table 7.1. and removal of commercial identifiers such as locations, companies and names of individuals external to the group. Sources of quoted material are stated with reference to Table 7.4, but also included as footnotes.

Client

The pivotal role of the client is perceived to be critical to the group's potential for pursuing innovative outcomes on this project, although this is contested amongst the team. For some members, the client maintains the role of determining expectations in relation to the task, whilst for others, it is the team who should educate the client in relation to its possibilities.

> *E3: It is up to the team to decide. Specially [A2] who will be doing the concept design.*
>
> *E2: Yes and No. It's up to the client to set requirements. Whether the delivery team decides to stick to that, it's up to them. And any changes can be negotiated with employer and set out in MIDP[2].*
>
> *E3: Blue sky thinking Yes it is the client who must specify these requirements. However clients our architects deal with, they have no idea what LOD[3] even stands for. Usually architects help them to set these types of objectives.* *[OF][4]*

[2] Master Information Delivery Plan
[3] Level of Development (though sometimes Level of Detail)
[4] Online forum

On speculating upon this issue, the team imply that the capabilities of clients to expect or support the novel approach may present a barrier to subsequent innovative performance.

Procurement

Knowledge relating to industry protocols and practices within the construction industry is also described as insufficient, particularly within the procurement process. Following the team's facilitated discussion with attendees at the industry conference, they record in the online forum that procurement managers are unable to understand and assess novel approaches (in this case BIM Level 2) within tender submissions. They identify that this is both a skills issue as well as a lack of tools or techniques for organisational capability assessment.

Practice guidance

A significant barrier to the design team's ability to innovate on this project, is the sheer complexity and variability of the practice standards relating to BIM and project protocol. The team highlight that guidance, standards, and tools are frequently produced by individual disciplinary bodies but are not always coherent across these disciplinary boundaries. Furthermore, the large number of these standards, which are not always co-ordinated, means that the project team is not able to comply with all of them. This requires a prioritisation process that is incumbent upon the design team as prioritisation recommendations do not exist at the overarching industry level.

> *M1: When we're looking for compliance, how far do you go and how does has anybody got the expertise to ensure that they've got this falls, this does fall compliant?*

[C3][5]

[5] Conference call 3

In light of this complexity, the team appeared to feel that they made decisions that they weren't entirely comfortable with in hindsight. The complexity also hinders the team in defining clear roles and responsibilities.

> *A2: Yeah coz I've previously brought up about the clash detection erm and and sort of put myself forward for that. But we, we kind of, we've gone and said we'll discuss that at a later date. So, so, y'know, I've got the architectural role. The responsibilities with it that fall under that role are still sort of up in the air so…*
>
> *G: So how about we put a t.b.c.[6] on the pass then?*
>
> *[C1]*[7]

The difficult activity of determining roles and tasks within this complex environment not only demotivates the team in pursuit of their innovative venture, but also results in a negative social climate amongst the team in relation to their goals.

> *E1: Just don't have the energy to argue anymore [emoticons: unamused & pensive]*
>
> *[OF]*[8]

This negative social climate is manifested as heated online discussion in relation to the goal of compliance versus the goal of action in a real world context.

> *E3: Well then if you are saying this project will never work in reality, whatever produced within this project will be of no use what so ever to the industry.*
>
> *E2: The whole point of this project is to do things right. Not wrong like everyone else. We show the way. We don't mimic bad projects.*

[6] to be confirmed
[7] Conference call 1
[8] Online forum

[OF][9]

Professionalism versus profit

A prevalent subject of discussion within this design team is the tension held between a professional ethic of improvement for public good (Bordass & Leaman 2013; Bresnen 2013; Duffy & Rabeneck 2013) and the profit-led goals of industry. This code of professionalism embeds an altrustic intention amongst its institutional members that individuals and practices should contribute to the development and improvement of their discipline and industry. However, there is an inherent conflict between the profit-led commercialisation of innovative output and altruistic industry sharing.

> *A2: Around the issue of the DPoW*[10]*, I was under the impression that this is a government funded initiative to assist the industry in adopting good working practices. I can't see how they could commercialise it as its going against what it's intended to achieve. I'm sure there would be uproar from industry!!*

[OF][11]

This conflict inherent in the project also causes design team members to feel conflicted in their motivations towards innovative effort.

Innovation drivers

The design team motivation towards altruistic industry sharing is further challenged by the difficulty in reaching interested individuals. This requires significant work on the part of the design team to engage "*individuals who are all over the place*" *[F1*[12]*]*

[9] Online forum
[10] Digital Plan of Work
[11] Online forum
[12] Face to face meeting 1

to explore the details of their practice, without deference to the generalised reporting of the institutional bodies.

Innovation dissemination

The shared altruistic motivation of individual professionals to disseminate innovative outcomes faces numerous barriers in the case study project. This is not least due to the time to disseminate information which is in addition to the time taken above normal practice to produce innovative outcomes in the first place. This results in frustration amongst the team when dissemination of information is not being further dispersed by parties outside the design team. It also presents points of conflict as individuals interact to define the group's objective in this respect, with dominant roles determining final direction, with acquiescence from submissive members.

> *M1: Well, this is where you go, this is where I think the endgame is - either we sell this thing and we all make loads of money, but that's not how you do it. You make it open, then people can have a crack with it and go 'oh, I can't use it. You're the experts in using it' and you make money from that. Just think of it as money eventually.*
>
> *A2: I think the idea is to make it user, user-friendly though.*
>
> *M1: Well, it is, and that's when you make it open and it's not user friendly, then you're making it difficult.*

[F1][13]

An apparent additional criterion for design team motivation relates to the likelihood that they will receive due credit for their innovative output and this becomes an area of interest that tempers their altruism with personal reward.

> *M1: You know, there is the potential that people want to run with these documents and we want the credit, and the, I don't know if*

[13] Face to face meeting 1

there's any rights to the information, but you know it'll all come back to us.

[C1][14]

The concept of branding of their work is agreed by the design team as a way to mitigate the risk of losing the commercial potential of their innovative work and to protect their intellectual ownership. However, protection of corporate privacy of their individual organisations is also an area for concern. The team are, thus, required to compromise the quality and value of their output by removing organisation-specific sensitive information from information to be shared with industry.

A2: I think it would be useful for people to see, to be honest with you.

E2: We could just have a mock up one that just doesn't actually reflect anyone's company, but sort of responds to these questions from..

M1: I think, okay listen, definitely no to this information. There's no point. That's the last thing we wanna do is, if we publish something that's not right.

[F1][15]

Feedback and recognition

This design team was evidently, significantly, and extrinsically rewarded by positive recognition from industry. During numerous discussions, they expressed anxieties about possible ways to obtain positive recognition or ways to protect themselves against criticism. This was particularly the case where positive recognition may lead

[14] Conference call 1
[15] Face to face meeting 1

to the securing of further funding. With this as a primary concern, they prioritised stakeholder engagement to elevate levels of awareness of their work across the industry:

> *M1: I don't know is the answer. So, I need to meet, meet with them and what, what, coz funding might not mean cash, it might mean you get someone to work on a website for 2 days a week, or it might be you get free access to something, or I don't…*
>
> *A1: Or…*
>
> *M1: I literally, literally, don't know, but they are keen. They are aware of our multi - they're aware of all of you. Erm, I've just got the [location] office as the main point of contact, so we're basically, I'm going to meet them with our [project] office the [location] office…er… I think the intention, then, is to have a conf' with everybody, so everyone knows what's going on.*
>
> *A2: Yeah, that's brilliant.*
>
> *A1: Cool, yeah. [Name], if you can get them to give me a raise that'd be good. Heh heh heh heh…*
>
> *[C1]*[16]

Individuals felt particularly rewarded when their contribution to industry was recognised, presumably as it confirmed a positive aspect of their professional identity. This culminated in a celebration of their achievements at an industry conference which afforded positive effects to the team's social climate both before and after the event.

> *M1: well done everyone - we got our messages across*
>
> *E1: Cheers [M1].*

[16] Conference call 1

> *A1: One good show can change the world. Great job. Great crack well done team I'm proud of all of you. Enjoy your selves and give yourself a pat on the back*
>
> *[OF][17]*

Whilst promotion of the work to attract external recognition was valued by the group, this was qualified as team-based rather than self-promotion.

> *M1: We need to be a bit selfless, and actually…*
>
> *[F1][18]*

Industry feedback was not only valued as an extrinsic reward. It had a further role in fostering team learning in an evolutionary process of testing the fitness of their ideas across the wider professional landscape.

> *M3: 'Coz one of the things, one of the really useful things is, that comes out of what we're doing here, is we crystallise a decision making points for attention that are subjective, that you do have to make a decision around, and I would, it might be interesting to throw them out to a group of people and say, well, I just, at this point in the project, faced with this problem, what is it that you, you would do, and you can capture that back and put it back into the project as intention, and look at what the project actually did do. Yeah, what was, what was the decision that we made and why, and we generate some discussion around the choices that have been made.*
>
> *[F1][19]*

However, the valued rewards of positive recognition from the industry had an opposite scenario. Positive recognition for their innovative work was not guaranteed

[17] Online forum
[18] Face to face meeting 1
[19] Focus group 1

and the industry environment was not always considered a psychologically safe place for expressions of failure. This fostered risk aversion amongst the group who sometimes altered their riskier decisions and outputs in light of anticipated feedback. For example, when the planner highlights feasibility issues in relation to the construction of the project in the floodplain, the group are unsupportive as the new information will undermine their previous work.

> *A1: I'm just voicing not the obvious negative peer review we will receive for the [project name]. Should we continue down this path we need a architect to justify this in writing. and at the very least something in the learning to say that in the real world what effect this would have on the project. if we ignore this we will be penalized.*
>
> *I think the path of lease resistance is to make it very clear that it is a totally abstract project, Also who make the decision here I guess it is in the hands of the Client. I do agree that the process is the most important step.*
>
> *[OF]*[20]

This conflict results in the planner leaving the group and the team rationalise the information as an irrelevance to minimise the risk of industry criticism. The issue is not mentioned again but instead, the team are mindful to engage stakeholders as a more constructive method of protection against industry conflict.

> *M1: Erm, so I think with the [external agency] bit is, I think before we put on our newsletter what we want to say, but, but we want to be, you know, with a keen eye, but before we release our newsletter later, we will, erm alright, we will obviously discuss that with [external agency] because the last thing we want to do is p**s them off and they don't want to talk to us about it, coz we want to work with them.*
>
> *A1: Absolutely, yeah, if we're criticised, you know, by [external agency] in any way, we definitely need to talk to them first.*

[20] Online forum

[C1][21]

The design team adopt this new, more constructive strategy of early stakeholder engagement, in dealing with an external agency, careful to consult them on their proposals before progressing the project or publicising its outcomes.

Interdisciplinary knowledge

The purpose of the project as a test case for implementation of BIM Level 2 protocol prioritised interdisciplinary learning as a core value for the team. This purpose had arisen not only from an industry need but also from a practitioner perspective that the team environment provided a space for interdisciplinary reflection that was needed on all projects but not always possible.

> *M3: Yes, and one of the benefits we've got here, and we said this right at the start, is that we there isn't a sort of capturing of that learning. You don't have the time to do that on a project, because you have to deliver it, but on this we have got a load more space to think."*

[F1][22]

Despite the collectively valued goal of interdisciplinary reflection, the design team are challenged in overcoming the disciplinary partitioning inherent in industry protocols and practices.

> *E2: Yes, on that note, you're thinking about my needs, right? But I'm as a QS on the other spreadsheet, right, and on the other spreadsheet, I have to consider your drawings. So, is that a, right, like an overlap of your requirements will be my requirements for you, or is that…*

[21] Conference call 1
[22] Face to face meeting 1

> *M1: No, I think it's almost a stand alone. Here's a whole project team - you get your tab and you think about it in your own little bubble.*
>
> *E2: Yeah, that's what industry does best, isn't it?*

[F1][23]

The industry level disciplinary partitioning, thus, presents a barrier to delivery of the team's additional value of a multidisciplinary approach to their innovative endeavour. This barrier incites some mild conflict within the team in relation to this value. Overcoming this conflict and delivery of the multidisciplinary innovation is recognised by the team as beyond the expertise of construction industry professionals, as it requires non-construction technological capabilities to deliver an information system that can transcend disciplinary boundaries.

> *A1: Y'know, if you're gonna make a password, use it to this guidance whatever it is, y'know, I, I, I think that, er, maybe the wrong people are setting us up. Maybe what we don't need is construction people. Maybe what we need is an I.T. egg head, y'know*

[C1][24]

Intra-team behaviour

Following convergence of support towards the team's primary goal of industry improvement, the team focus on fostering a dynamic of cohesiveness towards fulfilment of this goal. This results in their generating a team specific brand which they use to protect intellectual ownership. Additional benefits of this branding also include motivation of the team toward delivery of this value as well as strengthening of group cohesiveness, by strengthening collective pride and individual attraction to the group.

[23] Face to face meeting 1
[24] Conference call 1

> *A1: I would still dedicate my free time to this project with no funding. Because this [project name] is a valuable project.*

[OF][25]

The cohesive climate promotes the explicit 'no wrong answer' culture as an expression of psychological safety that encourages its members to contribute risky ideas for discussion.

> *A1: Effectively, there's not a wrong answer, really.*

[C5][26]

Where potential failure may need to be presented to industry, the group cohesiveness facilitates collective risk sharing by group narrative, using the plural pronoun to describe potential risks of failure as collective action.

> *M3: … and we could be criticised, coz we've not done it the way that we said, but we've got those justified fails. We haven't failed. We just decided to not do it that way, because this doesn't make sense.*

[F2][27]

Group cohesiveness is sustained between face to face meetings by employing industry standard communication technologies, which enable informal interaction on a daily basis. However, the team acknowledge that the capabilities and acceptance within AEC to support use of these technologies to be limited in comparison with other industries.

> *A1: Well, I think we should focus some of our efforts on working remotely, I mean this with the utmost respect but, I find the typical 37.5 Hr a week 9-5 herd mentality a bit boring. If we were able to promote working remotely and lose the travel I think it could save us a lot of time and resources, the AEC industry seems behind, web*

[25] Online forum
[26] Conference call 5
[27] Face to face meeting 2

designers, or software developers seem better off, as they can work from home and simply attend meetings, rather than clog up the roads everyday for a job that could be done from home, or in an exotic location of sorts. just a thought?

[OF][28]

This is expressed both by individual team members, but also recorded during the facilitated discussions with groups of practitioners during the industry conference.

7.6 Thematic discussion of discipline-level agency

Client

Against the backdrop of the late appointment of the design team within BIM procedure, the design disciplines were established not only at a psychological distance from the main group, but also from the client. This was realised by appointment of a non-design related client advisor.

M2: So, if you're on some sort of framework with them, then you will be advising them.

M1: Yeah, I know. Agreed. I appreciate that. Totally, I agree with that [M2]. There's absolutely got to be representative, but that representative might be like a project…

M2: Generically, generically, you would have a client advisor, but it could be directed so…

M1: I KNOW, BUT LOOK! But I don't think they would have the entire design team appointed coz if you look…

[C1][29]

[28] Online forum
[29] Conference call 1

It may be inferred from this client-architect separation, that project vision and definition now relies upon communication from members of non-architectural disciplines. There is a risk in this scenario that architects are now unable to obtain answers to architecturally-nuanced questions and resultant information may be filtered according to non-architectural priorities.

Practice guidance

Within the complexity and variability of industry standards of practice and guidance in relation to the BIM project, disciplinary roles and responsibilities reflected the assumptions and relationships within the design team. Where assumptions of architects' low capabilities existed, this resulted in exclusion of the architect from specific project processes.

> *E3: Blue sky thinking Yes it is the client who must specify these requirements. However clients our architects deal with, they have no idea what LOD[30] even stands for. Usually architects help them to set these types of objectives.*
>
> *E2: You will be surprise that even some architects still trying to grasp the concept.*
>
> *[OF][31]*

This deference to team level assumptions and relationships in response to a lack of clarity in the guidance is also reflected in a similar lack of clarity in defining output requirements, which are interpreted differently by different disciplines.

[30] Level of Development (sometimes Level of Detail)
[31] Online forum

Innovation adoption

Definition and creation of a clear and user friendly result is perceived by the group as a necessity for subsequent adoption of their innovative output. However, the construction disciplines present, as well as those who inform the guidance, lack the technical expertise to implement them.

> *A1: But we can't all be expected to be, y'know, I.T. experts.*
>
> *[C1]*[32]

This lack of expertise presents frustration amongst the team who perceive this lack of expertise as a barrier to their innovative performance. Additionally, they perceived the lack of technical expertise across the industry as a further barrier to its adoption.

Feedback and recognition

At the discipline specific level of agency, feedback and recognition remained relevant to team motivation. However, this tended to be focused towards showcasing innovative work to respective professional bodies.

> *A: …when we come on to the [professional institution] bim conference, coz I've got some good ideas about how we can really showcase not just us as individuals, about the project as a whole. So, they're really, really interested in what we're doing.*
>
> *[F1]*[33]

Interdisciplinary knowledge

Motivation was hampered however by the absence of discipline specific knowledge within the group which caused delay to project progress. This was observed in the frustration of the team who had not included the necessary disciplinary expertise to

[32] Conference call 1

[33] Face to face meeting 1

provide maintenance information for the Government Soft Landings (GSL) requirement.

> *M1: So, Stage 1[34] we're being hamstrung by no GSL.[35]*
>
> *[F2][36]*

Absence of disciplinary knowledge was also implied as the cause of the conflict surrounding selection of the flood-prone site, raised by the planner who was appointed to the team after the feasibility phase. However, frustration was also expressed by the group in relation to the BIM requirements for timing of design team appointment, which, in the perceptions of the group, was too late to be able to inform project definition.

> *E6: Having reviewed the way in which we have done the [project name], I note that both the pre and post contract BEPs[37] have been done at Stage 0[38]. i.e. on the basis that the pre BEP is 'pre' design team appointment and the 'post' is after the design team have been appointed. So my question is this, if the latter ([project name] approach) is correct, what is the point of doing a Pre-contract BEP before the appointment of the main Designers - it seems like the wrong approach.. comments?*
>
> *[OF][39]*

This resulted in much discussion to resolve the ambiguity of the BIM document production programme balanced with timely procurement of disciplinary expertise as well as frequent reappraisal of disciplinary roles that were absent from the group. This ongoing management of disciplinary expertise, whilst likely to be helpful in terms of quality of outcome, was potentially at the expense of time available for creative activity.

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[34] RIBA Plan of Work Stage 1 Preparation and Brief
[35] Government Soft Landings
[36] Face to face meeting 2
[37] BIM Execution Plan
[38] RIBA Plan of Work Stage 0 Strategic Definition
[39] Online forum

The complexity of the industry standards and guidance introduced additional project roles which further confounded traditional disciplinary role definition

> *E6: apart from Figure 10 on page 18 of PAS1192-2[40], can anyone tell me where any descriptions as to the roles of: Task Team Manager, Task Information Manager and Interface Manager may be shown. I have a contractor who has asked how many of each we have at [company name] and despite me saying that the roles are a 'load of over complicated nonsense' and that we simply appoint a 'BIM Coordinator' for each project that warrants one - he still wants us to jump through some hoops!! Any advice or guidance would be appreciated.*
>
> *[OF][41]*

As a result, individuals found themselves performing tasks outside their traditional disciplinary boundaries as well as struggling to determine when traditional role-based actions should take place. Confusion tended to be resolved by market deference rather than by group determination according to their innovation goal.

> *E4: But, you gotta think, it's got to be what mass market tells you.*
>
> *[F1][42]*

In addition to quality of outcome, multidisciplinary expertise was considered vital to a full interpretation of the standards which rely on sharing of perspectives from which to gain a rounded view of appropriate action towards innovation. This can be summarised by the statement "*sharing things to shape stuff*" [F1][43], which was articulated by a group member as a philosophical value of the project team.

---

[40] PAS: Publicly Available Specification / PAS1192-2: Specification for information management for the capital/delivery phase of construction projects using building information modelling http://shop.bsigroup.com/Navigate-by/PAS/PAS-1192-22013/
[41] Online forum
[42] Face to face meeting 1
[43] Face to face meeting 1

Intra-team behaviour

As the management of disciplinary role presence required additional team members to be appointed, the team expanded in number. This presented difficulties in maintaining inclusive communication and consensus gathering in an already complex project environment. The team responded by imposing fragmentation of the group into separate entities

> *M1: But what I, what I said on twitter the other day, I see it as, right, the team's potentially a three tier team. So, tier 1 is a project delivery team, which is called right now, tier 1. So, that's all project delivery team and then, tier 2 is the client team, and then tier 3 will be those people that just come and go on the project as we need them.*

[C4][44]

This strategy of team fragmentation appeared successful inasmuch as it appeared to preserve the internal cohesiveness of each group. However, it also extricated members with specialist disciplines from the team identity of the main group and, thus, ingroup project knowledge. However, specialist contributors were rewarded with positive feedback when their specialist role was performed according to these group expectations.

> *E8: I also think there might be a problem with the south west green, so if you agree, I can do some analysis based on this design, you know, share it with everybody.*
>
> *M1: Perfect. I think that's exactly what we want. That's why you're here. Top of the class. Right, and hopefully when that thing in excel happens, we'll share round what we want to play.*

[F2][45]

[44] Conference call 4
[45] Face to face meeting 2

The creative outgroup

Evidence of the idea of a creative outgroup of design based disciplines was not explicitly expressed by the team. Nevertheless, when examples of poor delivery were cited, it was most usually the architect who was used as the subject of the hypothetical discussion.

> *M1: So, in a sense, you know everybody's rushing, coz the architect's taken too much time, so you need individual dates for individual tasks.*
>
> *[F2]*[46]

Repeated implicit derogation of the architect may have effected an ingroup/outgroup status within the team, although any causal links were unclear in the qualitative analysis of the social climate anchor theme.

However, when considering the idea of the creative outgroup beyond the three anchor themes, further evidence emerged. The team agreed that the definition of new project roles within BIM protocol had imposed an interdisciplinary competitiveness.

> *M3: This was one of my frustrations, that all the professional bodies were going for that landgrab to try and grab this new role. That's one of the ironies, but then also at the expense of looking at their, at their membership and constituencies. Something that did was this - the practice of the QS being neglected and it was the same for everyone. Everyone tried to grab.*
>
> *[F1]*[47]

Within this broad competitive context, the late appointment of the architect to the design team embedded within BIM protocol, further exacerbated disciplinary separation. The separation of design disciplines from BIM project process fuelled

[46] Face to face meeting 2
[47] Face to face meeting 1

assumptions of a lack of architect understanding in relation to project mechanisms, diminishing design as an integral leadership role to one of lesser specialist input.

> *A1: You can't expect, y'know, an architect to know the difference between his https and an ftp, really, y'know.*
>
> *[C1]*[48]

Such assumptions are mutually held by both architects and their colleague disciplines, as their capabilities are determined by role precedents on other projects.

> *A2: Sustainability isn't really my bag, to be honest with you. Whilst I'm not…in order to do that, experience wise, it's not something that an architect is getting pulled in to date.*
>
> *[F2]*[49]

The architect's diminished position is further exacerbated by the frequent jocular derogation of this specialist input.

> *M1: Jesus, okay, that's quick. Right, so architect's done his stage 2*[50] *design in a week. Well done. I didn't know this architecture was so easy.*
>
> *[F2]*[51]

7.7 Thematic discussion of company-level agency

Client

The link between member agency as company employees and propensity for the design team to innovate, was observed in relation to client proximity. Where companies supported close links with clients, such as via long term framework

[48] Conference call 1
[49] Face to face meeting 2
[50] RIBA Plan of Work Stage 2 Concept Design
[51] Face to face meeting 2

agreements, individuals from those companies present in the design team were best placed to communicate with and to advise the client.

> *M2:…so if you're on some sort of framework with them, then you will be advising them.*

[C1][52]

This ability to filter and control client requirements and feedback directly influenced group decision making, positioning that individual as more dominant within the team.

Practice guidance

Within the complexity of BIM protocol standards and guidance, the team confirmed the absence of company influence on project delivery methods.

> *E6: just listening to [A2] do we highlight that BIM Level 2 is not about 'individuals' or 'companies' being Level 2 compliant and explain that we should be thinking about the 'Project' being Level 2 compliant i.e. make the point that Level 2 is about the entire journey...*

[OF][53]

This quote implies that project was perceived as a journey, collectively conducted by the design team, rather than the capabilities of individual companies or professionals in relation to the varying standards.

[52] Conference call 1
[53] Online forum

Professionalism vs. profit

Prioritisation of profit-led goals were a key influence on individuals as agents of their affiliated companies. These goals were clearly exhibited as being in tension with those of the altruistic innovation goal, mutually held within this design team.

> *M2: Copyright doesn't work in the light of your previous statement about making everything open.*
>
> *M1: It doesn't, but that's why there's two options - we can sell it or make it open, then sell it afterwards*

[F1][54]

As a result, conflict emerged between those who were members of companies and were keen to "*pricify*" [F1][55] the innovation and the specialist academic members of the group, who saw this as "*going against what it's intended to achieve" [OF]*[56].

