CREATIVITY, ORGANISATIONAL CLIMATE AND INNOVATION: AN INTERDISCIPLINARY, MULTILEVEL PERSPECTIVE

A thesis submitted to the University of Manchester for degree of Doctor of Philosophy (PhD) in the Faculty of Humanities

2014

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ABSTRACT

Creativity and innovation are increasingly recognised as important for business success. A primary concern for organisations seeking to encourage creativity and innovation is establishing an environment that is conducive to their occurrence. To gain a better understanding of the relationships between these constructs, the current research has taken an interdisciplinary, multilevel approach. Taking this approach answers multiple calls for empirical research that combines disciplines (in this case, the disparate psychology and innovation management literatures) and estimates cross-level relationships between Creative and Innovative Climate, Team Creativity and Front End Innovation, utilising advances in statistical analysis and computational modeling.

The current research comprised three studies. Studies 1 (n=117, n=841) and 2 (n=416, n=841, n=30) developed two new psychometric measures: the Front End Innovation Scale and the Creative and Innovative Climate Scale. Measurement of both Creative and Innovative Climate and Front End Innovation has been fraught with problems. These have been problems of conceptualisation, in that there is no consensus as to which dimensions comprise either Creative and Innovative Climate or Front End Innovation, and also a problem of statistical robustness, as the majority of previous measures of both Creative and Innovative Climate and Front End Innovation have not been developed following psychometric principles. Study 3 (n=841) explored the single and multilevel relationships between Individual and Team Creativity, Front End Innovation and Creative and Innovative Climate, and investigated whether Individual Creativity and Individual Creative Performance are synonymous constructs. All studies used quantitative data derived from a questionnaire, which was supplemented in Study 2 by qualitative narrative data.

In addition to the development of two new psychometric measures, the current research contributed to the understanding of what Front End Innovation and Creative and Innovative Climate are, and the factors that comprise them. Given the lack of definitional and measurement consensus surrounding these topics, this understanding can guide future research. Furthermore, Study 3 identified two aspects of Creative and Innovative Climate that seem to be the most important for creativity and innovation (Internal Networks and Team Cohesion), particularly at the team level where they accounted for a greater proportion of the variance than at the individual level. The dual role of formalised processes surrounding creativity and innovation was also discovered, in that formalised processes were perceived to hinder individuals but benefit Team Creativity and Front End Innovation. Very little previous research has explored these relationships and none identified this duality. Lastly, Study 3 represents the first comprehensive empirical investigation of the relationship between Creative and Innovative Climate and each aspect of Front End Innovation.
DECLARATION

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DEDICATION

I would like to express my thanks to Dr Mark Batey and Dr Andrew James, for their support during the PhD process. Their knowledge has been invaluable in guiding me in the right direction.

To my parents, for their continuous encouragement and unwavering belief.

To Brendan, for having recently gone through this process too and therefore being completely sympathetic to its unique challenges.

To Ria, for broadening my horizons in so many areas beyond the topic of this PhD over the last three years.

Last but not least, to those who provided the data for this PhD and to MBDA and RADMA for their financial support. This PhD would not have been possible without willing participants and the Knowledge Management and Innovation team at MBDA supporting this PhD.
INTRODUCTION

1.1 Chapter overview

This chapter introduces creativity, Front End Innovation and Creative and Innovative Climate, which are the main themes in the current research. The academic and industrial importance of these constructs is discussed.

1.2 The importance of creativity

Creativity has been attributed to and defined as many things. In this thesis, creativity will be defined as a syndrome at the individual or team level involving: 1. the processes underlying an individual or team’s capacity to generate new ideas, 2. an individual or team’s characteristics facilitating process operation, and 3. an individual or team’s characteristics facilitating translating ideas into action. This definition is adapted from Mumford and Gustafson (1988). A more detailed exploration of the definitional issues surrounding creativity will be explored in the Literature Review.

Creativity has been hailed as the driving force behind critical advances in medicine, technology and consumables, improving individual and societal wellbeing, both physical and psychological (Letti, Herstatt & Gemuenden, 2006; Restivo, 2005). The importance of creativity can be seen in everyday activities, in our ability to cope with challenging and changing situations, and in specific situations when creative ability is called for (Sternberg & Lubart, 1996; 1999).