Time and workload

Typically, the main contributor to a construction consultancy's income is the chargeable output of its employees. Hence, companies are likely to aim towards maximising deployment of this chargeable resource. It is, therefore, quite usual to find practitioners holding membership of a number of design teams across a number of projects. This presents challenges in managing time and workload, according to company expectations. Members of this design team established a group norm at its outset that member workload would be respected by limiting face to face interaction.

> *M1: We've tried to minimise our face to face, coz of costs and time, which I think we should continue, and that's a good approach*

[F1][57]

[54] Face to face meeting 1
[55] Face to face meeting 1
[56] Online forum
[57] Face to face meeting 1

The design team also considered their project productivity to be enhanced where an autonomous work ethic was supported by their company.

> *E2: I cant believe you spent that much time for all that lol all I have to do is ring in on the day and say I feel like working from home, as [M1] said flexible working style. You dont need to drive 2 hours a day to show your motivation, we have a project and a deadline, the path is clear.*
>
> *[OF]*[58]

Companies similarly determine design team contribution via their own specific workload management systems, which may include approval of annual leave irrespective of project requirements.

> *E2: I'm gonna stop there folks, i'm feeling very lonely on this task that we all KTP associates agreed to do. (I understand about people on leave)*
>
> *[OF]*[59]

However, the effects of company-approved, annual leave appeared to be detrimental to the motivation of others to continue with tasks in their absence.

Innovation drivers

As the case-study was a temporary, project-based team, as is usual in the construction industry (Barrett & Sexton 2006; Emmitt & Gorse 2007; Love et al. 2011), it was expected that team members would afford increased attachment to their roles as agents of their respective companies by whom they were permanently employed. However, it became apparent that this was not always the case. The

[58] Online forum
[59] Online forum

project was considered by most members to be valuable to industry innovation, as well as an opportunity for professional learning and development. Hence, members tended to form stronger attachment to the design team.

> *E1: Started drafting my final report [Emoticon: crying_cat_face] ktp over in June !*
>
> *A1: What happen after KTP?*
>
> *E1: Plan at the moment to stay on with the company, as of yesterday I was fired up! Now not so sure [Emoticon: confused]*
>
> *[OF]*[60]

This implied that the project design team itself and the innovative value of the project can be factors, which motivate an individual to remain with a company, as the attachment to the group and the project can provide significant intrinsic motivation for the individual. Hence, this expresses Herzberg's theory within the construction industry, suggesting that company based hygiene factors alone are not sufficient in addressing employee motivation (Herzberg 1965).

Innovation dissemination

As respective companies legally maintained intellectual ownership of the innovative outputs of their employees, company representation was also required for project branding.

> *A2: Ah, ah, I think, erm, in consideration to the to the mugshots, it's not whether or not they go on there, I think it might be a good idea to, maybe, include some, er, company logos, or any academic institution logos as well next to the, er, the team section.*
>
> *[C1]*[61]

[60] Online forum
[61] Conference call 1

This embedded company affiliation within the identity of the design team, both internally and externally.

Intra-team behaviour

In the early stages of the design team formation, the team established a group norm of remote virtual interaction in deference to company costs. This norm was established in response to company pressures. There was no evidence of consideration relating to how design team dynamics and propensity for innovation might be affected by this response. Individuals further deferred to their company norms when interpreting procedures relating to risk management.

> *A1: Yeah, but you know everyone's got their own interpretation of it, of a risk assessment.*
>
> *[C5]*[62]

This may represent a reticence to embrace new techniques and concepts when dealing with the risks inherent in a project. The team also experienced corporate allegiance across the industry, in relation to sharing of pre-existing innovations and commercial protection.

> *M1: How many projects have been undertaken must have an element of bim? And I'd like to do it, but no-one is sharing that. No-one is showing what people have done and that's the thing that frustrates me, there must be some good examples out there.*
>
> *[F1]*[63]

[62] Conference call 5
[63] Face to face meeting 1

7.8 Thematic discussion of individual-level agency

Client

In this case study project, the client takes a supportive role, which many team members agree to be untypical of many construction projects.

> *M1: What this project is about, getting that workflow in our minds, obviously, how that's gonna work, and then it's quite difficult, because we haven't got a client screaming and shouting at us. We're forgetting there, that part of the rub.*
>
> *[F2]*[64]

This quote implies that a supportive client can allow design teams the space to think about optimal performance, whereas a client, who is committed more toward programme delivery than innovative output, is more likely to limit the latter aspect. However, should client feedback be limited, even for those in non-dominant roles such as specialists or technicians, the potential for conflict becomes embedded, as dominant members are scrutinised for possible client information filtration.

> *E1: Did [client name] come back to you with regard to… I was speaking to someone, I can't remember, and [client name] sort of shut me down, like he didn't shut me down, he said…*
>
> *A2: Ah, right, on the BRE?*[65]
>
> *E1: Yeah, BRE. Did that, did [client name] speak to you about that, or is he given you an update or anything?*
>
> *[C5]*[66]

[64] Face to face meeting 2
[65] Building Research Establishment
[66] Conference call 5

Procurement

Whilst initial procurement of the project team is executed by the client, later in the project, when the need for specialist roles become apparent, it is the dominant members of the project team act as filters and co-ordinators of group membership. For example, when one of the architects recommends a structural engineer who may be useful for the team, the dominant member of the team requests that he be the conduit for appointment by repeatedly emphasising that he should *"give me a call and I can have a chat with him"[C3]*[67].

BIM process also influences individual appointment to the group as it determines when specific roles should be appointed. Unfortunately, it also indirectly influences individual withdrawal, as conflict arising from late appointment, as in the case of the planner indicating feasibility issues relating to site location, presents individuals with the sense that they cannot meaningfully contribute to decision making.

Practice guidance

The team recognise that a design team's ability to navigate the complexity of the BIM Level 2 guidance depends not just upon company strategy and experience, but particularly the tacit professional knowledge derived from individual experience.

> *M3: What we're actually doing is giving content to that, because you're looking at the process, you're looking and you're going, well, actually, from my point of view, this, this, and this are not that important. That part has an impact on what went down and that's what we're getting involved with, and that's what that means for us.*
>
> *[F2]*[68]

[67] Conference call 3
[68] Face to face meeting 2

However, where this individual tacit knowledge is not available, dissatisfaction with group decisions begins to erode the social climate and introduce disintegration and conflict.

> *M1: You know, you know, don't get me wrong. This is just, this is arguing what we're just trying to piece it together, the other day. Now, if some people want to disagree with that, that's absolutely fine, but that's how we saw it.*

[C1][69]

This is exacerbated by the emergence of a fragmented purpose, which although all the team is cohesive in their valuing of innovation as a project goal, individual members struggle to unify their purpose to create an innovative outcome that operates in the *"ideal world" [OF]*[70] or the *"real world"* [OF].[71] The dual purpose is subsequently and divisively held amongst team members.

Time and workload

Workload pressures are one of the most significant factors that influence the motivation of individuals in this design team to contribute to the group's innovative work. The complex and variable nature of industry guidance creates further pressures within their constrained work schedules.

> *E1: The reason I'm asking the question is that there seems to be a metric s***-ton of different answers out there*

[OF][72]

---

[69] Conference call 1
[70] Online forum
[71] Online forum
[72] Online forum

Documented progress of the project is a motivating factor for individuals in the team. Demotivation occurs when time pressures increase. This demotivation is further exacerbated when individual team members fail to contribute.

> *E1: I think they should be there, as [M1] brought up a pretty good point before Xmas, asking the question of what the [company name] are actively contributing to this... (not pointing any fingers!!!)*
>
> *[OF]*[73]

However, the group strongly value the project and its potential outputs and this drives them tenaciously towards their goals.

> *M1: I, I think we gotta move forward. Whatever that means, we <u>gotta</u> move forward.*
>
> *[C2]*[74]

Certain instances, such as the flooding issue, demonstrate decision making at the expense of full resolution of design problems in relation to the tenacious progress towards the innovative goal. However, progress is more constructively maintained by intra-team co-operation relating to project workload when compromised by extra-team activities. For example, when one member has to focus on a professional exam, other members supportively step in to relieve her of project tasks. It might be speculated that, in this circumstance, they do this because this action reinforces the group value of learning, which, in turn, supports their innovation purpose. The team also maintain their minimisation of face-to-face meeting in support of workload management toward project momentum.

When time is particularly pressured, the group reject their preceding principle of consensus, valuing this less than the need to complete their task when positive external recognition may be at stake. Initially, a strategy of "i*s everyone happy with that*" [C1][75] is prevalent. This is repeated in the first conference call. On the day

[73] Online forum
[74] Conference call 2
[75] Conference call 1

before the industry conference, when pressure increases, presence on the online forum states that "*JUST ONE PERSON needs to take ownership*" [OF][76].

The recurring issue of 'ideal world' or 'real world' based innovation also generates some conflict as lack of resolution hinders progress. One member expresses his frustration in the online forum asking, "*can we stop drawing arrows between boxes and actually review what's already been produced*" [OF][77]. This is in response to a looming project stage deadline where 'ideal' programmes are being considered at the expense of 'on the ground' progress.

Innovation drivers

The group's inherent purpose to produce an innovative outcome is, in itself, a motivational factor for individual engagement in the project. Members tended to feel strongly about what they wanted to achieve, going as far as describing it as a "*love affair" [F2][78]*. This description appears to derive from the way innovation is produced, that is requiring more emotional and practical effort (Blau 1964; Amabile et al. 1986; Janssen 2000) than would be required of a 'platonic' project relationship. The perception of the design team as a unique collective also appears to enhance individual attachment and motivation towards their innovation goals.

> *M3: There's also a bit of me that feels that, as a group of experts involved, and I can't imagine that there's many other tables that have people like this around it, that some kind of comment that says, 'well, actually, looking at the kind of project that we're doing..'*
>
> *[F1][79]*

However, this individual attachment to the project and the hoped for positive external recognition, overshadows pragmatism in decision making as the issue of

[76] Online forum
[77] Online forum
[78] Face to face meeting 2
[79] Face to face meeting 1

flooding is ‘removed’ from the problem space in order to conserve motivation towards perceived success.

> *E4: yeah all you need to do for that is yeah turn your contours off on your plan and then no-one will be any the wiser will they if those contours are on it*
>
> *[F2]*[80]

Innovation dissemination

In principle, individuals within the group are encouraged to “*spread the word*” [OF][81] about the innovation project with the view to obtaining widespread industry recognition. In practice, however, dominant members had a tendency to discourage others from doing so, resulting in dominant members becoming filters to external engagement. This was observed in relation to one team members offer of his contact’s help in improving the usability of a spreadsheet. The team member is then deterred from pursuing this support in preference to the dominant member’s own contact. This is submissively accepted by the proponent of the initial suggestion.

Feedback and recognition

Individuals within the design team tended to be motivated by the recognition for their creative contributions. Positive recognition of individual contribution was received either in conversations at industry events, in online discussions or as expressions of interest to be part of the group from peer networks. In particular, motivation was enhanced by the opportunity to showcase themselves as individuals to the industry in addition to the project team as a whole.

> *M1: …when we come on to the [professional institution] bim conference, coz I’ve got some good ideas about how we can really*

[80] Face to face meeting 2
[81] Online forum

> *showcase, not just us as individuals, about the project as a whole. So, they're really, really interested in what we're doing.*
>
> *[F1]*[82]

Positive recognition clearly motivated individuals to work towards the innovative goal. However, the fact that this was likely to foster future project success or funding was also a motivating factor.

> *M3: …and, and [external agency] are wanting to fund this ktp. They're, they're looking at this and they're salivating.*
>
> *[F1]*[83]

The motivational factor of positive industry recognition and potential reward through future project success or funding motivated the design team to focus a significant amount of their activity towards sharing their creative thinking with as wide an audience as possible, especially using social media.

> *M1: …okay, I just think we've got to use all…there's been some great talk today and I think we just need to share it with everybody else, but we need to let people know it's there as much as possible. We wanna look cool too.*
>
> *[F2]*[84]

Conversely, the risk of negative feedback, which might make individuals feel that they were "*looking like an idiot*" [OF][85], prevented individuals from making risky but potentially innovative changes. Individuals' fears of negative perceptions were also experienced when the team lacked progress, feeling that they needed to appear productive in their innovative output.

[82] Face to face meeting 1
[83] Face to face meeting 1
[84] Face to face meeting 2
[85] Online forum

> *E2:….I see very little progress and I'm getting nervous about it guys. I've said it for weeks, I won't look like a clown on stage*
>
> *[OF]*[86]

Similarly, motivation to innovate was limited when it seemed unlikely that they would get recognition from their employers.

> *A1: Dropping [part of project name] is an option for me buddy. My main project has not much to do with this team work and I am not getting credit for this work even from [company name] side.*
>
> *[OF]*[87]

Professional identity

The strength of attachment to the project and the hoped for positive external recognition appeared to be tightly bound with the individual's professional identity. There was a visceral and admirable desire amongst the individuals to improve their industry and remain focussed on *"great output" [OF]*[88]. External recognition of their involvement in successful output is, then, inextricably linked to individual career aspirations.

> *M1:….if we can be the focal point for acid testing stuff in a multidisciplinary team, we're gonna be the people. People are gonna come to us to test more stuff, coz when we test it and we give feedback on it, and it's in relation to a wider project with all the other stuff linked in, it just gives us an elevated position.*
>
> *[F2]*[89]

[86] Online forum
[87] Online forum
[88] Online forum
[89] Online forum

However, individual differences between career aspirations manifest as conflict within the group between those who aspire to become pivotal in the industry as knowledge providers and those who aspire to *"make loads of money" [F1]*[90].

Interdisciplinary knowledge

The environment of psychological safety within the design team is explicitly created, not just for a space to present riskier ideas, but also as an acknowledged link between this climate and a success which can be measured by its benefits for all disciplines and roles in the team.

> *M1: [E1] raised an important - if anyone is unsure or needs to ask a question about what we doing, then they should feel free to ask away - there are no stupid questions. we want this project to work for everyone, regardless of their BIM knowledge*
>
> *[OF]*[91]

Intra-team behaviour

Individuals interacted with the group using technologies which facilitated conversation beyond the constraints of time, cost, and geography. However, at the industry conference seminars, it was recorded that practitioners felt that *"the construction industry is not conducive to collaborative working environments"* [OF][92] with regard to its culture and technological appropriation. This was further evidenced when poor technology set-up in meeting locations and individual set-up frequently prevented key team members from taking part in important conversations, subsequently dampening motivation towards contribution.

[90] Face to face meeting 1
[91] Online forum
[92] Online forum

> *E1: Guys im dead in the water here no network no internet in the office meaning no phones!*
>
> *[OF][93]*

Mutual learning towards innovation was thematic as a group value throughout observation of the case study project. Individuals received stimuli for this core value through repeated emphasis from dominant members of the group. This was verbalised implicitly within conversational narrative.

> *M1:…I just think we've got an opportunity to be different, to be interesting. I think we should take it and we need to work out what that looks like.*
>
> [F1][94]

The role of dominant members of the group in influencing decision making was also observed when the group were deciding whether to take a risk. This appeared to echo leader confidence theory (Burnstein 1969; Butler 1981) as the self-appointed chair of the meeting proclaimed that the group could move on to the next stage simply by stating "*I feel confident that we've answered the PLQs[95] maybe not 100%" [F2][96]*. The motion to proceed is carried by the group's silence. The role of leader confidence in influencing decision making is not employed when a riskier strategy is being discussed. This is so that the leader does not remain accountable for the decision and can attribute it to group consensus.

> *M1: but in light of those different points, all in all [E2], copy everyone in and we'll get an answer on that.*
>
> *[F2][97]*

[93] Online forum
[94] Face to face meeting 1
[95] Plain Language Questions
[96] Face to face meeting 2
[97] Face to face meeting 2

Dominant members are also influential in establishing a psychologically safe design team environment where individuals feel able to express their riskier ideas. They achieve this either by explicitly acknowledging acceptance of failure via a "no wrong answer" culture or by actively and visibly reassuring members following failure.

> *A1:…so it's kind of my cock up a little bit, er, proactive in that sense.*
>
> *M1: Right, right, don't worry about it.*
>
> *[C1]*[98]

It is evident that the mutual learning and success translates into a group cohesiveness which further motivates individuals to contribute to the innovative tasks.

> *E1: just looking at the success matrix again guys looks class! makes me proud to be a part of the group!*
>
> *[OF]*

Group cohesiveness is further reinforced by friendly 'banter' which, while at individuals' expense (in this case-study, in relation to nationality or dress sense), serves to determine a shared social connection for those who 'get the joke.'

> *E2: Dassault, they are french, don't trust them.*
>
> *E3: [emoticon: joy]*
>
> *M1: Au Revoir to those guys*
>
> *E2: Goodbye? Thats all you could find?*
>
> *How about: Qu'ils aillent se faire foutre ces cons. ?*
>
> *E3: Excuse Adrien's language*
>
> *E1: merde*

[98] Conference call 1

E6: mangetout, mangetout... [E2] is just not going to get that at all!

E1: ! only fools !

M1: Whats the french for duck a l'orange

[OF][99]

However, at the face to face meeting during the morning following the Brexit referendum result, the shared political perspective in the climate of perceived adversity serves to end this banter, which never reappears again during the term of observation.

M3: But what's the immigrant? Everyone's an immigrant.

E2: Yes, but it's like it's all conspired.

[F2][100]

The shared adversity of the pressured preparation and presentation at the industry conference also reinforces the team's identity and cohesiveness.

M1: [E8], you are welcome to present on your own or with others. Anyone else?
Tom - good luck, don't get dragged down with the [external agency] - keep it real instead [emoticon: smiley]

E1: will do! Ill have my [project name] hat on dont worry

[OF][101]

[99] Online forum
[100] Face to face meeting 2
[101] Online forum

Those who subscribe to the group cohesiveness reap rewards in task focus and success recognition, which is emphasised by dominant members to sustain motivation.

> *M1: I think we've made good progress. If we keep things up, we're gonna be a lot more focussed on delivering what we wanna do.*

[C4][102]

However, when the identity of the team is challenged from outside the group, these individuals become excessive in their criticism. When a funding body requests that the group change the project name, individuals strongly defend the title with no tangible or task-related motivation to do so.

> *M4: They are concerned about [project name] but not [part of project name] with other words?!!*
>
> *E1: Absolute w*****s*

[OF][103]

Maintenance of cohesiveness requires conflict to be resolved quickly, so that the team can maintain the core value of documented progress. Those who maintain views which are not compliant with group norms become subject to a concealed disparagement, which underlines their separateness to the cohesive ingroup. For example, when one of the architects expressed dissatisfaction with the decision to move on to the next work stage without complying to all the standards, he decides at short notice not to attend the face to face meeting. During the introductions, a minor disparagement implies the group tensions relating to this view and his decision not to attend.

> *M1: Have I left anybody, oh, er [A1], erm, what can we say there? He’s not here and, well, I think we’ll leave that there.*
>
> *E2: Don’t forget, you’re filmed.*

---

[102] Conference call 4
[103] Online forum

[F2][104]

Cohesiveness is also maintained by establishing a group norm of pro-task rather than pro-self action. For example, in relation to dissemination of activity via social media toward the highly prized positive industry recognition, the team are directed to, and comply with, instructions to disseminate information only under the design team identity, rather than their individual identities.

However, there are circumstances where attachment to the group and its norms conflict with company commitments. For example, the team wish to pursue excellence in production of the Employer's Information Requirements (EIR), which require sensitive company data to be included. From a company perspective, this information, which is to be widely shared should not be included. However, as a design team, they recognise that the data would contribute to the quality of the output. This issue was never fully resolved, but reflects a conflict that may be relevant to other cohesive design teams.

The social team

Tacit and individually held knowledge is valued by the team as a resource that will assist in directing innovation both in this project and those in the future. Hence, members recognise that design team membership can also offer a networking device that will support their own professional development through social interaction.

> *E1: I agree [E3] the only thing the [project name] has done here has given us a network to find all of us*

[OF][105]

The shared goals and mutual learning that exist within this network reinforce individuals' social ties to the group. They subsequently express these strong ties and identity through a vehement resistance to external pressure to change the name.

[104] Face to face meeting 2
[105] Online forum

E5: What is wrong with these people? _[external agency] :-/
*Talk to the f*****s rather than changing it last minute.*
This is a huge change. Logos etc. the whole 9 yards.
Have they said what the problem is? or is it someones ego boost?

[OF][106]

Once a more professional tone was adopted, the associated jokes regarding team t-shirts and tattoos evinced their group commitment.

7.9 Discussion

The thematic analysis of the case-study interactions confirmed many of the findings from the focus groups study in relation to the validity of the social psychology themes established during the systematic literature review and tested via the survey study. Furthermore, the observation methodology facilitated identification of the influence of multi-level agency which directed normative and adaptive behaviour of individuals.

Agency

Thematic analysis of the interaction data confirmed the existence and influence of multi-level agency in the behavioural process of dynamic interaction (Reynolds et al. 2010) within the group. This reflected Lewin's theories relating to gestalt psychology, where Lewin's 'life space' (Lewin 1954) was defined as the 'interaction space' across which team members normatively adapted and responded to the contributions of their colleagues. This normative interaction process directed the scope and nature of the innovation as an outcome responsive to the group dynamics.

In the case-study design team, multi-level agency was defined by a series of interdependent stimuli resulting from the role of the individual as a representative of

[106] Online forum

their industry, their affiliated discipline, company by whom they were employed; and the self. These interdependent stimuli of individual action cohered to produce behaviour that was regulated and mediated within the interaction space towards the collective outcome (Brown 1929; Lewin 1935; Read et al. 1997; Burnes & Cooke 2013).

Additional to the concept of multi-level agency, the thematic analysis also identified a number of the social psychology constructs established during the systematic literature review and tested for relevance in the survey study. These constructs are grouped by the social psychology anchor themes of motivation and reward, risk attitudes, and social climate.

Motivation and reward

Membership of the design team required individuals to subscribe to its purpose which prioritised process innovation and a creative approach to the project. Hence, individuals tended to demonstrate that they were intrinsically motivated towards industry improvement. This confirmed the presence of the social psychology theme, intrinsic motivation. Intrinsic motivation towards maintaining their membership of the group was also demonstrated. This was especially the case where discussions or activity focussed upon the uniqueness of their endeavour.

Design team members' intrinsic motivations to improve industry were, however, challenged by several extrinsic barriers. These barriers reflected Amabile's (1983) findings that extrinsic pressures can limit abilities for cognitive processing towards innovation. In this case, these pressures were exerted by a perceived over-complexity and interpretative variability in the practice guidance relating to BIM Level 2 procedures and protocols. Further extrinsic barriers were established by the actions of those external to the design team, namely the client and the company to which the team member belonged. Members expressed demotivation where there was limited capability of the client to expect or support their novel approach. Where companies managed the workload and absence of a team member without consideration of the project's delivery programme, then this also had the effect of demotivating the remaining members of the group.

The main reward structures of the project, in this case, were not financial. Members were primarily rewarded by positive recognition from each other, from their client, from their employers, but most importantly, from the wider industry. This may suggest that, where projects have innovation goals, then the direct availability of mechanisms for industry recognition of achievements will have a significant effect on performance. These mechanisms were, therefore, implicit as key motivational factors, which were categorised as motivational factors in the social psychology literature review. Additionally, the mechanisms for reaching individuals who were potentially interested in the innovation outcomes were also a motivational factor, giving purpose to their endeavour.

The strong collective purpose to improve industry processes in relation to BIM Level 2 projects defined a prospective reward that was co-operatively gained and would be co-operatively held as a team entity. However, a contradictory purpose was also implicit in their discussions. Team members, as agents of a commercial organisations, were also mindful of the prospective rewards that might benefit themselves or their companies in the future. These rewards were sought on a pro-self basis and included, for example, future commissions or funding. Hence, a tension appeared to be produced by the varying pro-social and pro-self motivations across the team. This was consistent with the social psychology theme of co-operation and competition, derived from the literature relating to this phenomenon (Deutsch 1949; Pruitt & Rubin 1986; de Dreu et al. 2000; Beersma & de Dreu 2005; Bechtoldt et al. 2010).

Risk attitudes

Whilst it was vital for the team to disseminate their innovative work outside the team environment, so as to gain recognition and to facilitate its implementation, loss of team authorship of the innovative outcomes presented a real risk to the group. Similarly, whilst positive feedback from industry offered a significant motivating factor, the possibility that this feedback might be negative also presented a significant degree or risk for the team. These risks were team-based and so the team responded with a collective expression of risk tolerance. This tolerance level tended to be low for this team, and the collectively low risk tolerance translated to the design itself, as they sought to minimise the chance of receiving negative feedback.

In relation to shared risk responsibility, potential risks tended to be expressed and managed by the dominant members of the group in accordance with the findings of Fischoff et al. (1981), which link balance of power with definition of risk value norms. The attitudes of dominant members to risk tended towards aversion and so, there did not appear to be a pronounced risky shift, in this case (Stoner 1968; Cartwright 1971; Pruitt 1971). However, risky ideas were encouraged for discussion by establishing a 'no wrong answer' culture, although it may be speculated that the risky ideas were not forthcoming due to the social cues which indicated the collectively low risk tolerance (Friedman & Förster 2001; Madjar et al. 2011). This convergence to group risk norms also indicated higher levels of group cohesiveness, as individuals tended towards conformity to these norms (Miron et al. 2004; Zhou et al. 2009). Where riskier decisions, or even failure, required expression outside the group (Luhmann 1993), a strategy of cohesiveness was adopted. This had the purpose of deflecting negative feedback from the dominant members towards the team, as a whole.

Where circumstances arose, individuals were required to act as agents of their company as well as the design team itself. This occurred in relation to the necessary sharing of commercially sensitive corporate information. Individuals tended to be averse to the risks associated with corporate sharing, even though it would be likely to result in a better project outcome. Individuals were, thus, conflicted in their attitudes to risk by the delineation of their agency as company employees and as design team members.

Social climate

The case-study design team appeared to be a strongly cohesive group, particularly in relation to their task, reflecting the social psychology sub-theme, group cohesiveness (task). This is evidenced by the collective conformity towards the project goals and also towards innovation as a team value. This was expected, as innovation was a defined project goal and an established core value, and the case-study was selected for these characteristics. However, an unexpected finding was that this core and collective valuing of innovation resulted in interdisciplinary learning being strongly supported as a means to this innovative end.

Group cohesiveness is maintained by face to face meetings, with supporting daily interaction using an online forum. Selection of media for interaction appears to have relevance for the nature of social cohesiveness because each determines a different social climate. Face to face meetings create a more formal climate, with associated formalities in speech and behaviour. The online forum creates the converse atmosphere, with a higher likelihood of informal speech. The conference call appears to offer a social climate that lies somewhere between the two.

The poles of social climate appear to be mutually supportive in sustaining group social cohesiveness. The face to face meeting emphasises the formality, purpose and focus of the professional environment, whilst the online environment facilitates 'banter' as a way of reinforcing social connection.

Social connection supports group cohesiveness defined by attraction to the group, but this is particularly reinforced through the strengthening of team identity. As a temporary, distributed, project team, typical in the construction industry, the development of this identity through creation of the project brand serves to channel positive recognition as a shared reward that is collectively celebrated. This collective celebration creates a positive team climate and serves to enhance collective motivation. This appears to have a lasting effect.

The group express that they seek to create an environment of psychological safety in support of creative thinking (Baruah & Paulus 2011). However, the efficacy of this group norm was not explicitly assessed, although other social factors, such as those relating to risk tolerance may indicate that this environment was not necessarily realised, as there was no demonstrable tolerance or valuing of failure (Wong et al. 2009).

When considering the effects of cohesiveness, these are observed to have a protective value in relation to risk mitigation. Where potential failure is realised, the group use their cohesiveness to bear its consequences collectively, rather than directing them to one person.

Another effect of cohesiveness, which is predicted in the social psychology literature, relates the concept of groupthink (Janis 1982). There is some evidence amongst the case-study team that individuals feel that they have supported decisions with which, in hindsight, they were not entirely comfortable (Janis 1982; Postmes et al. 2001). This is observed in relation to the complexity and variability of the BIM project guidance and standards, where members appear to agree to take actions that they later regret.

Whilst the team commences the project as a cohesive unit, the need for a multiplicity of roles to satisfactorily execute the work results in expansion of its membership. The team becomes too big to sustain its cohesiveness. In response, the team leadership fragment the team into smaller task-focussed groups. Each individual group appears to maintain internal cohesiveness, but this is challenged across the team overall. An ingroup/outgroup hierarchy is soon established, with resulting issues of motivational differences, competition emergence and stereotyping as anticipated by associated social psychology literature (Tajfel 1978; Tajfel & Turner 1979; Tajfel 1981; Branscombe et al. 2002). In particular, it is noted that a 'design team' forms one of these separate outgroups. This results in some implicit derogation of design roles by ingroup members (Walton 2003).

The creation of ingroups and outgroups is exacerbated by the timing of appointment of various disciplines specified in the BIM Level 2 project protocols. The 'design team' are appointed significantly later than the 'project team' resulting in a perceived and observed separation of designers from the client vision, project definition, and strategic discussion. This indicates towards the validity of the notion of the creative outgroup, highlighted in the findings of the industry survey.

Some conflict is observed between team members. Conflict was most prevalent in response to the complexity and lack of clarity of BIM project guidance and standards. This conflict had particular effects. The variability in protocol interpretations across the group highlighted divisions in member perceptions of the project vision and purpose. For example, the discussion relating to whether the project should be compliant or reflect the real world became quite heated.

Conflict is also observed as tensions between specific team members. Whereas these may be dismissed as ‘personality clashes,’ it was observed that the relationship between one individual and the group became problematic once the individual had expressed ideas that were contradictory to the cultural norms. Thus, the influence of cultural norms may be considered to support group cohesiveness where members subscribe to these norms (Adarves-Yorno et al. 2007; Bechtoldt et al. 2010). This describes the process of social tuning. However, should members not exhibit conformity, then they may become socially distanced from the group and less able to influence the outcomes.

Comparison of findings with the focus group study

The analysis of the case-study observation data paralleled and confirmed many of the thematic inferences drawn during analysis of the focus group data. Common themes emerged. These were the client, procurement, professionalism vs. profit, innovation drivers, feedback and recognition, interdisciplinary knowledge, intra-team behaviour, practice guidance, the social team, and the creative outgroup.

It also identified new themes that were not able to be inferred from the self-reported data. These were innovation dissemination, time and workload, and innovation adoption.

7.10 Summary and implications for the framework

Qualitative analysis highlighted a range of themes in relation to propensity for creativity and innovation, which emerged from coding within the overarching social psychology subject areas of motivation and reward, risk attitudes, and social climate. The additional theme of the 'creative outgroup' expressed by the survey findings, was also apparent as a relevant construct that warrants further research. The emerging AEC specific sub-themes can be considered for explicit incorporation within the proposed framework. The themes were additionally observed as having multilevel agency which stimulates individual behaviour towards the group, echoing a gestalt psychological theory of social behaviour. These themes are distributed across agency levels defined by industry, discipline, company, and individual, as shown in Table 7.5.

This multilevel distribution is also embedded within the proposed framework. This indicates, not only specific subject areas for further research, but also the levels at which they can be investigated. In terms of practice, the multilevel thematic distribution additionally indicates which levels may be best placed to instigate action and improvement in relation to specific areas of activity.

Qualitative analysis yielded a number of valuable findings which generated AEC-specific themes and content which has been incorporated with the proposed framework. However, it also indicated the significance of member dominance, prominence, and the presence of ingroups and outgroups in relation to aspects of creativity and innovation. A quantitative methodology has, therefore, been employed to complement the qualitative findings, with the purpose of measuring the existence and scope of these aspects of interaction within the case-study group. This complementary approach was conducted using a social network methodology which is described, together with its findings, in chapter 8.

A review of the findings across each of the three studies (survey, focus groups, and case-study observation) is discussed in chapter 9. This discussion supports the generation of the framework which is presented in chapter 10.

	Industry	Discipline	Company	Individual
Feedback + recognition	■	■		■
Interdisciplinary knowledge	■	■		■
Professionalism vs. profit	■		■	
Procurement	■			■
Innovation drivers	■		■	■
Practice guidance	■	■	■	■
Innovation dissemination	■		■	■
Intra-team behaviour	■	■	■	■
Client	■	■	■	■
The creative outgroup		■		
Innovation adoption		■		■
Time + workload			■	■
Professional identity				■
The social team				■

Table 7.5: Multilevel AEC-specific themes generated by qualitative analysis of observations

8. OBSERVING THE SOCIAL PSYCHOLOGY THEMES IN PRACTICE: A QUANTITATIVE APPROACH

8.1 Introduction

Whilst qualitative analysis of the case-study observation data identified a number of AEC-specific themes that warranted incorporation within the proposed framework, it also highlighted several concepts that were interpreted as having an influence on creativity and innovation, but required further study. The study of these concepts required supporting quantitative analysis, as an understanding of their scope and nature required a clarity in relation to frequencies and distributions. These concepts included the prominence of individuals within the group; the sub-groups that emerged; and the disciplinary characteristics of dominant interactions.

This research stage, therefore, was implemented to complement and build upon the findings of the previous qualitative stage. Thus, it shared the following objectives of the preceding focus group study.

- To explore how the socio-behavioural constructs emerging from the literature review and survey manifest themselves in AEC practice.
- To elicit key socio-behavioural themes that influence creativity and innovation in AEC teams.
- To examine the relationships between the socio-behavioural themes that influence creativity and innovation in AEC teams.

Within these objectives, this research stage also sought to analyse quantitatively, the frequencies and patterns of interaction, so that the proposed framework could provide a richer picture of design team interaction.

8.2 Methodology

Data source

The same datasets as those analysed for the qualitative analysis of design team observation were used. The methodology for collection of these datasets is described in section 7.2. These datasets included those collected from the three media formats used by the case-study design team. Hence, this chapter presents findings derived from the same data, but analysed in a different way, so as to expand and deepen understanding of how this design team interacted to support creative thinking and produce innovative outcomes.

A background to social network analysis

Interpretation of the social life of the design team with regard to its creative propensity need not exclude quantitative analysis. Certain concrete variables may 'naturally' occur in the construction of the group, which may lend themselves to quantitative measurement which can be integrated with the qualitative method, from which to draw further interpretative results (Vann & Cole 2004). This integrative approach to the use of social network analysis is appropriate within the critical realist perspective of the thesis, where it facilitates the postulation of new research directions (Buch-Hansen 2014).

Whilst the thematic analysis could provide a qualitative investigation of meaning contained within the design team, it could not easily provide expression of the patterns of relationships and the position of individuals within these patterns. This was a facet important for contextualising the themes derived from the qualitative analysis. More specifically, a quantitative method of pattern detection and representation would assist in the investigation of the strong or weak ties (Miron et al. 2004; Hülsheger et al. 2009; Zhou et al. 2009), which determined social cohesiveness within the team. In addition, systematic recording of the structure of relationships would help to explore the notion of the 'creative outgroup,' which emerged from the survey study. For these reasons, and supported by the premises of Nohria (1998), a network perspective was adopted.

Social network analysis, as a device employed in mathematical sociology, emerged from graph theory (Doreian 1974; Wasserman 1977; Wasserman 1980; Wasserman & Faust 1998). It provides a representative tool for quantifying and visualising directed data relating to the ties (edges) between individual entities (nodes) (Wasserman 1977; Wasserman 1980; Kirke 2007; Knoke et al. 2008), as summarised in Figure 8.1. Statistical calculation is applies to generate hierarchies of centrality, density, and groupings within the network.

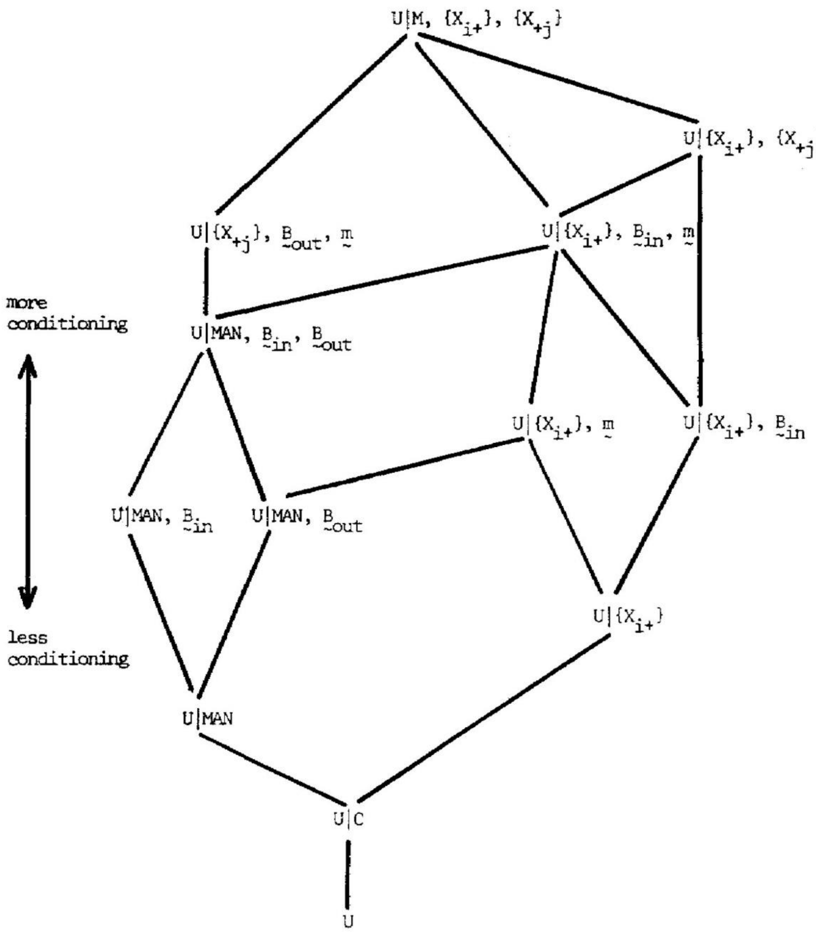


Figure 8.1: Network of random digraph distributions summarising the relationships of partially conditioned mathematical relationships (Wasserman 1977)[1].

[1] Image reproduced with permission of the rights holder, Taylor & Francis

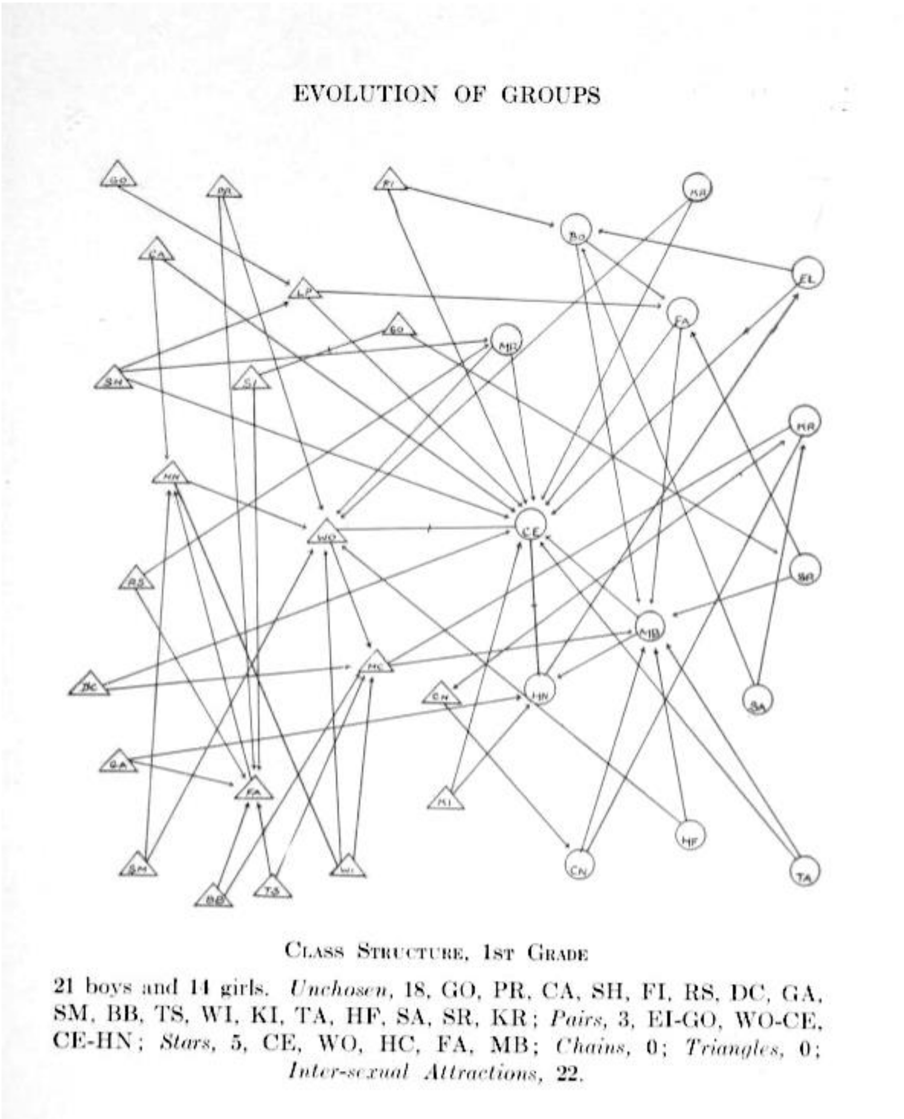


Figure 8.2: Moreno's (1934) sociogram of classroom groupings

Building upon Moreno's (1934) sociograms (Figure 8.2) as visual representations of relationships between actors in a closed system, social network analysis has subsequently been applied in social psychology to investigate social connectivity patterns that impact upon human life (Peay 1974; Doreian 1986; Kirke 2007), from studies of peer influence on adolescent smoking (Ennett & Bauman 1994) to student retention (Eckles & Stradley 2012), and applied to workplace contexts (Totterdell et al. 2004; Zohar & Tenne-Gazit 2008). Social network analysis has also been applied in the construction field, most notably by Pryke to explore the effectiveness of contractual and incentivisation conditions within project coalitions (Pryke 2004; Pryke 2005; El-Sheikh & Pryke 2010; Pryke 2012).

The coding strategy

Pryke's studies and the social psychology studies explore the overall framework of interactions within a group, from which to identify key actors and network dynamics. The purpose of this research, however, was to examine the nature of actors and networks in the context of the three thematic areas of motivation and reward, risk attitudes, and social climate as antecedents to creative performance. A generalised sociogram was not likely to facilitate knowledge specific to these themes. Hence, the research required a sifting of activity prior to a more theme-specific examination of associated actors and networks.

This sifting of activity was conducted by coding each interaction according to the overarching themes. Each time a positive expression of the themes was observed, this was quantitatively recorded together with the originator of the expression and the receiver(s), where relevant. Expressions were recorded as point events, that is to say short points in time when the expression occurred. However, expressions of positive regard tended to continue for longer periods. Rather than skewing the data with high frequencies of point events, expressions of positive regard were recorded as state events and so, would be quantified as single instances. The coding strategy is summarised in Table 8.1.

Expressions within the motivation and reward, and risk attitudes themes tended towards verbal content, except where nodding or head shaking expressed agreement or disagreement. Hence, expressions within these themes could be simply recorded as instances where individuals declared their motivations in relation to the task or group belonging, rewards anticipated or received, and their aversion or inclination towards a risky decision or idea. Expressions within the social climate were observed to be less likely to be verbal. Instead, expressions of conflict or positive regard were frequently observed as physical cues, such as facial expression, gesture or disengagement. Reliance on the subjective, non-systematic inference of these non-verbal expressions may have compromised the reliability of the coding process beyond acceptable limits. Hence, a generalisable non-verbal coding method used within the social psychology field was adopted.

Parent Theme	Behaviour Name	Behaviour Type	Modifiers
Motivation + Reward	Expressing motivation or reward	Point event	none
Risk Attitudes	Expressing willingness to take risk(s)	Point event	none
Social climate	Expression of conflict	Point event	Participant direction
Social climate	Expression of positive regard	State event	Participant direction

Table 8.1: SNA coding strategy

This coding method was provided in the form of the Specific Affect Coding System (SPAFF) used widely in a variety of interaction observations (Coan & Gottman 2007). The SPAFF system describes latent psychological constructs such as anger and enthusiasm and describes verbal content, facial indicators, and physical cues associated with that construct. SPAFF is a developing tool. However, the current codes are listed in Table 8.2.

Within these 18 codes or Action Unit (AU), the SPAFF describes a variety of physical and verbal indications. For example, 'positive surprise,' sometimes observed when participants are enthused by a remark or idea presented by a colleague, is indicated by prominent smiles and loud verbalisations, such as "Really?!" (Coan & Gottman 2007). A full description of physical and verbal indicators prescribed by the SPAFF method is included at Appendix 3.

However, the diversity of the coding included in the SPAFF method was not necessary for this study, which only required a positive or negative affect circumstance, according to the specific thematic category. Hence, the SPAFF system was simplified to binary positive and negative affect states using associated verbal and non-verbal cues to indicate the expression of a positive or negative manifestation of a theme within the group. This was supported by additional and contextual analysis of discussion content. For example, 'enthusiasm' may be positively expressed in relation to a novel idea that has been expressed by a fellow team member. This would be coded as a positive manifestation point event within the social climate category. However, 'enthusiasm' may also be expressed in relation to collective motivation to take part in an event, or to take a particular risk. Hence, positive expression would be coded within these respective categories.

Positive Affect	Negative Affect
Affection	Anger
Enthusiasm	Belligerence
Humour	Contempt
Interest	Criticism
Validation	Defensiveness
	Disgust
	Domineering
	Fear/Tension
	Sadness
	Stonewalling
	Threats
	Whining
Neutral	

Table 8.2: Current SPAFF codes (adapted from Coan & Gottman 2007)

Given the multimedia context of the observation, not all indicators could be recorded in all media. Hence, the data richness provided by each media type corresponded with the range of cues able to be recorded as described in the qualitative analysis, and repeated in Table 8.3. Expressions of positive or negative affect, which took place online or during a conference call were recorded by studying the data transcriptions. Verbal expression heard during conference call was inferred from the notation contained within the transcripts. Transcripts of conference calls had been made using the Jefferson method (Atkinson & Heritage 1984; Jefferson 1984), which provides for dynamics in tone, volume, and incidental noises to be captured within the resultant written record. Expressions of positive or negative affect, which took place during face-to-face meetings were recorded using the Observer XT software (Noldus) which facilitated concurrent quantitative recording of point and state events against video data. The three media formats, each analysed according to the three social psychology themes, thus produced nine datasets. These datasets were then individually analysed for their theme-specific and media-specific social network characteristics.

		Interaction format		
Observation media	*Recording format*	**Words only**	**Verbal expression**	**Non-verbal expression**
Online forum	Text file	■		
Conference call	Audio recording	■	■	
Face to face meeting	Video recording	■	■	■

data richness

Table 8.3: Interaction media and data richness

Social network analysis method

The quantitative datasets were exported from the Observer software in a spreadsheet format and imported into Gephi 0.9.1 by the researcher. Gephi is an open source, graph visualisation software from Gephi Contributors (www.gephi.org) (Bastian et al. 2009). Individual participants were identified as 'nodes' within the software data laboratory using the codes attributed in Table 8.1. Thematic interaction measured during observations were assigned by source, target, and frequency to generate directed weighted edges for each node.

Using the ForceAtlas2 visualisation algorithm embedded within the software, thickness was attributed to edges between nodes according to the data input. The imported data included total frequencies of the point and state events associated with the expressions of the parent theme. It also included the originator and receiver(s) of each expression, so that each interaction could be directionally quantified by the frequency of incoming interactions (in-degree) and outgoing interactions (out-degree). Thus, a 'weighted degree' was calculated from the sum of the directed in-degrees and out-degrees associated with a specific node and expressed as a percentage of the total number of interactions contained within the thematic expression category. The purpose of the ForceAtlas2 algorithm repels individual nodes, whilst attracting them according to directed weighting, with the aim of creating a visually balanced image that favours ease of interpretation (Jacomy et al. 2014). A uniform scaling of 200, with gravity set to 5 prevented node overlap, optimised visual communication of data, and facilitated consistency between diagrammatic outputs.

As a result of the calculations of weighted degrees, some nodes exhibited a large number of relationships, whilst others exhibit only a small number of relationships but these may be larger in frequency, thus generating a wider connecting edge. Attribution of edge and node size to weighted degree facilitated analysis of centrality as a measure of prominence within the group (Knoke et al. 2008).

Statistical modelling also described how the data could be compartmentalised into sub-networks, classes or communities. This was calculated using the modularity algorithm within the Gephi software. However, adjustments to the degree of data partitioning were made, so that results would offer real world interpretation and value. During analysis, it was found that resolution setting of 0.5 yielded the most realistic representation of data partition, when considered in the context of the immersive analytical process carried out during the qualitative analysis of the observational material. Attribution of colour to modularity class facilitated visual delineation of alliances and sub-teams that occurred across social psychology themes and media type, which enabled analysis and interpretation. The network graph was then exported as a pdf for analysis and reporting.

8.3 Results of the social network analysis

The social network graphs produced using the Gephi software are presented in accordance with the social psychology themes of motivation and reward, risk attitudes, social climate, in Figure 8.3, Figure 8.4, and Figure 8.5 respectively. Graphs are also presented within these categories according to media source.

Social network graphs are appended by data output relating to modularity and disciplinary prominence according to statistical calculation performed using the Gephi algorithms across themes and media. A clustering coefficient is presented to indicate relative states of cohesiveness or affinity between the modular communities within the group. Data is further explored to establish whether a hierarchical construct is expressed through calculation of prominence, differentiating 'strategic' and 'technical' roles based on individual team role definition and contribution.