There is arguably no work task for which creativity cannot be in some sense beneficial (Berger & Berger, 2011; Sternberg & Lubart, 1999). Moreover, the economic impact of creativity is so large that the number of people working in jobs considered creative (including engineering, the arts and entertainment) has been proposed as a more accurate calculation of economic performance than the traditional method of assessing the educational attainment of the populace (Florida, 2002; Marrocu & Paci, 2012).

1.2.1 Creativity: An academic perspective

Within an academic context, creativity has been primarily studied within psychology. Within psychology, creativity can be approached from a cognitive, differential, developmental or social perspective (Simonton, 2012). Creativity research is often claimed to have started with
Hargreaves (1927) and Guilford (1950) who aimed to identify the characteristics of the ‘creative person’. To date, the vast majority of studies have followed this theme, focused upon identifying individual differences as antecedents to creative achievement or performance. Among others, researchers have examined Divergent Thinking (Batey, Furnham & Safiullina, 2010), Openness to Experience (Hughes, Furnham & Batey, 2012; Kaufman, 2013), Extraversion (Furnham & Bachtiar, 2008; Furnham & Nederstrom, 2010), Neuroticism (Zabelina, Robinson, Ostafin & Council, 2011), Agreeableness (Silvia, Kaufman, Reiter-Palmon & Wigert, 2011), Extrinsic Motivation (Sacchetti & Tortia, 2013) and Intrinsic Motivation (Kasof, Chen, Himsel & Greenberger, 2007).

Creativity has progressed from an extremely small research area (of 121,000 research titles in Psychological Abstracts between late 1920s and 1950, only 186 focused on creativity) into a more substantial research area that continues to grow. This growth may be attributed to the many applications of creativity research (Runco & Albert, 2010). However, it has been argued that creativity remains under-researched (Batey & Furnham, 2006), perhaps due to the definitional and measurement difficulties discussed later in this thesis, and the complexity of the much-needed multilevel approach.

Empirical creativity research has predominately focused on the relationship between creativity and a number of individual differences, namely intelligence, personality, motivation, confidence and creative performance. To a lesser extent, empirical creativity research has taken a neuroscientific approach (e.g. Dietrich, 2007; Fink et al., 2014; Jung et al., 2009).

**1.2.2 Creativity: A business perspective**

Within a business context, creativity is a crucial component of commercial success. Governments realise this; the UK Government commissioned a review of approaches for increasing creativity (Science and Technology Committee, 2010), Russia undertook a similar review (Directorate for Science, Technology and Industry: Russian Federation, 2011), and Singapore, China and India have all positioned themselves as creative knowledge economies, as opposed to the industrial economies they once were (Konana & Balasubramanian, 2002; Sawyer, 2012).

Organisations that endorse and encourage creativity, often with the expectation of it leading to innovation, can experience significantly increased profits (Hilles, Ding & Ahmed, 2009; Power & Hallencreutz, 2002) and competitiveness (Baer & Oldham, 2006). A recent IBM survey found
CEOs identified creativity as the most important business skill for economic recovery (IBM CEO Survey, 2010). Similarly, the McKinsey Global Survey (2010) and a report by Ernst and Young (2010) found overwhelming evidence that organisations are looking to creativity to achieve growth. Survey and reports such as these highlight the increasing emphasis organisations are placing on creativity. Indeed, organisations historically perceived creativity as disruptive, whereas now it is viewed as something manageable, and something to be managed (Bilton, 2010).

1.3 Creativity as the first stage in the innovation process

Creativity and innovation are two distinct concepts, although they are not always treated as such (Baer, 2012). Despite their distinctness, creativity is inextricably linked to innovation as creativity from individuals and teams is the starting point for innovation (Bissola, Imperatori & Colonel, 2014). Moreover, creativity can explain 41% of the variance in an organisation’s innovation capability (Hassan, Malik, Hasnain, Faiz & Abbas, 2013). Creativity is essential for generating the ideas that are progressed through the innovation process (Amabile, Barsade, Mueller & Staw, 2005; Amabile & Khaire, 2008; Munoz-Doyague & Nieto, 2012).