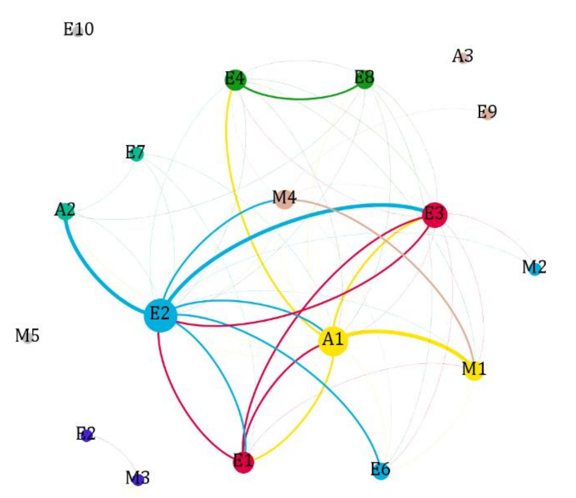
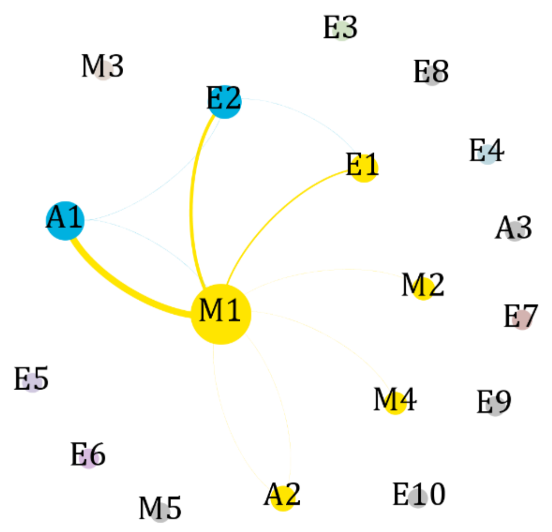
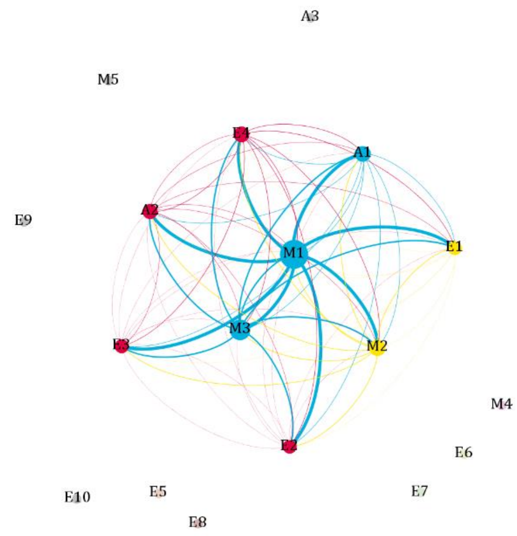
<table>
<tr><th>ONLINE</th><th>CONFERENCE CALL</th><th>FACE TO FACE</th></tr>
<tr>
<td>
</td>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>Modularity:
No of communities: 10
Clustering coefficient: 0.381
Prominence:
Disciplinary affiliation of highest weighted degree node: Engineering
Status of highest degree node: Technical</td>
<td>Modularity:
No of communities: 13
Clustering coefficient: 0.087
Prominence:
Disciplinary affiliation of highest weighted degree node: Management/Financial
Status of highest degree node: Strategic</td>
<td>Modularity:
No of communities: 12
Clustering coefficient: 0.500
Prominence:
Disciplinary affiliation of highest weighted degree node: Management/Financial
Status of highest degree node: Strategic</td>
</tr>
</table>

Figure 8.3: Social network graphs within the 'motivation and reward' anchor theme

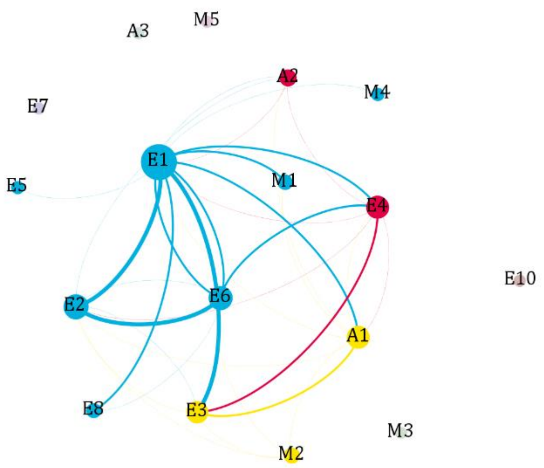
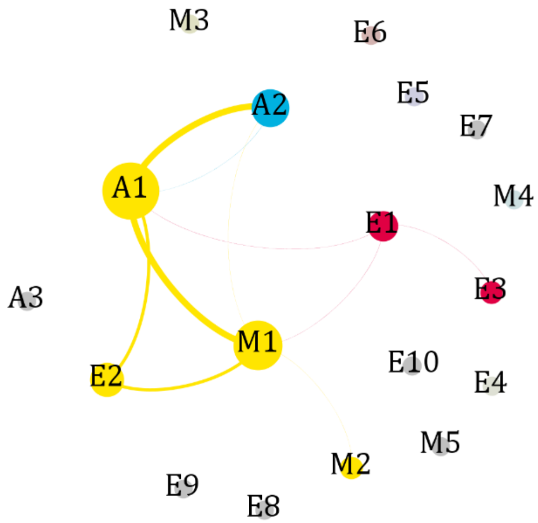
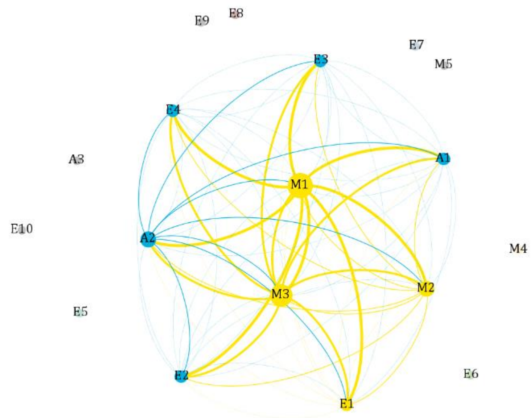
<table>
<tr><th>ONLINE</th><th>CONFERENCE CALL</th><th>FACE TO FACE</th></tr>
<tr>
<td>
</td>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>Modularity:
No of communities: 8
Clustering coefficient: 0.331
Prominence:
Disciplinary affiliation of highest weighted degree node: Engineering
Status of highest degree node: Technical</td>
<td>Modularity:
No of communities: 14
Clustering coefficient: 0.090
Prominence:
Disciplinary affiliation of highest weighted degree node: Architecture
Status of highest degree node: Technical</td>
<td>Modularity:
No of communities: 11
Clustering coefficient: 0.500
Prominence:
Disciplinary affiliation of highest weighted degree node: Management/Financial
Status of highest degree node: Strategic</td>
</tr>
</table>

Figure 8.4: Social network graphs within the 'risk attitudes' anchor theme

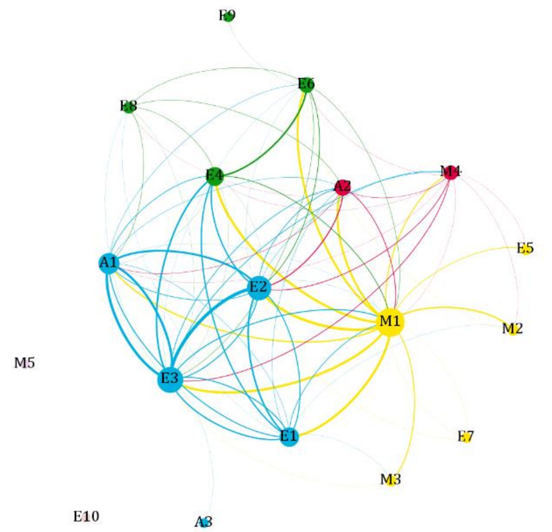
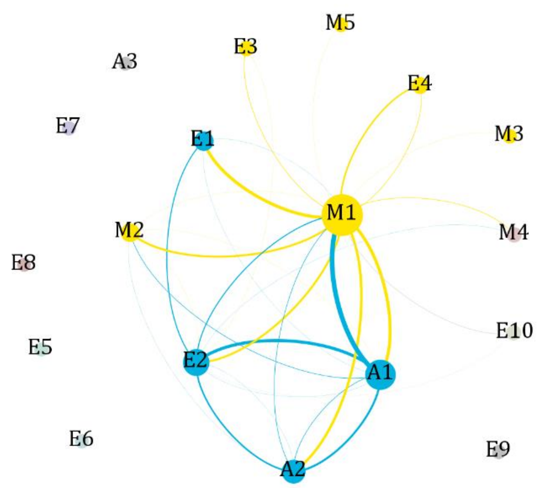
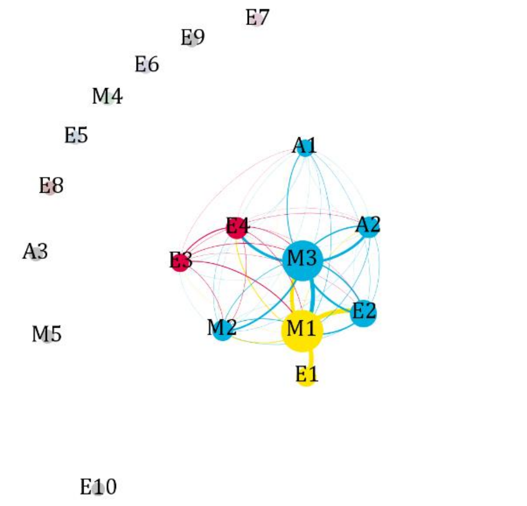
ONLINE	CONFERENCE CALL	FACE TO FACE
		
Modularity: *No of communities: 6* *Clustering coefficient: 0.511* *Prominence:* *Disciplinary affiliation of highest weighted degree node: Management/Financial* *Status of highest degree node: Strategic*	*Modularity:* *No of communities: 10* *Clustering coefficient: 0.389* *Prominence:* *Disciplinary affiliation of highest weighted degree node: Management/Financial* *Status of highest degree node: Strategic*	*Modularity:* *No of communities: 12* *Clustering coefficient: 0.385* *Prominence:* *Disciplinary affiliation of highest weighted degree node: Management/Financial* *Status of highest degree node: Strategic*

Figure 8.5: Social network graphs within the 'social climate' anchor theme

Differences between weighted degrees of interaction, as a percentage of all interactions within the respective anchor theme (to the nearest integer), are explored in Figure 8.6. This bar chart presents percentage weighted degrees of all possible interactions by disciplinary group (where A=Architecture and Design; E=Engineering; and MF=Management and Financial), and within the social psychology anchor themes.

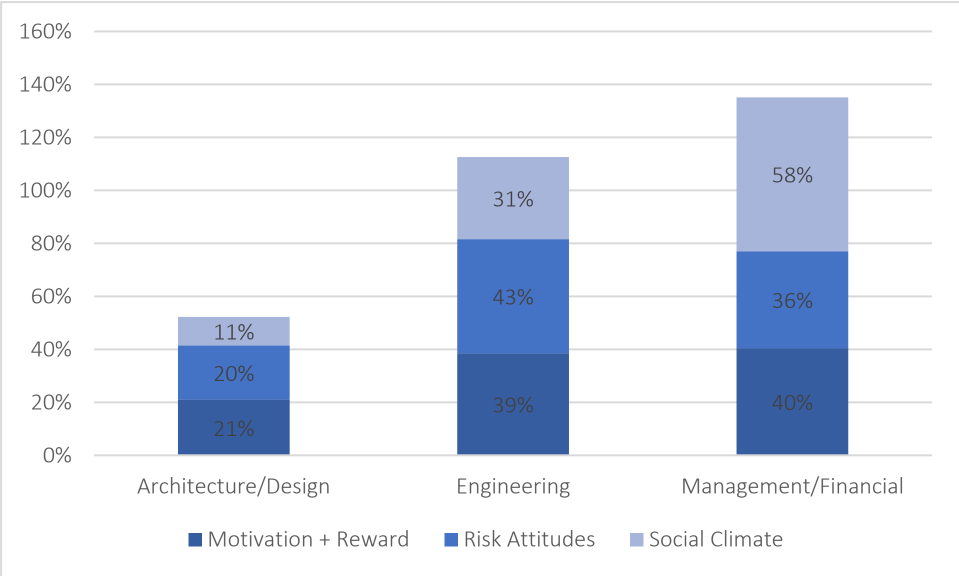


Figure 8.6: Bar chart of thematic percentage weighted degrees by discipline group

Figure 8.6 indicates that the highest percentage of weighted degrees occur within the management and financial discipline group, who appear to be prominent within the group, particularly in relation to interactions within the social climate anchor theme. The engineering discipline group, whilst also prominent within the group, tend to be more active in discussions relating to risk and associated attitudes. Interestingly, the architecture and design discipline group hold the lowest percentage of weighted degrees. From this, it may be inferred that the designers are the least prominent within this group.

Percentage weighted degrees are also presented by role hierarchy and grouped according to media context in Figure 8.7. This chart suggests that conference calls and the online forum tend to act as interactive environments for more technical members of the group, whilst it is the face to face meeting, which offers a forum for more strategic roles.

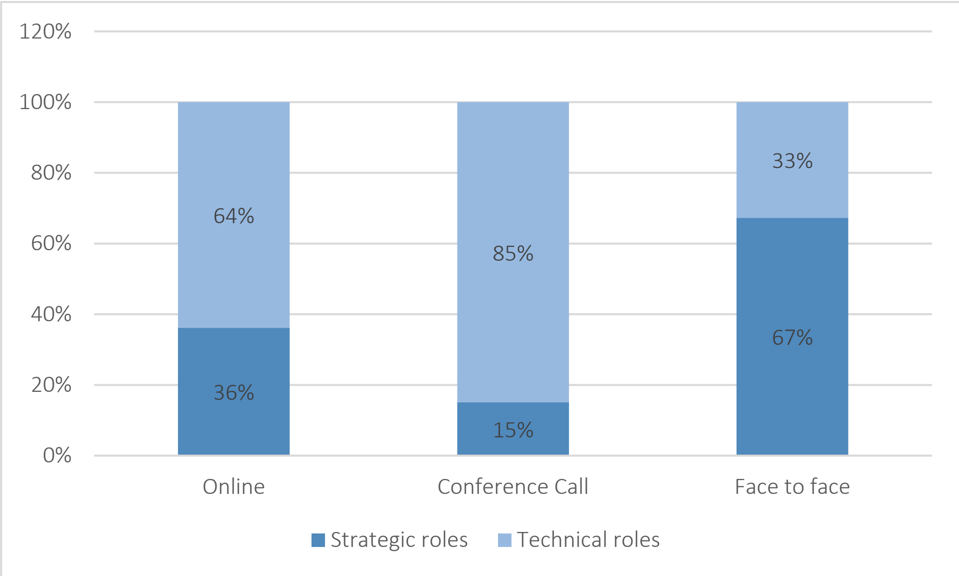


Figure 8.7: Bar chart of hierarchy-linked, percentage weighted degrees, by media

Results of the modularity calculations are expressed as the frequency of communities within the overall design team network in Table 8.4. These are deconstructed by the social psychology anchor themes to facilitate comparative discussion.

Social Psychology Theme	Total frequency of communities	Mean frequency of communities
Motivation and Reward	35	11.67
Risk Attitudes	33	11.00
Social Climate	28	9.33

Mean frequency across themes:	32

Table 8.4: Frequencies of communities by theme

Community frequency, however, expresses only a limited view of isolation or aggregation within the design team. Associated clustering coefficients are also presented in Table 8.5 to provide an indication of overall group cohesiveness within the social psychology anchor themes. Clustering coefficients express the connectivity of relationships across this design team. The closer the coefficient is to a value of 1, then the more connected each node is within each other node in the network. Conversely, the closer the coefficient is to 0, then nodes are more likely to be diasporic within the overall network. In the context of this study, the clustering coefficient may be interpreted as a quantitative measure of group cohesiveness. For this design team, the clustering coefficients indicate relatively high levels of connectivity and cohesiveness.

Social Psychology Theme	Clustering coefficient	Mean clustering coefficient
Motivation and Reward	0.97	0.32
Risk Attitudes	0.92	0.31
Social Climate	1.29	0.43

Table 8.5: Clustering coefficient data by theme

Clustering coefficients are expressed across the three media types and social psychology theme in Figure 8.8.

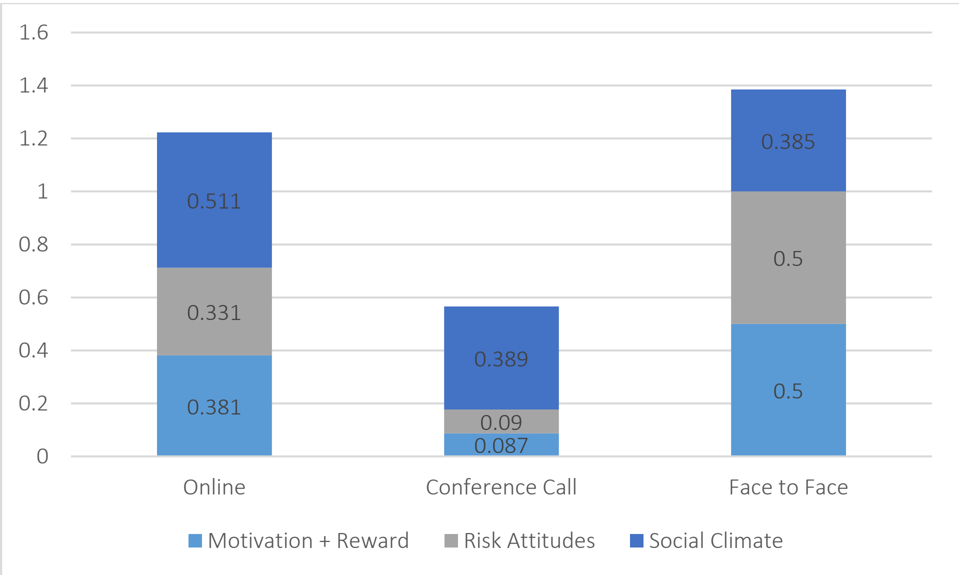


Figure 8.8: Bar chart of media format, including clustering coefficient within anchor themes

Figure 8.8 demonstrates that there is a higher level of connectivity amongst the team, when meeting face to face. The team are least connective during conference calls. From this, it may be inferred that the team experience higher levels of cohesiveness, when meeting face to face. However, connectivity in relation to the social climate anchor theme is highest when interaction occurs online. This may suggest that while the face to face meeting is an effective medium of interaction when discussing motivation, reward, and risk, it may not be the best environment for fostering a positive social climate.

8.4 Discussion of the social network analysis

Teams of modular communities

The social network analysis showed that sub-networks translate as subgroups within the overall design team. In this design team, between six and fourteen sub-communities emerge. However, the high number of communities expressed in the social network analysis is primarily due to the existence of peripheral team members who infrequently contribute to the group. Based upon node size and prominence of connections within the network, a core team comprising two to four alliances or sub-teams can be perceived.

Examination of these alliances or sub-teams suggests that they are not divided by discipline as they tend to accommodate each of the three discipline groups within their membership. This suggests that alliances may be formed on the basis of knowledge, role, and skill requirements as well as through social preferences.

The number of sub-teams varies between the social psychology themes of motivation and reward, risk attitudes, and social climate. However, comparative analysis of the frequencies of communities across the anchor themes shows that these differences are minimal. The 'social climate' theme appears to be least diverse in its generations of sub-teams. This may suggest that socially driven interaction, more than task-based interaction, better facilitates unity and cohesiveness.

A similar pattern emerges in relation to the clustering coefficients, which offer a broad measure of cohesiveness within the project group (Table 8.5). Again, the social climate theme exhibits a perceptibly higher coefficient, suggesting increased centrality and cohesiveness within the group in relation their expression of this theme during observation. During analysis of the observational data, expressions of social climate were measured by recording expressions of positive regard from a source to individual or generalised target. These results, then, may indicate the validity of nurturing positive climates for strengthening group ties in balance with task-based goal setting. As stronger group ties are linked to innovative performance (Miron et al. 2004; Hülsheger et al. 2009; Zhou et al. 2009), the importance of balancing task goals with fostering a positive climate within the group must be acknowledged in construction teams.

Member prominence

Consistencies in prominence emerge from the data visualisation, highlighting certain members as most prominent within the group, in terms of frequency and distribution of their interactions. A clear project leader emerges, with a comparable project leader who is present at face to face meetings. This dual prominence may explain, as well as fuel, some of the dichotomous issues that instigated conflict revealed in the thematic analysis. For example, the opposing group objectives of innovation for financial gain versus industry sharing may be a result of the two self-appointed and prominent leaders being from private sector and academic backgrounds respectively, each background directing associated dichotomous goals.

Media differences

Patterns of prominence and modularity vary across the interaction media. This is particularly noticeable on examination of the hierarchical structure of interaction during different modes of interaction. During online discussion and conference calls, alliances at the technical level tend to dominate interactions (64% of interactions). This suggests that the online environment is used for day to day project running. Dominance by strategic levels of the project team hierarchy at face to face meetings (67% of interactions) suggests a focal shift in conversation agenda according to media context. Closer inspection of the social network graphical diagrams indicated that the prominent project leader maintained an intermediary role between media environments albeit with lesser centrality in the online forum. This reflects his supervisory practice of linking technical conversations with the project's overall strategic direction.

It is apparent from the findings that in the 'risk attitudes' and 'motivation' theme, clustering coefficients are higher during face to face meetings. This suggests higher levels of group cohesiveness in relation to these themes in this environment. This pattern is reversed within the social climate theme. Qualitative examination of the data indicated that this may result from the generalised prominence of the technical levels of the team hierarchy within the online forum, compared with the strategic prominence at face to face meetings. These findings indicate an increased formality of language and behaviour in face to face meetings, with a more informal definition and characterisation of social climate in the online forum. This echoes previously studied findings that interaction media choice must be selected according to communication intention (Dainty et al. 2006).

It may be the case, then, that positive regard, as a measure of social climate, is higher in media interactions where technical levels prevail due to the less 'professional' language and 'banter' that is more democratically controlled than in a formal meeting scenario. It can be similarly noted that the online environment provides a more inclusive space for interaction as, in each case, it results in a lower number of communities, without apparent detriment to cohesiveness (measured by clustering coefficient). According to these measures, conference calls tend to offer an intermediate status between the remaining two media types. This analysis across media environments may indicate that design teams may need to adopt, purposively, specific media according to interaction requirements relating to task hierarchy, democracy, and inclusivity.

The creative outgroup

Investigation of disciplinary differences within the design team social network reveals that the management and financial discipline group tend to maintain prominence. The architecture discipline group retains the least prominence in the group compared with engineering and the management/financial group. It is probable that this is simply the result of a lesser number of architectural participants than those from other groups. However, this team composition, in itself, is consequential to disciplinary challenges that are process-driven and external to the team, rather than solely through ingroup prejudices. For example, the lower numbers of architectural members is a direct consequence of the lack of clarity of definition of the role of 'designer' in BIM protocol, together with its separate definition and late appointment within the project programme as inferred in the qualitative analysis of the data (see section 7.6: Thematic discussion of discipline-level agency).

The qualitative analysis implies other factors, which may also have influenced the lack of prominence of the architectural participants in this design team. For example, the growth of the design team and subsequent fragmentation to preserve internal cohesiveness created a distinct and separate 'design team.' This further disintegrates an already fragmented supply chain, which tends towards separation of design, production, construction, and manufacturing processes (Hugill 1998; Loosemore 2014). It also reinforces the 'silos' or subcultures that are observed to exist within project teams (Austin et al. 2007; The Edge 2015).

In light of the complementary findings of the qualitative and quantitative analyses, it may be possible to deduce that designers should not be separated from the main project team if creativity is to be nurtured across the group's activities. It may also be the case, that a more project-appropriate prominence may be controlled by elevating or limiting numbers within discipline groups with a view to assigning tasks and sharing knowledge towards more effective approaches to interdisciplinary synthesis and production.

8.5 Summary and implications for the framework

The social network analysis technique proved valuable in building upon aspects of design team interaction that were not able to be interpreted through the qualitative method. It confirmed the importance of strengthening ingroup ties as a mechanism for innovative performance, though the nature of these links require more extensive investigation. The social network analysis also indicated potential links between member prominence and the establishment of group values and objectives, with a likelihood of conflict arising where differing goals are held in tension between two or more peers in formal or informal leadership positions.

In particular, the social network analysis yielded findings in relation to the heterogeneity of interaction communities within this overall team. This indicated that potential ingroup/outgroup scenarios may be determined by individual differences in disciplinarity and hierarchy. There was a perceptible 'creative outgroup' identified by the analysis results, but it was not clear whether this was a result of the imposition of external protocol or ingroup prejudice.

Significant hierarchical differences appeared to occur across media contexts. Whilst, face to face meetings appeared to facilitate group cohesiveness, this was influenced by a predominating influence of members of the group who held more strategic roles. Conversely, the online forum offered a more democratic and inclusive space for interactions relating to the day to day running of the project. The resultant framework must accommodate these findings to enable the performative role of media contexts to be explored in more depth.