1.4 The importance of innovation

As stated above, creativity and innovation are inextricably linked, and therefore innovation is important for many of the same reasons as creativity. That is, improved products and services delivered for the benefit of society as a whole, and growth for industry and Governments. Such growth often leads to job creation, which in turn benefits society (Ahlstrom, 2010).

Globally, innovation activities are slowing. Countries which have typically been seen as leaders in innovation, such as the US and Japan, are experiencing lower levels of innovation than they have in previous years (European Innovation Scoreboard, 2010). In the UK, innovation capabilities also appear to be decreasing, with the European Innovation Scoreboard rating the UK as third in Europe for these capabilities in 2009, and fourth in Europe in 2010. This fall caused the UK to be relabelled an “innovation follower” as opposed to the “innovation leader” it once was (European Innovation Scoreboard, 2010), and this situation has not improved (Innovation Union Scoreboard, 2014). According to Boston Consulting Group’s 2010 Innovation Survey, six of the top ten most innovative companies are based in America. None are based in the UK.
1.4.1 Innovation: An academic perspective

Innovation is frequently conceptualised as a process with a series of stages (e.g. Cooper, Edgett & Kleinschmidt, 2004), with various strands in the innovation literature including service innovation, open innovation and product innovation (also referred to as new product development) (Bessant & Tidd, 2007). Innovation can be defined as “the intentional introduction and application within a role, group or organisation of ideas, processes, products and procedures, new to the relevant unit of adoption, designed to significantly benefit the group, the organisation or wider society” (West & Farr, 1989, p.16). Whilst this definition is widely accepted (Anderson, de Dreu & Nijstad, 2004), there is no consensual definition of innovation (Adams, Bessant & Phelps, 2006; Wolfe, 1994).

One strand of the innovation literature focuses on the front end of the innovation process, which is the focus of the current research. Cooper (2008) claims this is the most important part of the innovation process, and the front end of the innovation process is where research can make the biggest contribution (Brem & Voigt, 2009; Zhang & Doll, 2001). Focusing on Front End Innovation (FEI) provides a number of opportunities that focusing on the later stages of the innovation process would not. First, FEI has been related to improved performance of new products (e.g. Cao, Zhao & Nagahira, 2011; Cooper & Kleinschmidt, 1995), and has both a direct effect on eventual project success, and an indirect effect on project success through its effect on the next stage of the innovation process (Verworn, 2009).

Second, Smith and Reinertsen (1992) argue that the largest opportunity to shorten the development cycle is during FEI, and reducing development time means resources are required for a shorter time thus saving money.

Third, decisions made at the front end of the innovation process wield the greatest influence over the subsequent stages of the innovation process due to their chronological position at the beginning of the process (Hauser, Tellis & Griffin, 2006; Reid & de Bretani, 2004; Smith, Herbein & Morris, 1999). Actions taken at the front end can offer the greatest savings in terms of time and financial cost (Smith & Reinertsen, 1991), and if a product fails when it goes to market, it is likely to have done so because of decisions made during Front End Innovation (FEI) (Zhang & Doll, 2001).
1.4.2 Innovation: A business perspective

Large-scale surveys report innovation is the number one priority for 72% of companies (Boston Consulting Group, 2010), perhaps because 50% of a company’s revenue in five years will come from sources that do not currently exist (Ernst and Young, 2010). However, many organisations perceive the greatest weakness in the innovation process to be the front end (Khurana & Rosenthal, 1997), and managers have been criticised for preferring to focus on the later stages of the innovation process which have clearer processes and procedures (Gassmann & Schweitzer, 2014).

One reason why organisations are increasingly focused on innovation may be its relationship with organisational performance. Previous studies have identified this relationship (Bowen, Rostami & Steel, 2010; Garcia-Morales, Jimenez-Barrionuevo & Gutierrez-Gutierrez, 2012), although some of these have been criticised for claiming an effect between innovation and future organisational performance whilst using data based on past performance (Bowen et al., 2010).