This chapter has provided comparative discussion with the qualitative analysis presented in the previous chapter. However, before the framework can be formally presented, this requires further expansion, as well as further discussion, which also takes into account the findings of the survey and focus group studies. This overall discussion, which connects each of the studies conducted as part of the PhD, is presented in the next chapter.

9. STUDY SYNTHESIS TOWARDS AN AEC-SPECIFIC FRAMEWORK

9.1 Introduction

A primary objective of the PhD was to investigate whether the field of social psychology could offer theoretical constructs which could inform an AEC-specific framework for expanding and deepening knowledge in relation to the collaboration of multidisciplinary design teams. To this end, the research included collection of data from a survey, focus group interviews, and observations of a live design team in practice. The survey tested whether the thematic social psychology constructs were, indeed, experienced in practice. The focus group study analysed themes emerging from discussion amongst practitioner groups, identifying sector-specific themes which aligned with the socio-psychological literature, to describe the scope and nature of creative performance in the collaborative design team. Those ideas were then explored further in a live case study.

The current chapter collates findings from each study, describing a sector-specific body of knowledge relating to the dynamics of collaborative creative performance in the built environment design team. Collation and synthesis of study findings have been performed as a retroductive review of the social psychology and AEC literature to produce a dialogue between the evidence presented in previous studies and the inferences drawn in the current thesis (Danermark et al. 1997; Ragin & Amoroso 2011). Resultant concepts, thus, supplement the extant body of sector literature and are summarised as the proposed multi-level framework (chapter 10) to indicate key themes and future directions for practice, research, and pedagogy.

9.2 Applicability of the socio-psychological perspective

The initial literature review identified three overarching themes that offered potential for expanding frames of reference and understanding in relation to creativity and innovation in multidisciplinary design teams in AEC. These were (1) motivation and reward, (2) risk attitudes, and (3) social climate.

Motivation and reward

Analysis of the survey responses found that practitioners tended to be highly intrinsically motivated in relation to their design projects. In response to the social psychology literature, high levels of intrinsic motivation are predictive of creative ideation (Amabile et al. 1996; Shalley et al. 2004; Utman 1997; Zhou & Shalley 2003) High levels of intrinsic motivation were also expressed by focus group participants. However, whilst intrinsic motivation was widely discussed in relation to the task, it was also acknowledged as being influenced by social relationships, which combines both social and task-based factors. Peer recognition and peer learning, as examples of factors, which combined social and task-based interaction, appeared, therefore, to be important in offering intrinsic motivation to think creatively in relation to the project.

The focus group study findings also highlighted that intrinsic motivations could be conflicted. This was felt in relation the tensional relationship between practitioners' abilities to contribute to delivery of a collective, innovative outcome, and the need to individually generate profit for their company. In the case-study design team, intrinsic motivation was also manifested by the demonstration of individuals' verbalised desires to be attached to the team, due to its unique innovative purpose and capabilities. This suggests that innovation, itself, can be self-perpetuating, as it drives intrinsic motivation to sustain the creative approach.

Survey responses showed that the inhibitive effects of extrinsic barriers, as defined by Amabile (1983) and Parker et al. (2006), to creative performance to be low. However, focus group participants reported that a lack of time and workload pressures could inhibit their ability to think creatively and contribute to innovative outcomes. This was a response that could be predicted by the literature. 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 design team, with some designers 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. However, where equitable interdisciplinarity was embraced, this was reported and observed to provide a significant motivational factor for collaborative learning and consequent creativity. This finding echoes those which suggest that collaborative idea flow creates a conducive social environment for creativity (Amabile et al. 1996; Tierney et al. 1999).

Extrinsic barriers within the case-study design team were additionally 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 some conflict and demotivation apropos their innovative purpose.

Survey findings showed that the rewards for innovation were both financial and non-financial. With regard to the financial rewards for collaborative innovation, the survey findings suggested that a pro-self culture (Bechtoldt et al. 2010; Beersma & de Dreu 2005; Pruitt & Rubin 1986) may be entrenched in the industry, due to the predominance of separate, as opposed to collective or co-operative, procurement arrangements between design teams.

With reference to non-financial reward, the survey study found that the chance to work on a high profile project constituted valuable compensation. This hinted at the importance of personal professional development as a motivational factor, which tended to be prioritised over any shared rewards relating to project outcomes. The case-study design team was procured slightly differently to traditional procurement methods, with higher priority given to knowledge held, than to fee value. So, it was not a surprising finding that they tended, individually and collectively, to derive reward primarily from non-financial sources. Their predominant source of reward emerged from the positive feedback and recognition that they could receive for their innovative work. However, when financial gains were sought, this created a source of conflict between those who were driven by pro-self rewards and those who maintained a pro-team or pro-industry motivation. However, financial gains tended to be conceived as financial reward for the collective production of the innovation in relation to the altruistic industry improvement. This may suggest that a 'competitive altruism' (Hardy & Van Vugt 2006; Roberts 1998) was also at play in this design team. The social network analysis found that such discussions regarding their collective purpose, motivation, and potential reward tended to occur during face to face meetings, where dominant members would debate the topic and reinforce the outcomes to the wider team. The importance of face to face interaction with regard to collective motivation is consistent with the findings of Amabile (1996) and Nijstad et al. (2010). This highlighted the role of both member dominance and interaction media format in determining and reinforcing collective motivation.

Risk attitudes

The survey found that a degree of 'sharedness' existed in level-setting of collective risk tolerance. This was confirmed by focus group participants, although participants also expressed that, to facilitate better creativity, collective propensity for risk taking should be established during the early vision-setting stage of the project, though this rarely occurs. A conversation of this nature was not recorded during the case-study observation. However, the social network analysis found that collective risk tolerance was more likely to be communicated during face to face interactions, 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 significant when teams seek to distribute a collective perception of risk norms.

Observation of the case-study design team identified loss of intellectual ownership of outcomes and negative industry feedback as key project risks. In mitigating these risks, this design team removed content from the resultant design and withheld information that could have improved the project outcome. Given the concurrent positive or neutral affect states displayed amongst the individuals during these discussions, it is unlikely that this lack of information sharing was a result of malicious intent. Instead, it is more likely to indicate a potential link between the external industry and company culture and the resultant innovative capacity of individual project outcomes.

The survey also found evidence that risk responsibilities were shared amongst the design team. However, a picture of a risk averse industry emerged. A higher risk-taker tended not to be present in design teams, including the case-study team. This limited the possibility of the risky shift phenomenon to be exercised in elevating the tolerance levels of the group (Cartwright 1971; Pruitt 1971; Stoner 1968). The culture of risk aversion was found to influence design teams to eliminate potentially innovative alternatives, and to repeat tried and tested solutions, consistent with the findings of Friedman and Förster (2001).

Social climate

The survey and focus group studies found that practitioners tended to feel a sense of cohesiveness within their design teams. Cohesiveness was also found to be a characteristic of the case-study design team. In all of the studies, cohesiveness was reported and observed to be broadly conducive to creativity and innovation. However, whilst participants felt cohesiveness in relation to their task, it was not felt with much prevalence in relation to project team social relationships. This finding is of particular concern due to the findings of the social network analysis, which noted an indicative link between socially driven interaction and the strengthening of group ties, which are linked to improved innovative performance (Hülsheger et al. 2009; Miron et al. 2004; Zhou et al. 2009). This concern was further fuelled by participants reporting of the association between a team's social cohesiveness and their own intrinsic motivation towards creativity and innovation. Despite this concern, the studies found that the social aspects of interdisciplinary learning had a positive effect, not only on team motivation, but also on group cohesiveness. In turn, this cohesiveness was reported and observed as supportive of innovative outcomes. The case-study observation also highlighted that a positive social climate could arise from instances of shared adversity (as in the case of shared pressure relating to the industry conference), with associated shared rewards of success and lasting effects.

The complexity of a building project requires a multiplicity of core and specialist roles. Both the focus group study and the case study found that, where projects require a large number of team members, fragmentation is an inevitable solution to the management of the large number of interactions required. This was noted to support the internal cohesiveness of the subgroups, but it was also found that this fragmentation can instigate rivalries and motivational and goal dissonance across the team. This can foster the 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 the hypothesis of the creative outgroup, an additional phenomenon, which emerged from the survey findings. This phenomenon was corroborated in the social psychology literature through the work of Henri Tajfel who examined prejudicial relationships between ingroups and outgroups (Tajfel & Turner 1979; Tajfel 1981; Tajfel 1978). The concept of the creative outgroup was also affirmed by the focus group participants. However, focus group participants from other discipline groups also expressed concerns about their distance from the main project narratives. Hence, whilst the presence of ingroups and outgroups in the project team were confirmed in all studies, care is to be taken in defining AEC project outgroups as including only those from a creative background. It may be possible that additional outgroups exist defined by other disciplinary, commercial, and demographic characteristics.

Focus group participants were, however, emphatic about the need to select the correct media format for their intra-team communications. They considered the appropriateness of media format to be a critical factor in nurturing group cohesiveness, generally favouring face to face interaction, or even co-location, where cost allows. The social network analysis expanded these findings by highlighting that face to face interaction can foster cohesiveness in relation to motivation and reward, and risk attitudes. However, the social network analysis found that a positive social climate was well-supported by the informal, pluralistic, and democratic environment provided by the online forum. This suggested that no single media format is most appropriate in fostering group cohesiveness, but that different media offer different benefits, dependent upon specific social needs.

The survey findings indicated that, whilst design teams tended to be cohesive, the associated negative effect of 'groupthink' (Janis 1982; Postmes et al. 2001) may hamper their decision making. This effect was also observed in the case-study design team discussions relating to the practice guidance.

A positive finding of the study was that, in contrast to the AEC reform literature, conflict tended not to be a key feature of design team interaction. In fact, survey respondents reported that a mostly positive climate was experienced. This was generally confirmed by observation of the case-study team. Nevertheless, some conflict was observed. This was, in the main, generated by factors external to the design team, such as the complexity of the project-related standards and guidance; apparently over-zealous nature of compliance requirements; and challenge to the team's branding and identity. Low-level conflict was also observed as tensions between the group and one team member. Data immersion and interpretative analysis suggested that this was due to the non-conformity of the ideas of the isolated member in relation to established group norms (Baron & Kerr 2003; Levine & Moreland 1990; Postmes et al. 2001). However, this may also represent an affirmation of the formation of a creative outgroup, because his minority dissent (de Dreu & West 2001) may have challenged group norms of creativity acceptance, thus igniting ingroup conflict (Walton 2003).

Findings from the focus groups confirmed those in literature relating to psychological safety (West 1990). Participants of the focus groups recognised its importance for maximising contribution of new ideas (Baruah & Paulus 2011; Edmondson & Mogelof 2006; Gibson & Gibbs 2006). However, these participants also reported experiences which suggested that participative safety was not always implemented in practice. This contradiction was confirmed by the findings from the case-study observation.

Following deeper analysis of this contradiction, it was found that whilst design teams tended to collectively value creativity and innovation as integral parts of their project, practitioners require further support in providing conducive environments to its 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 prevented idea contribution, reflecting the views 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 supported a hierarchical dominance amongst the project team. Where such hierarchical dominance occurs, it may then create a team environment that is not recognised as a safe place for risk-taking (Amabile 1988; Burnside 1990; Chatman & Flynn 2001; Edmondson 1999; Nystrom 1990). Thus, an environment is likely to be created, which is not supportive of equitable creative contribution. Conformity may be of value in the implementation phase of design (Forgas 2000; Kaplan et al. 2009) but professional levels of supported subordination and dissent may encourage increased productivity in the idea generation stages (de Dreu & West 2001; Wiltermuth 2009; Wong 2010).

9.3 Collation of domain-specific constructs

From the three originating social psychology themes and their associated sub-themes, additional and parallel sector-specific themes were evolved. The three complementary studies of practitioners, who were actively involved in design teams in the construction industry, provided the catalysts for this evolution. The initial survey performed a simple test of experience of the phenomena in practice. The focus group study and observational study provided the data for evolution of the sector-specific themes. Further analysis, using social network analytical (SNA) techniques, generated findings, which described the dynamic environment within which these themes were observed to operate.

Sector-specific themes are summarised across the individual study data sets, indicating their prevalence within the overall research sample set. However, it is also important to note that an emerging theme may not be prevalent in the findings from all three data collection methods. Given the exploratory nature of the research, it may, in fact, still be found to be prevalent or significant across the industry. Hence, it would warrant further research. As such, this supports its inclusion within the emerging framework.

Motivation and reward

Table 9.1 identifies prevalence of the emerging sector-specific themes across the sample set in relation to the overarching theme of 'motivation and reward.' Where a theme is acknowledged as present in the findings of all three focus groups, this is highlighted in yellow. Standardised colour (black) is applied where the theme was described by one or two focus groups.

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
CLIENT	1. Clarity of client vision 2. Client capabilities as influence on scope for innovation		■	■
PROCUREMENT	1. Low fee/budget limits innovation potential 2. Specialists procured through core disciplines, not collaboratively 3. Innovation goals obfuscated by procurement complexity 4. Procurement processes inhibit scope for innovation	■	■	■
PRACTICE GUIDANCE	1. Process complexity inhibits task definition 2. Lack of prioritization of compliance to standards 3. Barrier to motivation via over complex and variable standards and protocols 4. Compliance-reality dissonance			■
PROFESSIONALISM VS. PROFIT	1. Company profit goal conflicts with innovative performance 2. Company rewards polarized to team rewards	■	■	■
TIME AND WORKLOAD	1. Documented progress motivates 2. Lack of time as barrier to motivation 3. Non-contribution by team members as barrier to motivation		■	

Table 9.1: Sector specific themes aligned with the 'motivation and reward' anchor theme (prevalence across all 3 focus groups highlighted in yellow) – continued overleaf

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
INNOVATION DRIVERS	1. Company culture as project innovation driver 2. Industry innovation driven by critical mass of individuals	■	■	■
INNOVATION DISSEMINATION	1. Innovation dissemination determined by time available 2. Contribution to industry improvement as motivating factor 3. Impact of branding to establish intellectual ownership 4. Barrier to motivation when 'word' is not being spread			■
FEEDBACK + RECOGNITION	1. Motivation derived by gaining credit for work done 2. Motivation derived from peer feedback 3. Impact of positive recognition from external funders on team motivation 4. Promotion of stakeholder engagement to enhance external recognition 5. Recognition of industry contribution as extrinsic reward 6. Pro-team promotion vs. self-promotion 7. Industry feedback as mechanism to foster team learning	■	■	■

Table 9.1 continued

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
INTERDISCIPLINARY KNOWLEDGE	1. Clarity of role understanding 2. Engineering subservience to architect 3. Specialist disciplines peripheral to process 4. Timing of appointment as factor in ability to collaborate 5. Willingness to share information promotes learning 6. Priority of project delivery in relation to collective learning and success	■	■	■
INTRA-TEAM BEHAVIOUR	1. Generational propensity for collaboration 2. Individual comfort in technological solutions for collaboration 3. Individual dedication to collaborative innovation 4. Motivation derived from collective success 5. Member non-contribution as motivation limiting factor 6. Team identity created as brand within industry 7. Team core value to improve industry	■	■	■
THE SOCIAL TEAM	1. Motivation to collaborate – association with inspiring people	■	■	

Table 9.1 continued

Some of the AEC-specific themes evolved from the motivation and reward category were prevalent across all the study samples, including survey respondents, focus group participants, and the team observed in the case study project. Some of these are not represented in the extant body of AEC literature reviewed in chapter 2. For example, the professional ethos of pro-team or pro-industry behaviour which inclined activity towards innovative output was reported and observed to be at odds with the pro-self, profit-led goals imposed by their respective companies, and sustained by the rewards of career progression and personal income. This complements existing studies which consider pro-self and pro-team or pro-project goal conflicts instituted by industry procurement and reward systems. For example, this echoes the findings of Blayse and Manley, who reported that participant's evaluations of equity and reward were at odds with those of their company's (Bresnen & Marshall 2000). Similarly, the collective performance effects of project-based risk/gain sharing in newer forms of procurement are also consistent with these findings of this PhD research (Love et al. 2011; Lloyd-walker et al. 2014; Loosemore 2014). However, this PhD research further expands the earlier work by introducing disciplinary variation and process complexity as barriers to innovation, appending the comparative discussion of the efficacy of the procurement or reward method.

Whilst resolution of disciplinary culture differences towards interdisciplinary synthesis of ideas is already established as a success factor for innovative performance within the sector (Ankrah et al. 2009; Austin et al. 2001; Austin et al. 2007; Kocaturk 2013; Loosemore 2014; Murray & Langford 2003; Spence et al. 2001; White & Morgan 2005), participant groups indicated that the motivation to contribute to a team's innovative performance can relate to issues of interdisciplinary equity in both longevity and frequency of interaction, as well as reward.

This requires clarity of role definition beyond the disciplinary skill set, towards a collective understanding of expectations of creative contribution. However, the culture of the design team dynamic maintains a significant influence on participants' motivation to contribute to collaborative creativity. This propensity for collaboration can be 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. Nevertheless, whilst newer generations of professionals feel more comfortable in collaborative relationships, so they may also feel more comfortable with the technological solutions intended to facilitate them. It was generally felt that this created 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 interactions. Participants of all generations were perceivably in unanimous agreement that face to face interaction was the most effective medium of communication, when collaborative creativity is the intention.

Focus group participants also identified additional drivers of innovation in the AEC sector and these were affirmed and appended by the case-study design team. Whilst the client, procurement, and team culture are widely considered to be drivers of innovation (Asad et al. 2005; Austin et al. 2007; Barrett & Sexton 2006; Blayse & Manley 2004; Egbu 2004; Gambatese & Hallowell 2011; Loosemore 2014; Salter & Torbett 2003), the participant groups identified innovation culture within the respective companies of team members, and the need for a critical mass of individuals motivated towards innovation, as additional potential drivers. Where innovation is achieved as a team deliverable, then it was recorded that feedback and recognition for this work was a critical success factor in sustained motivation throughout the project life cycle, as well as across future projects. As a result, it may be posited that if innovative performance is required, then it is imperative that loops of feedback and reward be established between team members and their peers, employers, stakeholders, disciplinary institutions, and industry funding organisations.

Risk Attitudes

Attitudes to risk did not generate a large number of thematic outcomes in comparison with the other two overarching social psychology themes (Table 9.2). Speculative reasons for this included the fact that the phenomena associated with attitudinal risk and creativity, such as ‘pluralistic ignorance’ (Levinger & Schneider 1969) required a micro-detailed analysis method, which was not included within the scope of this thesis. In addition, it may have been the case that participants found it more difficult to comprehend and express risk attitudes as an intrinsic preference. That reflects the widespread utilitarian and prospect-theoretic discussion in literature pertaining to risk which is reflected within the domain context (Djeriouat 2017; Hota et al. 2016). The construction industry is, however, well-versed in its comprehension, evaluation, and expression of risk as an extrinsic and quantifiable construct, resulting from project management techniques which seek to manage risks involving cost, political acceptance, and safety (Flyvberg et al. 2003). This contrasts with the remaining two overarching themes (motivation and reward, and social climate), which may more readily be understood, sensed, and expressed as intrinsically felt responses.

However, recent trends in psychological research consider the intrinsically felt propensity for risk-taking as a cognitive and heuristic process (Gigerenzer 1991; Pachur et al. 2017; Tversky & Kahneman 1971). The science of heuristics, which has undergone dramatic, post-millennial conceptual development, describes cognitive function as adaptive evaluation and integration of information towards the goal of making judgements (Gigerenzer & Gaissmaier 2011). When applied to judgement during uncertainty and risk attitudes, this translates the concept of risk from its traditional domain within systems and operational thinking (van Deventer & Zimmermann 2014; Lin et al. 2016), to one of cognitive psychology with implicit social contexts, which provide certain cues for cognitive processing (Hertwig & Herzog 2009). Reconceptualisation of risk as a cognitive and heuristic process within the AEC domain provides a new direction for future research, which would enhance practitioners' vocabulary and awareness, as findings are applied amongst the industry populism.

Nevertheless, an unexpected and prevalent risk discussion across participant groups related to feedback and recognition for innovative work. Whilst project risk may more usually relate to issues of safety, cost, quality, or delay (Smith et al. 2013), a collective anxiety appeared to exist relating to risks of negative perceptions from outside the design team. A fear of negative industry response appeared to be entrenched amongst participants. This prompted the design team to limit their propensity for risky and novel solutions. If such solutions were found, then this also limited their propensity for sharing them, thus provoking a disjunctive relationship between the group's risk attitudes and their professional ethos of industry improvement.

A cultural risk aversion was sensed by participants and they acknowledged that this inhibited teams in their problem solving activity towards innovative outcomes. It was also acknowledged that whilst this was the case, teams rarely, if at all, evaluated their collective risk attitudes as part of setting vision and goals at the outset of project and process. However, they reflected that this would, in fact, be a valuable discussion that might facilitate improved performance.

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
CLIENT	1. Client risk propensity		■	
INNOVATION DRIVERS	1. Group risk propensity established to determine vision 2. Risk aversion prompts removal of innovation potential rather than problem solving	■	■	■
INNOVATION DISSEMINATION	1. Risk of potential profit loss by expansion of stakeholder engagement 2. Risk of conflict with industry agencies 3. Conflict between corporate risk management and innovation dissemination 4. Risks relating to compromised intellectual ownership 5. Commercial privacy conflicts with innovation dissemination			■

Table 9.2: Sector specific themes aligned with the 'risk attitudes' anchor theme (prevalence across all 3 focus groups highlighted in yellow) – continued overleaf

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
FEEDBACK + RECOGNITION	1. Consensus used to manage risk of effect of output 2. Negative industry response as influence on decisions 3. Negative industry response as influence on innovation sharing 4. Project output influenced by expected industry response 5. Risk ownership shared to mitigate effects of negative feedback 6. Risk of negative feedback externally to team 7. Reticence to share information outside the team in case of negative feedback 8. Risk of being perceived as non-productive	■	■	■
INTERDISCIPLINARY KNOWLEDGE	1. Role specialism as factor in ownership of specialist risk 2. Corporate information protection inhibits information sharing			■
INTRA-TEAM BEHAVIOUR	1. Sharing of risk of failure performed via group narrative 2. Establishing risk norms for risk sharing 3. Influence of corporate information protection on openness and information sharing 4. Risk adoption according to leader confidence 5. Consensus as risk mitigation strategy 6. Corporate information protection limits role clarity	■		■

Table 9.2 continued

Social Climate

As expected, the transactions of directed behaviour between design team members were reported as variable, extensive, and prevalent in their influence on a social climate that would be conducive to creative performance (Table 9.3). These expectations are informed by the emphasis on trust and respect within AEC literature which aims to steer practitioners away from the entrenched adversarial relationships that inhibited innovation and reform (Harris et al. 2003; Loosemore 2014; Love et al. 2011a; Strategic Forum for Construction 2015; White & Morgan 2005). This imperative for trust and respect was echoed by participants. However, it was also expanded and qualified to describe specific issues that are at play in the design team social climate in contemporary practice. For example, participants recorded that, in some cases, high levels of competence can excuse obstructive behaviour, although more positive climatic antecedents of innovation are clearly preferred. This may involve the cultivation of a mutual support for innovation goals, observable as support for unilateral or multilateral activities which fulfil these goals.

A supportive climate is reported and observed to be undermined by dissonance in design team goals. Where members are not harmonious in their expectations for project processes and outcomes, then conflict is more likely to occur. This is identified as critical to innovation potential, where design team members are at odds in their ambitions for profit-led or industry-led goals. This was highlighted by the social network analysis which revealed that the prominence of two members, each holding differing project goals that were difficult to reconcile, caused an undercurrent of conflict within design team activity.

Even if a design team achieve harmonious agreement of expectations, then participants indicated that their goal fulfilment can still be hindered. Barriers to fulfilment of collective goals were reported and observed to include inappropriate meeting and agenda setting. This was particularly problematic, where it does not establish a pro-collaborative environment, towards evolution of a shared mental model of the imagined building.

Design team meetings which are unsupportive of true collaboration also challenge the cohesiveness of the group. Focus group participants, in particular, reported that sometimes this is inevitable due to the scale and complexity of the project, which requires a project team of corresponding size and diversity. However, a pro-active response to this, via team fragmentation to preserve optimal team sizes for effective interaction, is considered a valid solution. Consistent with the discussion in section 9.2 relating to 'groupthink' in cohesive groups (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. This appears 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 creative thinking in the design team environment, but implementation of this environment of safety becomes frustrated by the industry cultural norm.

It was widely recognised by participants that more informal interaction between design team members is not typically a feature of their professional relationships. However, where this does occur, the team is likely to benefit from improved cohesiveness, as well as mutual trust and respect, resulting in a more pro-collaborative environment for innovation. Such informal interaction was exercised as 'banter' interspersed in project meetings. The value of 'banter' must be prescribed with the caveat that it can unwittingly and quickly transform into prejudicial delineation of subgroups, which would be negatively counterproductive. Playful articulation or banter is observed in racially motivated microaggression in non-work environments (Burdsey 2011) and also in work settings, where it is used as pressure towards ingroup conformity (Collinson 1988). Banter is also frequently cited in litigious cases of transgression from workplace humour to bullying and harassment (Smeltzer & Leap 1988; Tinkler 2008). Further informal interaction was also experienced as those events taking place outside the meeting environment, such as practising commensality (Kerner et al. 2015) to celebrate successes. This removed the task-based imperative from interaction, allowing them to focus on individual characteristics and preferences of those with whom they were working.