1.5 The importance of Creative and Innovative Climate

Creativity and innovation do not occur in a vacuum. An individual or team may have the characteristics enabling them to be creative and innovative, however this alone may not lead to creativity and innovation; the environment needs to facilitate these outcomes (Evanschitzky, Eisend, Calantone & Jiang, 2012; Jaruzelski, Loehr & Holman, 2011). Therefore, to understand the antecedents and consequences of creativity and innovation it is necessary to consider the environment in which creativity and innovation occur.

Within an organisational context, ‘environment’ can refer to the physical environment or organisational climate. Organisational climate comprises attributes of the work environment that are reflected in individuals' perceptions and beliefs of their working environment, particularly regarding outcomes, contingencies, requirements and social interactions (Guion, 1973; Hunter, Bedell & Mumford, 2007).

Creative and Innovative Climate is important because it makes creativity and innovation more likely to occur (Ma, 2009). For example, climates supporting creativity and innovation lead to greater innovation as individuals and teams feel motivated and supported to generate and implement ideas (Acikgoez & Guensel, 2011; Baer & Frese, 2003; Luoma-aho et al., 2012). A lack of supportive climate hinders a team’s ability to create and innovate; Team Creativity
enhances innovation only when organisational climate is supportive (Somech & Drach-Zahavy, 2013). Moreover, individuals are unlikely to be creative unless the climate supports it (Ma, 2009; Unsworth & Clegg, 2010). Therefore, climate is important as it can facilitate or hinder creativity and innovation.

1.5.1 Creative and Innovative Climate: An academic perspective

Creative and Innovative Climate is the domain specific form of organisational climate. Climate is the observable and measurable manifestation of culture (Hennessey, 2003; McLean, 2005). More specifically, it is the attributes of the work environment that are reflected in individuals’ perceptions and beliefs of their working environment (Guion, 1973; Hunter et al., 2007). This implies that organisational culture is not easily measurable, and may not be measurable at all. Therefore, organisational culture is said to exist at a more abstract level than organisational climate and due to measurement difficulty cannot be related to tangible results in the same way that organisational climate can (Baer & Frese, 2003).

A primary tenet of the Creative and Innovative Climate literature is the lack of consensus regarding which dimensions comprise Creative and Innovative Climate. There is no consensus regarding which factors comprise creative climate and which comprise innovative climate. In 2004, Rank, Pace and Frese argued that differentiation between factors that influence creativity and those that influence innovation is one of the three most pertinent issues in the fields of creativity and innovation. Today, the situation does not seem to have changed. Also, these terms are often used synonymously, and examination of the dimensions comprising both constructs reveals little difference between their content (e.g. Hunter, Bedell & Mumford, 2005).

1.5.2 Creative and Innovative Climate: A business perspective

Unlike creativity and innovation, there seems to have been very little practitioner based literature on Creative and Innovative Climate, and there is not the same focus from organisational rhetoric and surveys such as those conducted by Boston Consulting Group (2009) and IBM (2010) on Creative and Innovative Climate when compared to creativity and innovation. However, there has been discussion of the broader construct of organisational culture, with a host of practitioner-focused texts focused on creating the “right” culture and, often, how to change an organisation’s culture (e.g. Ford, 2008; Schein, 2009; Stanford, 2011).
1.6 An interdisciplinary approach

The current research focuses on creativity and innovation in an organisational context. Specifically, individual and Team Creativity, the front end of the innovation process and Creative and Innovative Climate. Even within an organisational context, creativity and innovation are typically studied in different disciplines, however the contextual overlap suggests interdisciplinary research could be beneficial, and interdisciplinary research is increasingly called for (e.g. Agarwal & Hoetker, 2007; Anderson, Potocnik & Zhou, 2014; Hitt, Beamish, Jackson & Mathieu, 2007). The current research draws on the creativity and innovation management literatures.

1.7 A multilevel approach

Early creativity studies focused on the individual (e.g. Guilford, 1950) with attention then turning to team and organisational factors (e.g. Anderson et al., 2004). These individual, team and organisational factors were more often than not studied in isolation. However, recent advances in statistics and computational modeling mean that these factors can be considered more holistically and research may take a multilevel approach to more accurately estimate the relationships between constructs at different levels.

1.8 Summary

This chapter introduced creativity, Front End Innovation and Creative and Innovative Climate, which are the main themes of the current research. The academic and industrial importance of these constructs was discussed, and interdisciplinary and multilevel approaches to creativity and innovation introduced. The following chapter begins the literature review chapters, beginning with a review of the relevant creativity literature.
2 CREATIVITY LITERATURE REVIEW

2.1 Chapter overview

This chapter reviews the creativity literature relevant to the current research. Definitions and measurement issues surrounding creativity are discussed, followed by theories of creativity and empirical creativity and creative performance research. Empirical creativity research focuses on three areas: individual differences (personality, motivation and confidence), Individual Creative Performance and Team Creativity. Hypotheses 1 to 4 are introduced.

2.2 Definitions and conceptualisations of creativity

This section provides an overview of the main approaches to defining and conceptualising creativity, and presents the definition of creativity used in the current research.

Defining creativity has been cited as one of the biggest challenges in social science research (Sawyer, 2012). Various definitions have been applied to creativity, reflecting the many perspectives researchers have taken in trying to understand this construct (Batey & Furnham, 2006; Kirton, 2003). Defining creativity is further complicated by it being a multifaceted construct that is studied in a variety of disciplines, including economics, the arts, education, geography and various sub-disciplines of psychology (Florida & Mellander, 2014; Kaufman & Beghetto, 2009; Marrocu & Paci, 2012; Sawyer, 2012).

As a result, there is a great deal of confusion as to what creativity is, what it is not, how it should be defined and how it should be measured, leaving researchers in this field with no agreed creativity definition, and as a result no parsimonious and accepted measure (Fryer, 2012; Piffer, 2012; Walker & Batey, 2014). This makes it difficult to study creativity and leads to a lack of reliable research and theories (Batey & Furnham, 2006). Further, this may explain suggestions that extant creativity research has produced inconsistent findings from which few definite conclusions can be drawn (Batey, 2012; Montag, Maertz & Baer, 2012). The confusion surrounding creativity research is exemplified by the fact that 62% of creativity journal publications between 1998 and 2002 failed to explicitly define creativity (Plucker, Beghetto & Dow, 2004). Lack of consensual definition limits consensual measurement, causing difficulty synthesising and interpreting research findings.
2.2.1 Common approaches to conceptualising creativity

There are many existing definitions and conceptualisations of creativity. Most definitions of creativity make reference to novelty and utility. Barron (1955) was the first to introduce the concept of ‘new and useful’ to the definition of creativity, and it continues to be used as the basis of many creativity definitions (e.g. Amabile, Conti, Coon, Lazenby & Herron, 1996; George, 2007; Glaveanu, 2011; Gupta & Singh, 2014; Kim, Im & Slater, 2013; Munoz-Doyague & Nieto, 2012; Plucker et al., 2004; Sullivan & Ford, 2010). This approach to defining creativity focuses on creativity as something that is both novel, either to the world or to the creator, and can be used for a single purpose or multiple purposes. It has been argued, particularly in relation to obtaining a patent for a creative idea, that the intended use must be known in order for something to be considered useful (and by definition, creative) (Sawyer, 2012).

One of the most pervasive conceptualisations of creativity is the four Ps (Batey, 2012; Runco, 2004). The four Ps consists of Person, Process, Product and Press (environment) (Rhodes, 1961/1987), and reflects the ways in which creativity can be conceptualised, defined and measured. There can be a creativity of the person, whereby the characteristics of the person who is deemed to be creative are studied. Alternatively, creativity can be conceptualised as a process. For example, that creativity is a process comprising Fluency, Originality and Flexibility (Shalley & Zhou, 2008). Fluency refers to the number of ideas produced, Originality refers to how unique an idea is, and Flexibility refers to the number of categories an idea references (for example, a box is a container but also could be flattened and used as a door stop or note pad). Alternatively, creativity can be conceptualised as a creative output or product, or focused solely on the environment that supports or inhibits creativity.