Such informal interaction is most unlikely where team communication focusses upon technological means. It was widely accepted by participants that face-to-face meeting was most conducive to collaboration and idea generation, particularly when using hand drawing as a medium of idea transference. In some cases, this extended beyond the face-to-face meeting to organised co-location to facilitate the collaborative culture on a daily basis. Whilst, use of communication technologies, no doubt, minimised cost to the company and client, participants emphasised that the rewards in design outcomes far outweighed this cost and effort.

Whilst intra-team behaviour was expected to exert an influence on the dynamics of the design process towards innovation, it was much less expected that the process of synthesis of interdisciplinary knowledge would also have such a sizeable effect. Focus group participants described a discrepancy between industry disciplinary partitioning and the desired coalescence of expertise that was required to synthesise innovative solutions. Disciplinary partitioning was recorded to be engendered in education and continued through the limited interaction between professional institutions. This discrepancy was further observed in the case study project. Further partitioning occurs in the preferential timing of consultant appointment determined either by the client or fixed within project protocols and guidance. This partitioning limits practitioners' skills and abilities in developing a common language which can effectively communicate and transfer ideas, as well as introducing hierarchical structures between disciplines in the design team, notably between the engineer and the architect. Where this partitioning is addressed in the design team, participants reported and were observed to benefit from enhanced motivation toward the project, knowledge and skills acquisition, and a pro-innovation design process converging to a creative synthesis of interdisciplinary knowledge and thought process (Ritchie 2001).

The focus group study and case study observation confirmed the disciplinary divisions that were implied in the survey responses. There was a clear tension between architectural and engineering roles. Both disciplines concurred in their belief that the architect was the default creator and guardian of the collective project vision. This resulted in a resentment amongst engineers as they felt this distanced them from direct client relationships, as well as caused them to be subservient in the collaborative hierarchy. Meanwhile, architects expressed that they became frustrated when engineers did not 'buy in' to their vision, identifying the design process as one of persuasion and negotiation with other disciplines. In group activity, it was subsequently perceived that when examples of poor delivery were cited, it would be the architect who was used as the subject of derision. Thus, the implied division of 'creative' disciplines in industry culture is realised in practice. Combined with disciplinary differences in timing of appointment to projects, this delineated subgroups within the design team, with a surmisable separation of creativity from the rest of the group. This echoes findings within the social psychology literature that suggest that creative thinking which is counter to group norms of creativity acceptance can instigate the formation of a creative outgroup, operating according to a separate set of goals (Branscombe et al. 2002; Walton 2003).

The social climate for innovation can, thus, in part, be attributed to protocols and practices of appointment and briefing. Although, not usually present in the design team, this establishes the client as having a key role. Participants strongly emphasised that to innovate, they required a close relationship with the client, irrespective of their place on the role spectrum between lead consultant and specialist discipline. This may be a result of an increased likelihood of informal and frequent exposure to client interactions. Where the client is interpreted as a senior project leader, then the social psychology literature is relevant to this discussion as it suggests that these interactions can enable individuals to benefit from a better understanding of the client's visions, objectives, innovation capabilities, and expectations, as well as being able to inspire individuals towards enhanced creative performance (Amabile et al. 2004; Burnstein 1969; Butler 1981; Farmer et al. 2003; Shalley et al. 2004). Such a relationship would allow contribution to the project scope and vision, consequently shaping the project brief and determining measurable interdisciplinary project outcomes.

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
CLIENT	1. Ability for companies to develop brief 2. Correlation of member dominance with client proximity 3. Barrier to collaboration – lack of client proximity 4. Clarity of client-team communication of vision 5. Conflict caused by client distance from non-dominant team roles 6. Reticence to challenge client and brief 7. Client distance as barrier to collaboration		■	■
PROCUREMENT	1. Alliances formed based on experience 2. Dominant members as filter to team membership 3. Longevity of relationships 4. Team design response to project scale and complexity 5. Value of diversity within procured teams 6. Conflict caused by process constraints on appointment		■	■

Table 9.3: Sector specific themes aligned with the 'social climate' anchor theme (prevalence across all 3 focus groups highlighted in yellow) – continued overleaf

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
PRACTICE GUIDANCE	1. Role clarity determined by clarity of guidance 2. Confusion caused by process complexity 3. Decision validity compromised by lack of clarity in guidance 4. Conflict caused by conflicting guidance 5. Conflicting guidance results in unclear output 6. Market deference as response to variable disciplinary interpretation 7. Dissatisfaction with decisions taken in response to conflicting guidance 8. Conflict caused by dissonance between compliance and reality		■	■
PROFESSIONALISM VS. PROFIT	1. Corporate profit goal and process innovation goal conflict		■	
TIME AND WORKLOAD	1. Influence of time and workload on possibilities for face-to-face meeting 2. Conflict under pressure relating to theory vs. delivery 3. Project deadlines induce individual pressure 4. Time pressures inhibit collective information sharing 5. Intra-team co-operation of workload management leads to positive climate 6. Consensus damaging when under pressure 7. Conflict caused by request for changes that will cause delay			■

Table 9.3 continued

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
INNOVATION DRIVERS	1. Ability to accommodate change 2. The importance of constructive challenge 3. Quantitative measures of innovation, not just aesthetic recognition		■	
INNOVATION DISSEMINATION	1. Industry dissemination as shared team goal 2. Conflict caused by differing commercial/dissemination goals 3. Dominant members act as filters to external engagement			■
INNOVATION ADOPTION	1. Lack of knowledge overlap between technical providers and construction disciplines 2. Dominance of individual rather than disciplinary preference in innovation adoption			■
FEEDBACK + RECOGNITION	1. Importance of recognition for innovation via publicity 2. Stakeholder engagement as mechanism for minimizing industry conflict 3. Positive climate generated by positive external recognition 4. External individuals keen to be part of the group	■	■	■
PROFESSIONAL IDENTITY	1. Individual preferences towards introversion-extraversion		■	

Table 9.3 continued

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
INTERDISCIPLINARY KNOWLEDGE	1. Criticism of engineering engagement in team 2. Engineering subservience to architect 3. Interdisciplinary common language aids collaboration 4. Timing of appointment as factor in ability to collaborate 5. Abilities and expectations engendered in education 6. Benefits of direct interaction 7. Team success derived from shared learning experience 8. Disciplinary partitioning across industry 9. Availability of non-construction expertise for construction innovation 10. Reappraisal of team roles as key activity 11. Interdisciplinary sharing towards innovation 12. Disciplinary sector knowledge equates to member specialism 13. Innovation from extra-discipline knowledge 14. Disciplinary skills required for specific problem solving 15. Innovation derived from interdisciplinary processes 16. Positive climate generated by group supported learning	■	■	■

Table 9.3 continued

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
INTRA-TEAM BEHAVIOUR	1. Ability to contribute ideas limited by company hierarchies 2. Team collaboration norms dependent on company norms 3. Fragmentation to preserve cohesiveness 4. Appropriate selection of communication media 5. Collaboration fostered by co-location of individuals 6. Competence outweighs behaviour 7. Differing individual goals causes conflict 8. Dominant members establish psychological safety 9. Effort of face to face interaction reaps rewards 10. False consensus created via dominant member 11. Impact of the ‘negative’ member 12. Importance of climate of trust 13. Motivation from pro-collaboration team dynamic 14. Mutual support for innovative performance 15. Need for pro-active response to social dynamics 16. Need for respect 17. Norms of meeting organization and agenda setting 18. Personal characteristics for innovative collaboration 19. Role of ‘banter’ as social lubricant 20. Role of ‘banter’ to determine individual identity	■	■	■

Table 9.3 continued

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
INTRA-TEAM BEHAVIOUR *continued*	21. Shared mental model of the successful outcome 22. Subscribing to cohesiveness gives reward in focus and progress 23. Need for design process facilitator 24. Explicit ‘no wrong answer’ culture 25. Team identity forged within industry 26. Team core value to improve industry 27. Team pride in innovative venture 28. Communication tech adoption as collaboration facilitator 29. Fragmentation to preserve cohesiveness 30. Reinforcement of team task-focussed behaviour 31. Limited face-to-face meeting to reduce cost to company 32. Subscribing to cohesion reaps rewards in focus and progress 33. Reticence to discuss personal life 34. Sharing personal politics establishes norms and cohesion 35. Interpersonal tensions evident via concealed disparagement 36. Collective identity strengthened by shared adversity 37. Clarity of communication aids collaboration 38. Change to team identity disturbs and distracts 39. Call to focus on task rather than individual contribution	■	■	■

Table 9.3 continued

SECTOR-SPECIFIC THEME	Thematic content	Survey	Focus Groups	Observation
THE SOCIAL TEAM	40. Social interaction outside design team meetings		■	
THE CREATIVE OUTGROUP	1. Architect as dominant vision holder 2. Disciplinary land grab of project roles 3. Frustrations with project managers 4. Architect as example of poor delivery	■	■	■

Table 9.3 continued

9.4 The gestalt agency of the AEC practitioner

Study of group creative propensity in both the AEC and social psychology fields has recognised the multilevel nature of antecedents, which direct individuals behaviour when operating in teams (Baiden et al. 2003; Cash et al. 2015; Chicken & Posner 1998; Hennessey & Amabile 2010; Loosemore & Chin 2000; Morrell 2015; Poirier et al. 2016; Pryke 2004; van Amstel et al. 2016; Zohar & Luria 2005). The thematic analysis also confirmed this multilevel agency, via alignment with social psychology by rooting findings within a gestalt, interactionist perspective (Brown 1929; Burnes & Cooke 2013; Higginson 1926; Humphrey 1924; Lewin 1936; Lewin 1954; Lewin 1935; Lewin & Lippitt 1938; Lewin et al. 1939; Read et al. 1997).

The gestalt perspective enabled the 'self,' represented by the individual AEC practitioner, to be understood as an agent of multi-level drivers and constraints, which direct thought and capacity for creative contribution via normative action amongst and in response to the group. As each member of the group is also engaged in this normative action and response in relation to their own individual agency characteristics, so the group dynamic emerges, determining that group's propensity for generating innovative outcomes. However, a directly proportional relationship between complexity and variability of interpretation, and goal compatibility was inferred form the observations. This finding is consistent with the study findings relating to multilevel social climate (Zohar & Luria 2005).

Thematic analysis findings postulated that these levels can be categorized as industry, discipline, company, and individual, with each influencing a practitioner's behaviour in varying ways and degrees at any one time. It was also observed that agential factors may frequently be conflicting, resulting in tacit deference of the practitioner's action to the group norms. Thematic outcomes were more prevalent when considering practitioner agency as an individual. It was postulated that this resulted from the primacy of the 'self' - as distinguishable from affiliated groups - within the interaction space (Gaertner et al. 1999; Haslam et al. 1997; Markus 1977; Reynolds et al. 2010; Tajfel & Turner 1979).

9.5 Ingroups and outgroups in the AEC sector

The test of social psychology themes relating to collaborative innovation and creative performance, via survey of industry practitioners, highlighted a potentially prevalent issue. This was provisionally termed 'the creative outgroup' in response to the body of work in social psychology that explores ingroup/outgroup relationships and associated effects of prejudicial behaviour (Boen & Vanbeselaere 2001; Tajfel & Turner 1979; Tajfel 1981; Tajfel 1978; Walton 2003), and the disciplinary affiliation of the perceived outgroup. It was deductively hypothesised that emergence of a creative outgroup may limit the possibilities for creativity to be embedded within the collaborative design process and further delivered as innovation. The creative outgroup hypothesis was then further explored during analysis of the focus group discussions and case study observations.

Application of a social network analysis method revealed that subgroups did, indeed, exist in the project team. However, these tended towards multidisciplinary communities divided by an individual's place in the professional hierarchy. Those with more senior roles tended to form groups separate to those in more junior positions.

Nevertheless, the qualitative analysis brought a perceptible creative outgroup to light. When poor practice or lack of understanding was exemplified, it tended to be the architect who was described as the hypothetical subject. This was a repetitive and generally consistent finding. Consistent with survey findings, non-architectural focus group participants gave further weight to the apparent negative perception of the architect by suggesting that architects were not predisposed to collaborative work. Furthermore, non-architectural focus group participants tended to resent architects for their own subservience imposed by the architect's traditional creative guardianship and client proximity. These views were echoed by architectural participants too, though in inverse expression.

The emergence of status, implied by the discussion of 'subservience' is pertinent to the studies of intergroup rivalries amongst traditional sociological groups. These studies explore 'upward comparison' between groups who perceive themselves to be of low-status and those who hold an apparent high-status (Caricati 2012; Festinger 1954; Maxwell-Smith et al. 2016; Tajfel & Turner 1979). These groups are observed to develop a pervasive and toxic resentment of the 'other,' instigated by apparent injustice (Leach & Spears 2008; Mead & Maner 2012; Wert & Salovey 2004), which can be damaging to motivation (Fiske 2010). The discussion of resentment in relation to the 'other's' proximity to the client also contains echoes of psychological studies, which explore sibling rivalry in connection with parental relationships (Calladine 1983; Kiracofe 1992; Prochaska & Prochaska 1985; Saint 2007; Smiseth et al. 2007).

The apparent culturally embedded resentment and separation of the architectural role appears to have forged a disciplinary competitiveness within project teams and across the industry. However, more recent contractual relationships and design process protocols, developed more recently in response to technological developments and industry reform, have created new roles in the projects with the purpose, amongst others, of facilitating collaboration. In attempts to redress the balance of the architectural dominance, focus group participants expressed that there has been a 'land grab' of those new roles. This is not necessarily a helpful solution, as it serves only to reinforce cultural disciplinary competitiveness and may even be detrimental to project outcomes. For example, as management and engineering disciplines assume their deserved place at the project helm, effects are observed to inhibit collaborative creative thinking and innovation. Whilst timing of appointment is an issue present in many traditional and more recent forms of procurement, it is noticeably problematic in BIM protocols. Here, the design team is appointed after the project's strategic definition and brief formulation (Building Information Modelling (BIM) Task Group 2013). Thus, collaborative design is partitioned from vision setting and strategic project implementation. This further exacerbates the perception by engineers that they are subservient to architects. It also demotivates architectural practitioners, who feel that their previously integral project roles are diminished, and they are less empowered to contribute to creative outcomes.

9.6 The media context of interaction

The social network analysis revealed important differences across the three interaction media in the observation case study. Significant differences between online and offline formats have been found in an emerging body of work, which compares the varying nature of interactions relating to learning (Cho & Kim 2013; Saghafian & O'Neill 2017; Todd et al. 2017), attention (Hogan et al. 2016), and social connectedness (Callister & Love 2016; Ferguson 2010). The analysis found that the online environment tended to be used for the day to day project running, with involvement led by more junior and technical roles, with only an intermittent and supervisory involvement from more senior members. The converse was true for face to face meetings, suggesting a focal shift in the nature of interaction according to media context.

It was also noted that, during face to face meetings, the group was more cohesive in relation to the anchor themes of motivation and reward and risk attitudes. This is consistent with some studies of face to face and computer-mediated group communication (Chang 2005; MacDonnell et al. 2009; Shin & Song 2011). Conversely, the group appeared to be more cohesive in relation to social climate when interacting via the online forum. Further qualitative examination of the transcripts indicated a predilection towards reiteration and emphasis of strategic goals and risk norms by senior members in face to face meetings, with more informal relationships and democratic discussion held online.

These findings indicated that media context is likely to be a significant consideration when selecting communication media according to task and preferred outcome. This was confirmed by focus group participants who emphasised the need to select the appropriate media for creative purpose, strongly favouring face-to-face interaction, where creative thinking is required. The emergence of media selection, as a key success factor in defining the task-adaptive interaction space, is implicit in parallel professional fields who require synchronous and asynchronous interaction towards effective performance. These parallel fields include education in relation to blended learning environment development (Kuo et al. 2014; Szeto & Cheng 2016); professional development (Lockyer et al. 2006); management training (Thornton & Yoong 2011); and multidisciplinary decision making in the medical sector (Munro & Swartzman 2013).

9.7 Summary and implications for the framework

Findings from each of the research studies, verified the applicability of the three social psychology anchor themes (motivation and reward, risk attitudes, and social climate) to innovation and creative performance in the AEC sector. Furthermore, analysis of the focus group and observation data evolved domain-specific themes from these social psychology baseline themes. The framework, thus, proposes these domain-specific themes as influencing factors to collaborative creativity in the design team.

The research also discerned a multi-level agency of the practitioner in their normative action and response to the design team dynamics, which determined their gestalt capacity for creative contribution. Agency levels were discerned as thematic influences arising from industry, discipline, company and individual, some of which may well be in conflict, thus requiring mediating professional judgement, reappraisal, or acquiescence. These levels were reflected in the presentation of the framework.

The research highlighted the possibility of the existence of a ‘creative outgroup’ which, if established within the group, may well detrimentally influence the creative propensity of the design team. Evidence from the studies suggest that subgroups do, indeed, occur within design teams and that the architect is quite frequently the subject of derogation. However, whether a ‘creative outgroup’ is generalisably entrenched across the sector cannot be established within the scope of this study and must be researched further. Nevertheless, the ingroup/outgroup concept appears to be prevalent and is likely to influence the scope, nature, and success of designed outcomes. As a result, it is important that the proposed framework acknowledges their existence, prevalence, and potential impact.

Subgroups tended to form within the varying media contexts and differences between innovation potential provided by different media were firmly emphasised by participants. Thus, the proposed framework illustrates media variability as a key factor in the locus of collective creative performance.

The framework proposes diagrammatic, tabular, and narrative representations of the overall, synthesised findings presented in this chapter. These are presented in the next chapter, with explanatory discussion of each component. Furthermore, the following chapter also evaluates the quality and validity of the framework using methods appropriate to the critical realist research approach.

10. FRAMEWORK PROPOSITION

10.1 Introduction

The current thesis has presented the methodologies and findings of a series of studies which have investigated the appropriateness of supplanting into AEC, key social psychology constructs that can be influential in fostering group creativity and innovation in design teams. Through the study series, these constructs have been developed and adapted to reflect, and be of value, to the AEC industry. In this chapter, these findings are structured into a diagrammatic, tabular, and narrative framework that can offer new directions in AEC practice, pedagogy, and research. Quality and validity of the framework are also discussed in this chapter, in order to evaluate this outcome within the critical realist research approach.

10.2 Purpose of the framework

The framework responds to the call embodied in existent AEC literature for expansion of the referential frame for understanding social behaviour and its dynamic influence on design teams' propensity for creative thinking and innovation. The framework, thus, fulfils the direct aim of the research, which was to establish a conceptual scaffold, which expands and deepens AEC domain-specific knowledge in relation to (1) the socio-behavioural aspects of design team interaction, and (2) their influence upon creative thinking and innovative outcomes.

This was achieved via fulfilment of the supporting objectives:

- To investigate whether the social psychology concepts relating to creative performance and innovation identified in the literature review held validity within the AEC domain; and

- To collate domain-specific constructs within a multi-level framework that expands and deepens our broad understanding of the social aspects of creative performance and innovation in teams and can support future research, pedagogical and practice direction.

- To propose a structural framework based upon research findings which captures, arranges, and communicates the key factors and their broad relationships that influence the creative performance and propensity for innovation in built environment design teams.

This structural framework is presented below in Figure 10.1 and described in the associated narrative and tables. The framework is a direct outcome of the complementary, mixed methods research approach. Application of this approach directed data analysis using a broadly interpretivist perspective to infer and distil themes and relationships across multilevel agencies, which were observed in the verbal and non-verbal interactions of, and reported by, AEC practitioners.

Survey data were quantitatively analysed to confirm the relevance of the themes which emerged from the systematic review of social psychology literature. In the focus group and observation studies, a series of domain-specific themes were developed from the social psychology anchor themes, via qualitative analysis (thematic analysis) of the resultant data. Additional socio-dynamic structures of interaction were deduced from the quantitative analysis (social network analysis).

By observing and capturing the views and experiences of practitioners in industry, the resultant findings responded directly to this industry context. This is consonant with the overall aims of the research, which intended to contribute knowledge which has relevance and impact for the AEC industry. Hence, the proposed framework is constructed, so that it may inform and direct the following:

1. *Industry improvement and interdisciplinary guidance in relation to collaborative skills and innovation.*
   The nature and influence of interdisciplinary collaborative performance is increasingly and acutely realised across the industry, for example in the industry-wide development and early implementation of techno-operational

performance tools, such as BIM (Singh et al. 2011, Adamu et al. 2015). The framework offers a timely and valuable structure for guidance which can run parallel to the technological and contractual protocols, so that such performance tools may be employed appropriately and to their full potential. New initiatives may now be developed and existing ones reviewed, using the framework as a checklist for the industry-specific consideration of the 'soft' skills necessary for effective implementation. The diagrammatic representation of the framework (Figure 10.1) may also be overlaid on to industry process recommendations (such as the RIBA Plan of Work or BIM protocols) in order to gauge whether ground level dynamics are likely to be conducive to effective implementation.

2. *Further research and development of knowledge that can support industry performance improvement.*
   In providing an evidence-based structure for industry knowledge relating to the behavioural aspects of collaboration, the framework also identifies the key headings which now require more detailed research. As an exploratory study, this thesis has highlighted industry-specific thematic concepts, making only tentative conclusions about specific behaviour, rather than detailing generalisable findings. However, it provides a clear direction for expanding AEC knowledge and invigorates this area of research. As such, the thematic headings should now be taken individually and used as new foci for new research projects, bids, and subjects for postgraduate research. Successful completion of these projects will inevitably create detailed knowledge that can be transferred to practice.

3. *Higher education professional course curricula and associated professional body validation criteria relating to collaborative skills and innovation management.*
   On the degree courses of construction disciplines, professional practice is necessarily taught according to the criteria of the associated professional bodies. In the absence of a sector-specific framework of criteria for understanding the socio-behavioural aspects of design practice, these criteria remain vague and unfocussed, leaving individual educators to identify and

tailor curriculum content to students. For example, General Criterion of the Architect's Registration Board (ARB) and Royal Institute of British Architects (RIBA) GC11.2 requires students of accredited courses to have adequate knowledge of "*the professional inter-relationships of individuals and organisations involved in procuring and delivering architectural projects, and how these are defined through contractual and organisational structures*." (ARB, 2012). This criterion omits the significant influence of the socio-psychological realm and directs educators to a body of knowledge which is extremely limited. This thesis presents a framework which enables professional practice education criteria to be more appropriate to the needs of students and the professions they will shortly join. The thematic content of the framework also provides the headings which tutors may use to inform content and delivery, thus directing specific and appropriate learning according to industry learning requirements. It also enables educators to employ research-informed teaching where research directions respond to the framework (item 2).

4. *Continuing professional development (CPD) course curricula relating to collaborative skills and innovation management.*
   Similarly, training managers within construction organisations have noted that graduate development and CPD programmes relating to collaboration, innovation, and team working principally draw upon generic models. These models are not tailored, or particularly relevant, to the specificities and needs of the construction industry. The framework presented in this thesis offers a series of curriculum and thematic content headings, which may be used to inform these programmes, thus enabling organisations to provide focussed development for employees, towards enhanced performance.

5. *Performance assessment of collaboration and innovation performance within business models.*
   The framework may be applied to define and monitor the business models of construction organisations. Organisational policies, procedures, and practices may be appraised using framework concepts and thematic content. This would enable an organisation to carry out a collaborative 'health check'

which can identify key areas for improvement, which, once implemented, would enhance overall business performance.

6. *Management and evaluation of projects in relation to collaboration and innovation goals.*
   In a similar way, practitioners can now apply the thematic content to their own projects. Projects may be evaluated using the framework's themes and concepts, so that key improvements can be made in relation to collaboration and team working, towards overall project success. For example, evaluation of communication media channels may lead to better awareness of the methods and effectiveness of engaging particular team members. Subsequent adjustments to communication methods, where necessary, would then enable better accessibility to ideas and problem solving abilities, and thus optimal and excellent solutions are more likely.

7. *Individual performance evaluation in relation to collaborative projects and innovation.*
   Where business and project performance management in relation to collaborative design is implemented via assessment of key indicators within framework themes, then this may also be cascaded to individuals. This may be carried out within project environments, or organisationally via employee performance appraisals. In each case, awareness and application of the proposed framework, its themes, and its concepts, will facilitate improvements to overall business and project performance in relation to collaboration and design excellence. Collectively, awareness and application of the framework will then serve to make improvements across the AEC industry as a whole.

10.3 The framework proposition

The framework is summarised by the diagram presented at Figure 10.1. The framework diagram comprises the following components - (1) interaction space, (2) dynamic exchange of normative response and action, (3) self, (4) ingroups and outgroups, (5) agency, (6) AEC themes, and (7) innovation outcome.