Lastly, there are those that propose creativity involves the confluence of these four Ps, and that the definition and measurement of creativity should reflect this through multi-componential models that allow for the assessment of product, characteristics of the person, the environment and the process, such as the model proposed by Batey (2012).
Batey’s (2012) framework for conceptualising and measuring creativity represents the confluence of the four Ps. Although early conceptualisations treated each P (‘facet’ in Batey’s (2012) framework) as independent, it is argued that they are interrelated, and although a single facet of creativity may be investigated, it exists in relation to other facets of creativity. Processes occur within a person or persons to produce a product. This unfolds within the creative environment, such that it may suggested that: Person x Process x Press = Product (Batey, 2012).

2.2.2 Existing definitions of creativity

The influence of these approaches to defining and conceptualising creativity can be seen in the plethora of creativity definitions that have been proposed. Table 1 summaries these definitions.
Table 1. Extant Definitions of Creativity and Their Key Features
Adapted from Batey and Furnham (2006)

<table>
<thead>
<tr>
<th>Author</th>
<th>(abridged) Definition</th>
<th>Key feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simonton (2012)</td>
<td>Creativity = novelty x utility x surprise</td>
<td>New and useful, based on Patent Office</td>
</tr>
<tr>
<td>Mumford (2003)</td>
<td>the production of novel, useful products</td>
<td>New and useful, products specifically</td>
</tr>
<tr>
<td>Weisberg (2006)</td>
<td>when a person intentionally produces a novel product while working on some task</td>
<td>New, products specifically</td>
</tr>
<tr>
<td>Boden (2004)</td>
<td>The ability to come up with ideas or artifacts that are new, surprising, and valuable</td>
<td>New and useful</td>
</tr>
<tr>
<td>Sternberg &amp; Lubart (1999)</td>
<td>The ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive concerning task restraints)</td>
<td>New and useful</td>
</tr>
<tr>
<td>Simonton (1999)</td>
<td>a creative idea or product must be original and adaptive in some way. Originality is defined by the particular sociocultural group</td>
<td>New and useful</td>
</tr>
<tr>
<td>Feist (1998)</td>
<td>both novel-useful and creative-adaptive</td>
<td>New and useful</td>
</tr>
<tr>
<td>Csikszentmihalyi (1996)</td>
<td>an idea, act or product that changes an existing domain, or transforms an existing domain into a new one</td>
<td>New and useful</td>
</tr>
<tr>
<td>Ochse (1990)</td>
<td>Bringing something into being that is original (new, unusual, novel, unexpected) and also valuable (useful, good, adaptive, appropriate)</td>
<td>New and useful</td>
</tr>
<tr>
<td>Barron (1955)</td>
<td>“If a response is to be called original, it must be to some extent adaptive to reality” (p.553)</td>
<td>New and useful</td>
</tr>
<tr>
<td>Amabile (1983)</td>
<td>the quality of products or responses judged to be creative by appropriate observers...the process by which something so judged is produced</td>
<td>New and useful</td>
</tr>
<tr>
<td>Rogers (1954)</td>
<td>something observable, some product of creation. A novel construction</td>
<td>New and useful</td>
</tr>
<tr>
<td>Runco (2004)</td>
<td>A useful and effective response to evolutionary changes.</td>
<td>Part of a process</td>
</tr>
<tr>
<td>Feist &amp; Barron (2003)</td>
<td>A specific capacity to not only solve problems but to solve them originally and adaptively</td>
<td>Part of a process, new and useful</td>
</tr>
<tr>
<td>Author</td>
<td>(abridged) Definition</td>
<td>Key feature</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Plucker et al. (2004)</td>
<td>The interaction among <em>aptitude, process and environment</em> by which an individual or group produces a <em>perceptible product</em> that is both <em>novel and useful</em> as defined within a <em>social context</em></td>
<td>Part of a process, new and useful</td>
</tr>
<tr>
<td>Finke, Ward &amp; Smith (1992)</td>
<td>A product of many types of mental processes, each of which helps to set the stage for creative insight and discovery. “In particular, we distinguish between processes used in the generation of cognitive structures and those used to explore the creative implications of those structures” (p.2)</td>
<td>Part of a process</td>
</tr>
<tr>
<td>Mednick (1962)</td>
<td>“We may proceed to define the creative thinking process as the forming of associative elements into new combinations which either meet specified requirements or are in some way useful” (p.221)</td>
<td>Part of a process, new and useful</td>
</tr>
<tr>
<td>Csikszentmihalyi (1996)</td>
<td>“Creativity can be observed only in the interrelations of a system made up of three main parts. The first of these is the domain, which consists of a set of symbolic rules and procedures...The second component of creativity is the field, which includes all the individuals who act as gatekeepers to the domain. It is their job to decide whether a new idea or product should be included in the domain...Finally, the third component of the creative system is the individual person” (p. 27-28)</td>
<td>Componential</td>
</tr>
<tr>
<td>Eysenck (1993)</td>
<td>Creative achievement requires cognitive ability, environmental variables and personality traits</td>
<td>Componential</td>
</tr>
<tr>
<td>Mumford &amp; Gustafson (1988)</td>
<td>A syndrome involving: 1. the processes underlying an individual’s capacity to generate new ideas, 2. an individual’s characteristics facilitating process operation, 3. an individual’s characteristics facilitating translating ideas into action, 4. the attributes of a situation affecting an individual’s willingness to engage in creative behaviour, and 5. the attributes of the situation influencing evaluation of an individual’s productive efforts (p.28)</td>
<td>Componential</td>
</tr>
<tr>
<td>Torrance (1966)</td>
<td>A process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and identifying the difficulty and communicating the results</td>
<td>Componential</td>
</tr>
</tbody>
</table>
The abilities most characteristic of creative people. Creative abilities determine whether an individual has the power to exhibit creative behaviour. Whether individuals with this power produce results of a creative nature depend on motivational and temperamental traits.