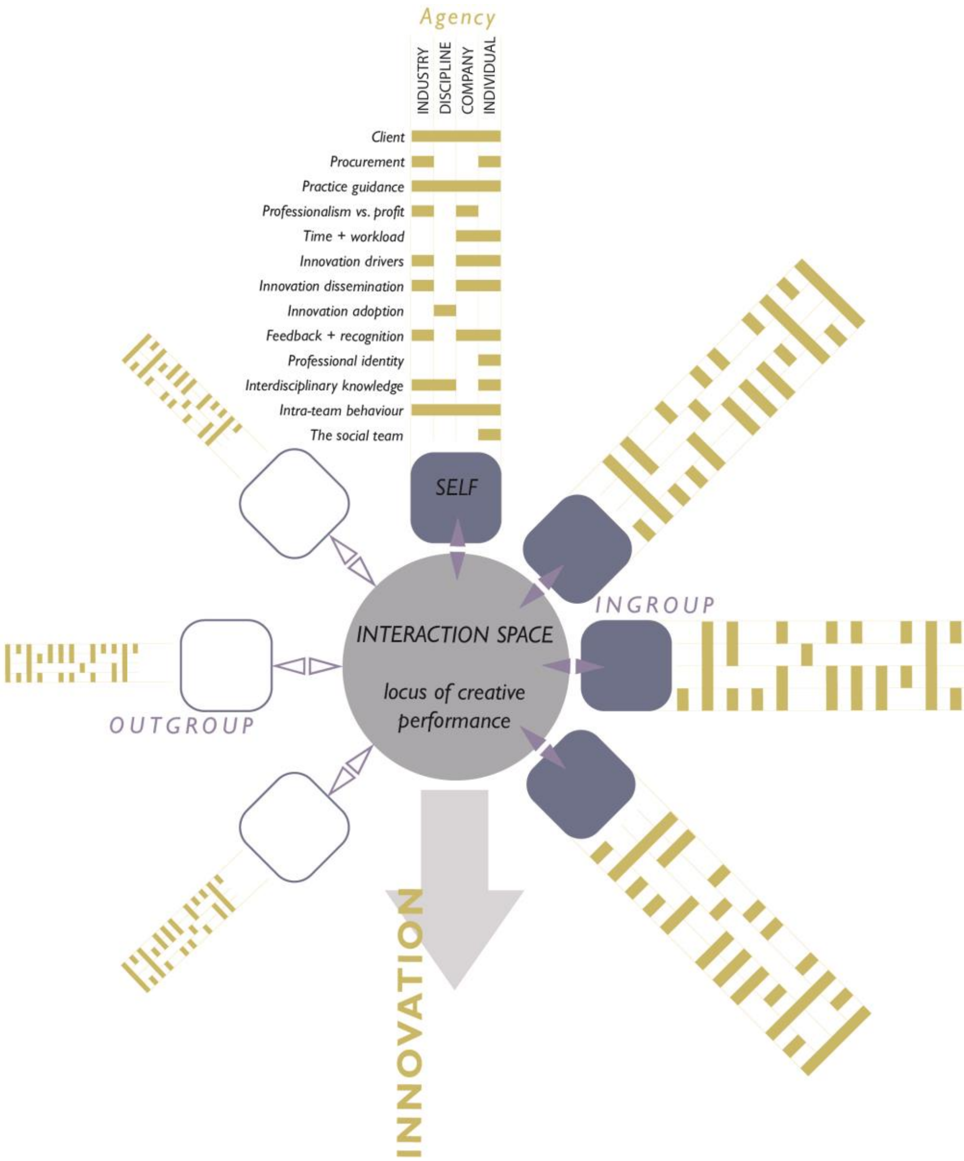


Figure 10.1: A social framework for exploring creativity and innovation in built environment project teams – diagrammatic representation.

*The framework diagram communicates the **Interaction Space (1),** the environment in which collaboration and interaction takes place, thus forming the locus of creative performance. This space is defined by the project team, each operating as the individual **Self (2)**. Some individuals practice as members of the Ingroup, whereas others perform as members of an Outgroup. Hence, the **Ingroups/Outgroups (3)** distance from the interaction space determines the normative influence that each can have upon creative thinking and innovative outcomes. Each Self operates with **Agency (4)** deriving from four multi-level drivers: the individual; their company; their discipline; and the industry. These multi-level drivers are informed by a number of **AEC Themes (5)**, which will influence the interactional exchange. This **Dynamic Exchange of Normative Response and Action (6)** is collectively and normatively tuned within the Interaction Space, thus dynamically influencing Innovation outcomes.*

The components of the framework describe the interpretative findings from the AEC focus group and observational studies, expressed through the socio-psychological lens. The proposed components described in the framework's extended caption are described more fully below.

1. Interaction space

The interaction space amalgamates Kurt Lewin's notion of life space (Lewin 1935; Lewin 1954) with the findings of the current thesis, as well as being inclusive of significant concepts within understanding of social interaction. These concepts include Gero's conceptually comparable design space as an evolutionary state space of collaborative creative exploration (Gero & Maher 1993; Gero et al. 1994; Gero 1996; Gero 2007); van Amstel et al.'s (2016) understanding of design space as a multilevel social entity; and Foucault's notion of space as a fundamental element in the dynamics of knowledge and power in communal life (Foucault 1984). The interaction space can, thus, be defined as the design team environment and is the locus of creative performance and meaning transfer, intention, and co-evolution of the shared mental model of the imagined building (Goldschmidt & Eshel 2009; Lloyd 2009; Luck 2009; McDonnell & Lloyd 2014). It is shaped by the behavioural processes of dynamic interaction according to the roles, purpose, and culture of the individuals within the team toward collective responsive and adaptive innovation outcomes.

The interaction space is also applied as the media environment within which such interaction takes place. In the current research, significant and prevalent differences were found between the purpose and inclusivity of the various analogue and digital media employed by AEC practitioners. Social dynamics within the interaction space must, therefore, be explored in the context of those media differences.

2. Self

The self, in the context of this framework, is defined as the individually-held self-concept and schemata, which normatively respond and act in the interaction space. This establishes a self-primacy within individual cognition by the dominance of self-schemata in information processing (Markus 1977; Kendzierski 1980; Hill & Bellew 1988; Gaertner et al. 1999). This individual cognition will vary amongst team members according to the levels and nature of gestalt agency and the intrinsic feelings of self-esteem and self-approval which reward conformity to the group (Deutsch & Gerard 1955). This, in turn, will influence motivation toward innovation norms, which may or may not be collectively supported (Vallerand & Bissonnette 1992; Walton 2003; Adarves-Yorno et al. 2007).

3. Ingroups and outgroups

Findings from the set of studies in this thesis showed that description of the design team as a multilateral collective of 'selves,' equivalent in their ability to inform and perform in the interaction space, was insufficient. It became apparent that individual prominence, dominance, and cohesiveness vary across the social interactions in AEC design teams. It appears that this finding is prevalent and significant in its effect on innovation outcomes. Variability was also found to be important and could be determined by hierarchical and disciplinary differences between individuals, causing subgroups within the team to emerge. These subgroups may then be subject to differential capacities to contribute within the interaction space.

The social psychology literature relating to ingroup/outgroup formation is prolific in its description of such phenomena, particularly in relation to the effects of stereotyping and prejudice (Tajfel 1978; Tajfel & Turner 1979; Oakes & Turner 1980; Tajfel 1981; Abrams & Hogg 1988; Rabbie & Horwitz 1988; Amâncio 1989; Haslam et al. 1997; Rubin & Hewstone 1998; Gaertner & Insko 2000; Stangor 2000; Boen & Vanbeselaere 2001; Branscombe et al. 2002; Walton 2003; Aronson 2007). From the study findings presented in this thesis, disciplinary stereotyping and prejudicial behaviour appear 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 creativity from the interaction space.

The broad and exploratory nature of the analysis methodology used in the current thesis could not generate conclusive findings in relation to this phenomenon. The study could be conclusive, based on the data derived from this sample set, that the presence of ingroups and outgroups are of clear significance to the design process and the creative propensity of the design team. As a result, the framework visually presents the outgroup at a distance from the interaction space, without suggesting the defining characteristics of those groups.

4. *Agency*

Overall, findings suggest that the AEC practitioner operates as an agent of a series of multi-level drivers which direct their creative contribution in the interaction space of a design project. As the levels and scope of agency characteristics are variable between design team members, so are the group dynamics that direct normative action in relation to ideation, creative thinking, and innovation production.

From the data, four levels of AEC agency seem to be at work in the design team. These were; (1) industry, (2) discipline, (3) company, and (4) individual. This provides evidence to support the assumptions of construction researchers, Cash et al. (2015) and Poirier et al. (2016), who both infer similar findings from social science literature sources. It also provides an AEC perspective to complement additional findings in the social psychology field (Zohar & Luria 2005; Hennessey & Amabile 2010).

5. AEC Themes

Within the four levels of agency, a series of overarching themes emerged as holding relevance and influence in relation to collective creative performance and innovation outcomes. These are: (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 were described in more detail as thematic content, which highlighted key factors that are likely to be prevalent in relation to a particular AEC theme (Table 10.1). These factors provide headings for the development of projects, models, practices, and research questions, which can support industry guidance, curriculum content, project management, and evaluation. The thematic content is derived from the social psychology anchor themes established during the literature review - (1) motivation and reward, (2) risk attitudes, and (3) social climate. Given their affirmed appropriateness to the AEC domain, thematic content is accorded the same divisions as subject headings.

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 (Sherif 1936; Schacter 1951) toward responsive and task-adaptive action.

AEC THEME	MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
CLIENT	1. Clarity of client vision 2. Client capabilities as influence on scope for innovation	1. Client risk propensity	1. Ability for companies to develop brief 2. Correlation of member dominance with client proximity 3. Barrier to collaboration – lack of client proximity 4. Clarity of client-team communication of vision 5. Conflict caused by client distance from non-dominant team roles 6. Reticence to challenge client and brief 7. Client distance as barrier to collaboration
PROCUREMENT	1. Low fee/budget limits innovation potential 2. Specialists procured through core disciplines, not collaboratively 3. Innovation goals obfuscated by procurement complexity 4. Procurement processes inhibit scope for innovation		1. Alliances formed based on experience 2. Dominant members as filter to team membership 3. Longevity of relationships 4. Team design response to project scale and complexity 5. Value of diversity within procured teams 6. Conflict caused by process constraints on appointment

Table 10.1: Thematic content – continued overleaf

AEC THEME	MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
PRACTICE GUIDANCE	1. Process complexity inhibits task definition 2. Lack of prioritization of compliance to standards 3. Barrier to motivation via over complex and variable standards and protocols 4. Compliance-reality dissonance	*no content*	1. Role clarity determined by clarity of guidance 2. Confusion caused by process complexity 3. Decision validity compromised by lack of clarity in guidance 4. Conflict caused by conflicting guidance 5. Conflicting guidance results in unclear output 6. Market deference as response to variable disciplinary interpretation 7. Dissatisfaction with decisions taken in response to conflicting guidance 8. Conflict caused by dissonance between compliance and reality
PROFESSIONALISM VS. PROFIT	1. Company profit goal conflicts with innovative performance 2. Company rewards polarized to team rewards	*no content*	1. Corporate profit goal and process innovation goal conflict

Table 10.1 continued

AEC THEME	MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
TIME + WORKLOAD	1. Documented progress motivates 2. Lack of time as barrier to motivation 3. Non-contribution by team members as barrier to motivation	*no content*	1. Influence of time and workload on possibilities for face-to-face meeting 2. Conflict under pressure relating to theory vs. delivery 3. Project deadlines induce individual pressure 4. Time pressures inhibit collective information sharing 5. Intra-team co-operation of workload management leads to positive climate 6. Consensus damaging when under pressure 7. Conflict caused by request for changes that will cause delay
INNOVATION DRIVERS	1. Company culture as project innovation driver 2. Industry innovation driven by critical mass of individuals	1. Group risk propensity established to determine vision 2. Risk aversion prompts removal of innovation potential rather than problem solving	1. Ability to accommodate change 2. The importance of constructive challenge 3. Quantitative measures of innovation, not just aesthetic recognition

Table 10.1 continued

AEC THEME	MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
INNOVATION DISSEMINATION	1. Innovation dissemination determined by time available 2. Contribution to industry improvement as motivating factor 3. Impact of branding to establish intellectual ownership 4. Barrier to motivation when ‘word’ is not being spread	1. Risk of potential profit loss by expansion of stakeholder engagement 2. Risk of conflict with industry agencies 3. Conflict between corporate risk management and innovation dissemination 4. Risks relating to compromised intellectual ownership 5. Commercial privacy conflicts with innovation dissemination	1. Industry dissemination as shared team goal 2. Conflict caused by differing commercial/dissemination goals 3. Dominant members act as filters to external engagement
INNOVATION ADOPTION	*no content*	*no content*	1. Lack of knowledge overlap between technical providers and construction disciplines 2. Dominance of individual rather than disciplinary preference in innovation adoption

Table 10.1 continued

AEC THEME	MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
FEEDBACK + RECOGNITION	1. Motivation derived by gaining credit for work done 2. Motivation derived from peer feedback 3. Impact of positive recognition from external funders on team motivation 4. Promotion of stakeholder engagement to enhance external recognition 5. Recognition of industry contribution as extrinsic reward 6. Pro-team promotion vs. self-promotion 7. Industry feedback as mechanism to foster team learning	1. Consensus used to manage risk of effect of output 2. Negative industry response as influence on decisions 3. Negative industry response as influence on innovation sharing 4. Project output influenced by expected industry response 5. Risk ownership shared to mitigate effects of negative feedback 6. Risk of negative feedback externally to team 7. Reticence to share information outside the team in case of negative feedback 8. Risk of being perceived as non-productive	1. Importance of recognition for innovation via publicity 2. Stakeholder engagement as mechanism for minimizing industry conflict 3. Positive climate generated by positive external recognition 4. External individuals keen to be part of the group
PROFESSIONAL IDENTITY	*no content*	*no content*	1. Individual preferences towards introversion-extraversion

Table 10.1 continued

AEC THEME	MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
INTERDISCIPLINARY KNOWLEDGE	1. Clarity of role understanding 2. Engineering subservience to architect 3. Specialist disciplines peripheral to process 4. Timing of appointment as factor in ability to collaborate 5. Willingness to share information promotes learning 6. Priority of project delivery in relation to collective learning and success	1. Role specialism as factor in ownership of specialist risk 2. Corporate information protection inhibits information sharing	1. Criticism of engineering engagement in team 2. Engineering subservience to architect 3. Interdisciplinary common language aids collaboration 4. Timing of appointment as factor in ability to collaborate 5. Abilities and expectations engendered in education 6. Benefits of direct interaction 7. Team success derived from shared learning experience 8. Disciplinary partitioning across industry 9. Availability of non-construction expertise for construction innovation 10. Reappraisal of team roles as key activity 11. Interdisciplinary sharing towards innovation 12. Disciplinary sector knowledge equates to member specialism 13. Innovation from extra-discipline knowledge 14. Disciplinary skills required for specific problem solving 15. Innovation derived from interdisciplinary processes 16. Positive climate generated by group supported learning

Table 10.1 continued

AEC THEME	MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
INTRA-TEAM BEHAVIOUR	1. Generational propensity for collaboration 2. Individual comfort in technological solutions for collaboration 3. Individual dedication to collaborative innovation 4. Motivation derived from collective success 5. Member non-contribution as motivation limiting factor 6. Team identity created as brand within industry 7. Team core value to improve industry	1. Sharing of risk of failure performed via group narrative 2. Establishing risk norms for risk sharing 3. Influence of corporate information protection on openness and information sharing 4. Risk adoption according to leader confidence 5. Consensus as risk mitigation strategy 6. Corporate information protection limits role clarity	1. Ability to contribute ideas limited by company hierarchies 2. Team collaboration norms dependent on company norms 3. Fragmentation to preserve cohesiveness 4. Appropriate selection of communication media 5. Collaboration fostered by co-location of individuals 6. Competence outweighs behaviour 7. Differing individual goals causes conflict 8. Dominant members establish psychological safety 9. Effort of face to face interaction reaps rewards 10. False consensus created via dominant member 11. Impact of the ‘negative’ member 12. Importance of climate of trust 13. Motivation from pro-collaboration team dynamic 14. Mutual support for innovative performance 15. Need for pro-active response to social dynamics 16. Need for respect 17. Norms of meeting organization and agenda setting 18. Personal characteristics for innovative collaboration 19. Role of ‘banter’ as social lubricant 20. Role of ‘banter’ to determine individual identity 21. Shared mental model of the successful outcome

Table 10.1 continued

AEC THEME	MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
INTRA-TEAM BEHAVIOUR *continued*	*no content*	*no content*	22. Subscribing to cohesiveness gives reward in focus and progress 23. Need for design process facilitator 24. Explicit 'no wrong answer' culture 25. Team identity forged within industry 26. Team core value to improve industry 27. Team pride in innovative venture 28. Communication tech adoption as collaboration facilitator 29. Fragmentation to preserve cohesiveness 30. Reinforcement of team task-focussed behaviour 31. Limited face-to-face meeting to reduce cost to company 32. Subscribing to cohesion reaps rewards in focus and progress 33. Reticence to discuss personal life 34. Sharing personal politics establishes norms and cohesion 35. Interpersonal tensions evident via concealed disparagement 36. Collective identity strengthened by shared adversity 37. Clarity of communication aids collaboration 38. Change to team identity disturbs and distracts 39. Call to focus on task rather than individual contribution

Table 10.1 continued

AEC THEME	MOTIVATION + REWARD	RISK ATTITUDES	SOCIAL CLIMATE
THE SOCIAL TEAM	1. Motivation to collaborate – association with inspiring people	*no content*	40. Social interaction outside design team meetings

Table 10.1 continued

7. *Innovation outcome*

The final component of the framework is described as the innovation outcome. This is the collective output of the team. The nature and quality of the innovation are largely dependent on creative performance within the dynamic interaction space, which in turn is determined by the normative and task-adaptive responses of its members. Conception of the creative and innovative propensity of AEC design teams as a dynamic system of interaction prompts an apposite return to Matthews's salient point, which helped to define the scope and purpose of this transdisciplinary exploration.

> *"The very identification of designers' normative orientations (e.g. to the local relevance of talk) is one important step towards the creation of formats of interaction that might be able to 'tamper' with social order, in similarly mild ways, so as to be more conducive to design objectives."*
>
> *(Matthews 2009, p75)*

By restating this quotation, the context and purpose of the framework can be affirmed as a structural system that can be applied, explored, and expanded to facilitate a more informed and conscious application of knowledge and management in relation to the social life of design teams, toward project creativity and innovation objectives.

10.4 Evaluating the framework

Evaluation of validity from a critical realist epistemological position is the subject of continued debate. The notion of validity emerges from a positivist approach to research, whereas the proposed framework emerges from an interpretivist approach to the qualitative analysis of the data. Thus, quantitively to evaluate reliability, objectivity, internal validity, and external validity would be unsuitable for the research methods implemented here. From the critical realist perspective, to determine that there are variances in the 'readings' would not necessarily indicate the presence of inherent flaws (Bhaskar 1998; Lawson 1998; Creswell & Miller 2000; Smith & Johnston 2014).

Instead, evaluation of the proposed framework through a critical realist lens must acknowledge that variances in readings will occur as individuals interpret experiences differently within a varied set of environments. This is not to say that it is appropriate to posit that, simply because the analysis is interpretative, it can be cursorily inferred as true. It would be more prudent, therefore, to engage in a more subtle realism, which acknowledges a need for quality and rigour in the evaluation and subsequent contribution to knowledge. Thus, evaluation of the research focusses upon Guba and Lincoln's criteria of credibility, transferability, and reliability (Lincoln & Guba 1985; Guba & Lincoln 1989) in its assessment methodology.

Creswell and Miller (2000) offer procedural solutions for suitable evaluative procedures in relation to qualitative research, according to the paradigm assumptions. This is represented in Table 10.2, with the adopted critical paradigm and associated procedures highlighted. These evaluative procedures have been implemented in a number of sociological studies within the critical realist paradigm, including ethnographic exploration of gender-based culture and agency (Duits 2008); interrogations of power and privilege in leadership education (McClellan & Sader 2012); and also used in management research (Lukka & Modell 2010).

Evaluation of the framework, therefore, will be performed using the three procedures of (1) researcher reflexivity, (2) participant collaboration, and (3) peer debriefing, attuned to the nature of the research subjects and scope of the PhD research. All three of the evaluative procedures have been embedded within the research design, methodology and associated reporting, but are set out more explicitly in sections 10.5-7.

Paradigm Assumption / ***Lens***	*Post-positivist or Systematic Paradigm*	*Constructivist Paradigm*	*Critical Paradigm*
Lens of the Researcher	Triangulation	Disconfirming evidence	Researcher reflexivity
Lens of Study Participants	Member checking	Prolonged engagement in the field	Collaboration
Lens of People External to the Study (Reviewers, Readers)	The audit trail	Thick, rich description	Peer debriefing

Table 10.2: Validity procedures within the qualitative lens and paradigm assumptions (with adopted paradigm highlighted) - after Creswell & Miller, 2000

10.5 Researcher reflexivity

Reflexivity has been employed throughout the research process, beginning with the formulation of the research question itself. This reflexivity has not intended to spot 'flaws' in the research (Dainty 2008), but has been used as a fundamental tool that complements the realist position and offers transparency in evaluation. This section, therefore, substitutes the passive voice to that of the passionate voice (Finlay & Gough 2008). The passionate voice, although subjective and value-laden according to researcher recollection, emotion, and personal context, has proven powerful throughout the research. In representing this voice, the remainder of this section will dispense with the passive voice in favour of the first person.

Beliefs and perspectives

As mentioned in the introduction to the thesis, my experience as a practising landscape architect, operating within and managing built environment design teams, brought me directly to the research question. It may be possible to say, then, that without this previous immersion in the cultures and practices of the construction industry, I may never have formulated the research question. It may also be possible to say that my experiences, recollections, and emotions collected during practice, as well as those accrued more recently, may well distort my interpretation of the data. These practice experiences have been, to a substantial degree, tempered by my engagement in the Interdisciplinary Design for the Built Environment (IDBE) course at the University of Cambridge. This directed a reflective and empirical perspective of design team practice. The course output comprised a participative, ethnomethodological case study and thesis submission relating to the influence of functional and social relationships on design outcomes.

Whilst this work tempered and enlightened my previous experience in preparation for the current study, during the course of the interpretative inquiry, I was aware of the need to rethink some long-held beliefs and to amend my own perspectives to include those of the participants (Maso 2003). For example, my previous experiences as a designer in built environment teams prompted my interpretation that the architect was frequently the subject of derogation within construction team culture. Interpretative findings suggested this may indeed be true. However, parallel interpretation of the perspectives of other disciplines revealed to me that such derogation may, in fact, be symptomatic of fissures that exist between the mutual understanding of disciplinary roles across the team. Engineers, in particular, reported similar experiences and comparative analysis of the two disciplinary perspectives revealed a new story. This amendment to my own perspective encouraged me to dispense with ‘creative outgroup’ as a specific theme within the framework, and to convert it to one of more general ‘outgroups’ which may or may not be characterised by the creative role.

Reflexivity in data collection and analysis

In acknowledgement of my personal perspectives, I also attempted to minimise the influence of my beliefs and biases within the overall research design. For example, rather than commencing the research with qualitative inquiry, I made the conscious decision to use a systematic literature review of the social psychology literature to establish the framework's 'anchor themes' with further quantitative testing of applicability to the industry domain of study. This allowed me to use these non-interpretatively derived and quantitatively verified anchor themes as the basis for the subsequent interpretation of the qualitative data, rather than deriving framework themes directly from my own intuition and expectation.

During data collection, I took care in limiting my own participation in facilitating focus groups and observations. However, the level of my participation was not always within my control. The simple knowledge of my dual identity, as a construction design professional as well as a researcher, led participants to establish my co-presence. Nevertheless, I understood there to be a degree of benefit from this co-presence. It instigated a degree of trust between myself and participants as I was linguistically, relationally, and emotionally part of the same culture (Finlay & Gough 2008). Similarly, I believe that the transcription process benefitted from my personal experiences and perspectives as I was able to infer deeper and more accurate meaning as a result of professional knowledge and empathy.

As this study was not a participative ethnomethodological inquiry, I traced a tight rope path between professional affinity and detachment. During transcription, detachment was sought by reflexive hearing and re-hearing, watching and re-watching of the data. Thus, I was able to notice my role in generating it. For example, when a group tension emerged between the case-study team and one of the architects, attempts were made to conceal this disparagement. During introductions to the second face to face meeting, the chair of the meeting simply said:

> *"[A1] erm what can we say there. He's not here and well I think we'll leave that there."*

One of the engineers reminded him that he was being filmed and the video file shows a number of the team members turning to smile at me. If my recording equipment or I had not been present, it may have been likely that the disparagement of the architect, in this case, may have been more open and extended. However, I maintained inclusion of this excerpt within the theme of "*interpersonal tensions evident via concealed disparagement*" as this was consistent with other media and similar events.

During focus groups, my role as facilitator was to keep the conversation going, as well as to encourage participants fully to explore their ideas and experiences. In some cases, my prompts inadvertently redirected the conversation which, although the results were deemed valid as data, would not have occurred without my facilitative participation. For example, during Focus Group 3, I attempted to clarify my facilitative question via use of generic example. However, this inadvertently redirected the group discursively to assess the comparative values of competency, education, and personality in relation to collaborative practice.

> - *It's just respect. There are some people you just know won't respect you.*
>
> *ME: So, what are the kind of people that [company name] like working with then?*
>
> - *What's the trait of a typical [company name] employee? Is that what you're saying?*
>
> *ME: No, not an employee. Say, a structural engineer, just say.*
>
> *((Loud laughter))*
>
> *ME: Is that a bad example?*
>
> - *Every one of us are thinking of the same structural engineer right now.*
>
> - *But, but that structural engineer, we've used for years and years and years because we know the way he works.*

- *He's very good at what he does it's just the way he does it.*

- *He can be objectionable. He can be in your face.*

ME: So, competency can outweigh some of his more objectionable characteristics?

- *Yes. Coz we know that and if you're able to adapt to that. If you know it, you can adapt.*

- *But it can come round to education coz if we're not suitably educated in structural engineering, we find that hard to challenge what he's saying. That's the only way you can do it.*

- *Yeah, yeah.*

- *So we find it hard to say 'no it's not' surely you can do it this way.*

During the process of coding and analysis, I followed a similar reflexive tight rope path. In the main, I attributed data to anchor themes based on an inclusive approach to semantic analysis. Only after this stage, did I produce and refine candidate themes, representing a transfer of knowledge in relation to the research objectives from the field of social psychology to that of AEC. In a similar way to the overall research design, this minimised the influence of my own intuition and expectations. However, during the latter stage, my previous experiences were employed, facilitating deeper insights, as the reflexive process of coherent thematic organisation required an accurate and tacit understanding of the data. Using software as a data management and coding tool also supported detachment.

Throughout the research, I maintained a series of notebooks, which has been my practice during my entire professional life, both to record factual information, as well as reflexive thought processes. I maintain reflexive journals as instruments of professional development (Schön 1983; Moon 1999) and have continued to do so for the PhD research. These were particularly helpful during data collection and analysis, as they performed the role of reflexive field notes. These notes highlighted questions that allowed me to engage in critical reflection on what I had seen and heard.

For example, during the first face to face meeting, I noted interesting aspects which would require later follow-up, such as emerging tensions between desired compliance with industry standards relating to timing of appointment and members' inner professional voice. The entry into the notebook reads:

> *Conflict is causing dissonance between protocol and intuitive professional judgement e.g. operation protocols about when to appoint people and what actually happens in practice. Will people actually follow the standard?*

This note enabled me to derive relevant themes relating to appointment and develop the concept of 'compliance-reality dissonance.'

When the group experienced success at the industry conference, my co-presence created an empathetic sense of pride in being part of the team. However, use of the reflexive diary during the coding process provided a cautious reminder to make sure that this sentiment was manifested across the group, rather than simply an expectation of mine, based on my own past experiences of success.

> *[E1] is expressing a real sense of pride here and I can feel this across the group. Is this real? Will I be able to evidence this in the narrative?*

In acting upon these questions, I was able to establish that the pride was indeed shared, but limited to the online media, supporting the observation that, for the case study, online media tended to be used for democratic and operational interaction.

10.6 Collaboration

Creswell and Miller (2000) describe the evaluative function of collaboration as a validity lens which builds the participant's view into the study. This functional objective has been fulfilled in three stages:

1. Focus Group/Case-Study pre-briefing

2. Immediately following focus group discussion/During case-study observation; and

3. Focus Group/Case-study de-briefing

These three stages are outlined below.

1. Focus Group/Case-Study Pre-Briefing

Before the focus groups or case-study observation could be conducted, discussion was held with key contacts in companies and teams to establish the objectives of the research. This involved discussion of my intentions and expectations, as well as theirs. This encouraged outcomes that could be useful to and supportive of both parties. These outcomes necessarily responded to professional learning objectives, which could be tailored to individual groups.

More informal pre-briefing discussion also included less tangible outcomes. For example, prior to focus group sessions, extended meetings with company directors included an extensive tour of the buildings, so that I could understand the nature of their projects, and the 'shop floor' processes and people that delivered them. These meetings exceeded basic information exchange as they enabled me to gain a greater understanding of their practices, business model, their successes, and their problems in relation to the research question. These initial interactions created a collaborative approach to focus group question framing and the consequent interpretation of the resultant discussions. This additionally facilitated participant collaboration in the proposition of the outcome itself.

For example, during the pre-briefing of Focus Group 3, the company director raised the question of how he might benefit from the research directly as he was very interested in the subject. This discussion was concluded with a collaborative agreement for mutual support in developing the research outcomes as a dynamic tool that could be used by an industry audience, for example as a 'pocket book' format, similar to those already employed in industry (Ross et al. 2011; Cobb 2014). Similarly, directors and a number of employees also expressed a desire for the research outcomes to be presented so that they could be developed as in-house professional development modules that reflected their own company's business model and aspirations. These discussions are ongoing.

2. *Following focus group discussion/during case-study observation*

Immediately following the focus group discussion, a period of 'informal' discussion was held. Recording equipment was switched off at this point and these discussions were not included within the analysis. During these periods, I was able to speak directly to participants to establish their own aspirations for the study outcomes so that their ideas or concerns could be addressed. During discussion following Focus Group 1 and 2, the embryonic idea of practitioner multi-level agency was raised, prompted by expression by a number of participants that they were unable to influence specific aspects of social dynamics in the design team, due to their positioning within the industry.

During the case-study, interim reporting of research methods and findings was undertaken. This was carried out formally as a presentation at the close of each face to face design team meeting. Responses were then recorded and considered during the next phase of research. In particular, the participants reported that they found the feedback from the research helpful in thinking about their project as it gave them a very different viewpoint from their own and, in turn, prompted their own reflection on their working practices. This was noted as particularly true in prompting a more mindful approach to media selection for their interactions as well as interrogating the perceived relationship between strategic and design roles.

During the case-study, conversations were also held with participants individually and informally where further information was required about the study. These were prompted by me, but also, on occasion, prompted by participants. For example, a participant contacted me directly to discuss ways that the findings might be developed to contribute to their own individual research projects. Another raised the subject of 'leadership' and how this was located in the research (See Section 3.2). All participant discussions were noted in the reflexive notebook and considered in critical reflection upon the research methodology development and interpretation of the data.

3. *Focus Group/Observation De-Briefing*

Research outcomes were also discussed with participants on completion to establish whether the findings were aligned to how their perception of their own experiences. Originally, this had been conceived as a presentation, with subsequent short survey that would determine the relevance, appropriateness, and completeness of the framework proposition. However, it was decided that this survey would not be conducted in light of likely unreliability and potentially unethical consequences.

A survey as an instrument for participant validation may be considered appropriate when the study requires those involved to confirm whether the representation is also how they saw the situation (Harper 2003). However, the framework comprises a summative representation of content from a variety of sources. Hence, participants are unlikely to be able to pinpoint their own contribution and some content will be included that was not discussed or performed in their particular group or observation session. In addition, the framework suggests thematic content with which participants may not be comfortable and may not wish to accept (Harper 2003). Such instances may include negative behaviour (as in the case of struggles for dominance) or observations that were beyond their own awareness and intention (Coyle 1995) such as fundamental dissonances between team member mental models. This would not only be demoralising for the participant, but also potentially damaging to the trust relationship that was built between researcher and participant during the course of observation and, it is hoped, will continue for further research projects after completion of the PhD.

As a result, the presentation was shown to three selected participants, with whom these issues could be discussed directly during a phone conversation. The result of these discussions was generally positive, although participants found it difficult to digest all the content. One participant raised the issue of using a single case-study from which to draw inferences, suggesting that the findings would, therefore, result in atypical findings. Whilst this is a valuable comment, the purpose of this research is not to produce generalisable findings, but to generate a framework of concepts that might be applied as hypotheses in future research and practice interventions. Another participant also suggested that a number of interaction spaces should exist, each identified as varying foci of interaction, such as media context and strategic level. Participant comments will continue to be monitored as the research findings are developed beyond completion of the PhD.

10.7 Peer de-briefing

Whilst the collaborative approach with participants has provided a valuable lens for framing questions and evaluating interpretation, a test of credibility must also be applied by non-participant input. It may be argued that the PhD process, itself, has provided the structure for peer de-briefing as a method of review by someone who is familiar with the research (Creswell & Miller 2000). This supportive challenge of method and interpretation has been performed formatively over the course of the research by the supervisory team and will be summatively reviewed during examination.

However, for further credibility, peer review external to the study has also been sought. This has been obtained via publication and presentation to peers from both academic and industry backgrounds. As the anchor themes provided the departure point for the interpretative inquiry, it was considered vital to obtain peer review of these prior to commencing the qualitative analysis. To this end, a paper documenting the systematic literature review and thematic outcomes was submitted, reviewed, and published in the academic journal "*Engineering, Construction and Architectural Management" (*Barrett et al. 2013). Interim study findings were also presented to peers and academics at the University of Central Lancashire throughout the course of the study. These included faculty poster presentations and internal academic review seminars.

Interim study findings were also presented to industry peers at the BE2Camp collaboration conference (2015). BE2Camp represents a network of multidisciplinary industry professionals who share an interest in delivering sustainability facilitated by Web 2.0 (which includes blogs, Twitter, wikis etc.). The research invited some debate and I have been invited to return with the final framework proposition for the next conference in October, 2017. Interim study findings were also presented at the International Association for Bridge and Structural Engineering (IABSE) 'Future of Design' Conference in April, 2016. This, again, received a positive response, particularly from the conference organiser, who has nominated the title for this year's conference as '*Creativity and Collaboration*' as a direct result. Further publication for peer review is planned following PhD completion.

10.8 Summary

Whilst positive response and review may reinforce the credibility of the research and its outcomes, the reflexive evaluation identified that the sample set may not be fully representative of the industry in totality. It is acknowledged, therefore, that the framework, as a summative outcome of interpretative findings, may be a subjective, partial, and fragmentary result. Nevertheless, it affords significantly more thematic content to supplement the constructs that already exist in AEC literature and thus, contributes further knowledge in this limited area.

The research has also sought to implement transparency and rigour in its methodology and a reflexivity in application of researcher presence and experience to facilitate findings through the qualitative lens. This transparency, rigour, and reflexivity, combined with the use of industry-based focus groups and case study as opposed to an experimental, laboratory-based research design, have provided a valuable degree of authenticity. The framework, therefore, whilst not without limitations, is a valuable initial step in identifying the antecedents, concepts and cultures that are likely to enhance the creative performance and innovation propensity of multidisciplinary teams.

11. CONCLUSIONS

11.1 Introduction

This chapter concludes the thesis by presenting the primary findings of the research. A review of the research aims and objectives is carried out and a summative report of the primary elements of the proposed framework is also presented.

This summary also identifies how the framework may now be applied within industry, to expand and deepen understanding of creative performance and innovation in built environment, multidisciplinary, design teams. A review of the research and its outcomes considers its limitations. In addition, this section also indicates how the framework now offers future directions to fill the research gaps identified in the review of AEC literature, as well as ways that the framework, itself, might be developed further.

11.2 Review of research, aims, and methodology

The direct aim of the research was to provide a framework for expanding and deepening AEC domain-specific knowledge, in relation to the socio-behavioural aspects of design team interaction and their influence upon creative thinking. Through extensive study of practitioner perception and behaviour, and complementarity of analytical method, this aim has been fulfilled. Adoption of the critical realist research strategy has provided a valuable lens, through which to scope new socio-behavioural themes and narratives, which have not previously been explored in the AEC context. Hence, both the research methodology and its outcome offer a valuable counterbalance to the techno-operational and positivist dominance within the sector.

The objectives set out at the beginning of the research programme, in order to achieve the aim, have been successfully completed. A systematic review of social psychology literature was conducted to identify key themes, which were likely to hold significance for design team creative performance. Three anchor themes were identified. These were: (1) motivation and reward, (2) risk attitudes, and (3) social climate. A thorough, exploratory investigation of the validity of these social psychology themes and associated phenomena was conducted, via three complementary studies, which used industry-based, survey, focus group, and case-study observation research methods.

The survey aimed to test the validity and nature of the emergent social psychology anchor themes. This was delivered via quantitative analysis, which confirmed the presence of a number of the sub-themes, but also indicated the possibility of a further theme relating to the idea of a 'creative outgroup.' This new theme, generated by the survey findings, suggested that creativity may be separated from project activity, as creative disciplines tended to be derogated by the 'ingroup' creating a dynamic, where creativity was extricated from the team's climate, norms, or values.

Focus group interviews were subsequently conducted to expand the findings of the survey using a complementary, qualitative approach. Given that focus group data consisted of self-reported experiences, the potential bias of these self-reports was balanced with a complementary case-study observation. Analysis of the significant wealth of data collected produced by the studies was carried out using methods commonly employed within the social psychology field, namely thematic analysis, observation coding, and social network analysis. These methods were valuable and successful in maintenance of the interdisciplinary partnership between the two domains, an approach which proved successful in enabling a bisociative response to the interrelationships between social behaviour and construction team practice.

Resultant findings were synthesised to describe how the socio-behavioural constructs manifest themselves in an AEC practice context. Synthesised findings revealed a series of AEC-specific, socio-behavioural themes, that are applied according to the multi-level agency of the AEC practitioner, and according to AEC-relevant media contexts.

A key objective of the PhD research, was to produce a multi-level, structural framework. This framework has been successfully composed. It captures, arranges, and communicates key concepts, which influence creative and innovative propensity in built environment design teams. It highlights new themes, relationships, and narratives, which expand and deepen our broad understanding of the social aspects of creative performance and innovation in built environment design teams. It also expands the AEC research frame and offers new directions for future research, pedagogy, and practice.

11.3 Primary elements of the social framework

The proposed framework coalesces the findings from the survey, focus group, and case-study observation. The framework collates these emergent constructs within a multi-level framework, expressing design team interaction as a dynamic, normative, and adaptive activity. This activity is responsive to a series of multi-level agencies, which cohere within the perceptions of individual members. The framework is presented in a diagrammatic, narrative, and tabular format so that it can be widely utilised to support future practice, pedagogical, and research directions. The framework, therefore, as an outcome of the research, demonstrates the fulfilment of the research objectives, and makes a significant contribution to AEC knowledge.

Whilst the initial literature review had not recorded a clear correlation of knowledge between the two fields of social psychology and AEC, the research methodology facilitated the testing of relevance of social psychology themes relating to group creativity and innovation within the AEC frame. This testing of relevance confirmed the existence of four themes that embrace the antecedents, concepts, and cultures likely to enhance the creative performance and innovation propensity of design teams in practice. These anchor themes are (1) motivation and reward, (2) risk attitudes, (3) social climate, and (4) leadership.

The fourth theme, leadership, was not explored as part of this study as this would require a separate study of individual characteristics, rather than the collective activity that may influence creativity and innovation in groups.

The framework takes the form of a series of overarching themes, rooted in the social psychology field and transformed to reflect and inform the AEC-specific context. These overarching domain-specific themes are as follows:

a. *Client*
b. *Procurement*
c. *Practice guidance*
d. *Professionalism vs. profit*
e. *Time and workload*
f. *Innovation drivers*
g. *Innovation dissemination*
h. *Innovation adoption*
i. *Feedback and recognition*
j. *Professional identity*
k. *Interdisciplinary knowledge*
l. *Intra-team behaviour*
m. *The social team*

In addition to the domain-specific thematic narrative, the framework also proposes a visual representation, which describes the dynamic structural relationships that exist in design teams (Figure 11.1). This incorporates the dynamic role of the interaction space, which normatively and adaptively mediates the varying multi-level agencies of the individual team members towards innovation outcomes. The multi-level agencies emerge not only from the findings of the research, but also from the review of existing knowledge in the social psychology and AEC fields.

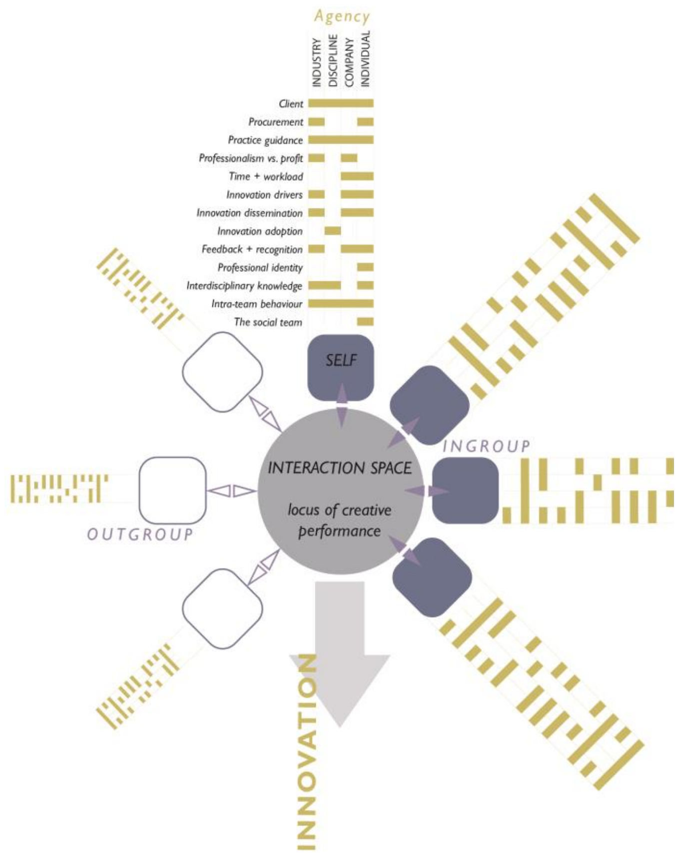


Figure 11.1: Resultant social framework diagram

Within the overarching themes, thematic content directs more detailed thinking about how creativity and innovation may be influenced in built environment teams.

This thematic content is organised within the three social psychology anchor themes from which they are drawn, thus verifying and consolidating the correlative link between the two fields.

The framework may now be applied within an industry context, either as a whole concept or within the level of agency in which the practitioner is more likely to be interested. For example, pan-industry practitioners (such as members of an industry BIM Task Group) may consider only those themes within the *industry* level of agency, as it will be difficult for them to influence those that are outside this level of control. They may then use the associated themes, diagram, and content as criteria to support industry performance improvement via professional development curricula and project evaluation. Similarly, if a company director is seeking to improve employee performance, they may prioritise themes under the *company* and *individual* levels of agency.

11.4 Limitations of the research

As an investigative and exploratory study, the PhD research has contributed key themes, narratives, and relationships to the AEC domain of knowledge in relation to the social dynamics that influence creativity and innovation in the multidisciplinary design team. However, certain aspects were not able to be fully explored within the scope and timeframe of the PhD.

Within the scope of their exploratory purpose and critical realist perspective, the studies sought to examine the experiences and behaviour of AEC practitioners across a range of disciplines, projects, and organisations. However, the expansive nature of the sector, coupled with study time constraints, limited possibilities for extensive recruitment of participant groups. This resulted in a fairly limited sample size for the initial survey (n=44) in relation to the potential size of the sample set, and so could not be termed representative. However, as the survey findings were merely considered as a tentative test of relevance of the social psychology themes, this was deemed acceptable for this study.

Practicality also embedded limitations to the research when conducting the focus groups. One of the focus groups may be considered to be quite large (with 45 participants). Indeed, all focus groups were conducted as one group, rather than fragmenting these groups into smaller sizes, which may have been more appropriate for discussion. These large sizes may have limited some members' ability to contribute freely and allow their views to be heard. In a similar way, each focus group included practitioners from across the business hierarchy, from new graduates to company directors. In hindsight, it may be considered that more junior members would not have felt able to contribute a view that they perceived would place them in a negative light amongst their senior colleagues. Conversely, company directors may not have wished to divulge certain confidential information about performance or information that would be likely to demotivate their staff. Should the research be conducted again, it would be more prudent to allocate more time to the data collection phase. This would enable researchers to work with focus groups of smaller sizes and similar hierarchical level.

In the naturalistic setting, case-study observation is wholly dependent on a project programme determined between the project team and their client, and separately from the researcher. For the case-study observed in this research, whilst initially within the PhD timeframe, the programme drifted and was then unexpectedly suspended prior to Stage 2 close-out. That drift and suspension were, in part and in hindsight, attributable to some of the issues that were recorded in the study findings. For example, frustration at the limited dissemination of the case study project's innovative outcomes amongst the industry diminished the team's motivation to overcome external barriers to progress. However, other external influences prevented continuation until a recommencement date which is yet to be determined. Had the case-study project continued according to its initial programme, then analysis across all pre-construction work stages may have provided additional findings, as well as providing further evidence for those already suggested. The research findings are thus limited to the early stages of the design process, rather than across the full range of the RIBA Plan of Work (RIBA 2013).

Practitioner consent also limited the scope for additional case-study observation. This appeared to be a particular cause of concern for those from architectural disciplines who, although their design team colleagues from other disciplines were keen to take part in the study, were reported to be hesitant about having the "*mystique of design sullied by being observed and re-broadcast!*" (Engineer [Name withheld for ethical reasons] 2015). In itself, this may offer a disciplinary-level finding which requires further exploration in another study, but as observation of project teams required all members to consent to their involvement, it, thus, generated difficulty in gaining access to further project team environments.

Whilst the single case study proved extremely fruitful in terms of this exploratory research, it would have been of value to ascertain whether observable behaviour and outcomes were typical across teams, or unique to the one studied here. The research design did, however, allow typicality to be partly inferred by thematic repetition within focus group discussions. In any case, the exploratory nature of the research sought to identify and record the existence of themes as tendential demi-regularities, rather than to draw inference on their prevalence and generalisability. As such, the framework presents a description of a reality that expands the current AEC research frame, as well as contributing meaningful conclusions for industry application and to direct future research. However, it is acknowledged that observation of additional case-studies could have considered prevalence as a means to prioritise the AEC themes and their content.

During analysis of the data, the social science qualitative methodologies were not without their inherent biases. As a semi-participatory observer, with a professional empathy, I was able to infer a great deal from the focus group discussions and case-study observations via thematic analysis. However, this status may also have coloured my interpretation. Should similar methodologies be applied again, it would be prudent to corroborate findings by employing two additional independent analysts. Should such independent analysis corroborate findings, then this would enable results to be considered as more robust. Alternatively, the methodology should incorporate a quantitative test by which to triangulate and verify the outcomes.

11.5 Recommendations for further research

The limitations of the PhD research also highlight the potential impact of its contribution. The framework and its content have illuminated an array of future directions for further AEC research, as well as facilitating a switch from the traditional positivist research lens. Whilst the critical realist research perspective only facilitates the determination of thematic 'demi-regularities,' findings must be taken with the caveat that they present only tentative hypotheses. More detailed causal and correlative social influences on creative performance and innovation outcomes now need to be further investigated, so that more generalisable findings can be established.

The framework itself provides the structure for this further investigation as each overarching theme with associated thematic content is intended to support the formulation of future research questions. Each of these points may now be investigated in detail to deepen our understanding of their role in determining project success, toward new knowledge and tools to support industry. In highlighting these new research directions, which, by their very addition to the AEC research frame, constitute a contribution to domain knowledge, the AEC literature framework presented in section 2.7 (Table 2.1) can now be modified and expanded. The modified and expanded AEC literature framework is presented in Appendix 4.

The expanded AEC literature framework (Appendix 4) demonstrates that the multi-level framework has made a significant contribution to the scope for future research in relation to creativity and innovation in design teams. Within the gaps highlighted in the literature review, it has established new thematic direction and established additional levels across which to draw new and detailed findings. The table is adapted from Table 2.1, which summarises the literature review, maintaining the highlighted knowledge gap. However, the original table is adapted to include the newly generated AEC themes. The emerging concepts now incorporate the newly identified themes generated by this research, either as distinct, new themes or by expanding those that were previously listed. The theme 'design process' has now been omitted from this revised list, as it was deemed to be implicit across the framework as a team's primary activity to which all the framework content applies. Similarly, the theme entitled 'individual capabilities and empowerment' identified in the initial literature review has been subsumed within the individual level of agency attributed to the 'project management' theme.

Whilst some gaps remain in the literature framework, these in themselves, also present opportunities for future research. These gaps present specific areas which were not found within the research datasets but may still hold relevance to the sector. Whether these absences are specific to this study or are maintained across the sector should be investigated. An additional area for future exploratory research is that of 'leadership' which was omitted from this study but, according to the social psychology literature, is likely to exert significant influences.

This thesis contributes both a detailed framework as well as a methodological shift from the positivist AEC tradition which has, historically, proven limited in its ability to illuminate fully the 'soft' aspects of construction projects such as behaviour and creativity. These entrenched traditions are also likely to appear in other professional disciplines, which may also be keen to switch lenses with the purpose of addressing questions of interdisciplinary creativity, such as in the creative practice of other design disciplines (Bowen et al. 2016; Wilson & Zamberlan 2015), as well as creative decision-making in the health and education sectors (Essen et al. 2015; Jones 2017). The methodology itself, then, may also be tested further for its transferability across these parallel sectors.

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