Creativity and innovation at work are the process, outcomes and products of attempts to develop and introduce new and improved ways of doing things. The creativity stage of this process refers to idea generation, and innovation refers to the subsequent stage of implementing ideas toward better procedures, practices, or products. Creativity and innovation can occur at the level of the individual, work team, organisation, or at more than one of these levels combined but will invariably result in identifiable benefits at one of more of these levels of analysis.

The majority of creativity definitions seem to have an element of ‘new and useful’, are non-specific regarding which form creativity should take, and are non-specific regarding creativity being an intentional or unintentional act, with only one explicitly stating the creativity must be intentional (Weisberg, 2006). Although some definitions use a common language, different meanings may be inferred. For example, a ‘product’ may be a physical entity ready for sale, a partially developed prototype, or even an idea (Boden, 2004).

The various creativity definitions also differ in their comprehensiveness, and it seems that they are either short and thus easy to understand, but too brief to be meaningful, or they are long and comprehensive, but so complex that the operationalisation and measurement of creativity is unwieldy (Batey & Furnham, 2006).

Definitions of creativity also frequently make reference to judgement. The issue of who judges whether something is creative is problematic due to the ramifications for the definition and measurement of creativity. Regarding the definition of creativity, the issue of judgement is problematic because it leads us to question who is in a position judge whether something is creative. An expert, an individual who possesses relevant domain-specific knowledge, may be an appropriate judge (Czikszentmihalyi, 1996). However, there is limited discussion regarding how to develop appropriate selection criteria for judges (Runco & Jaeger, 2012). Moreover, this approach assumes that individuals cannot judge their own creativity, however it has been argued...
that creativity occurs when an individual conceives of an idea that is new to them, irrespective of whether that idea is new to the world (Weisberg, 2006). In this case, the individual engaging in creativity is the only appropriate judge of creativity. This argument has implications for the use of self-report creativity measures, which are discussed on page 204.

Overall, it is difficult to argue that a single definition is better than the others, or to create a single definition out of the multitude of extant definitions. However, because definition precedes measurement it is important to present the definition that guides the current research.

2.2.3 The definition of creativity employed in the current research

The current research uses an adaptation of Mumford and Gustafson’s (1988, p.28) definition of creativity, which states that creativity is “a syndrome involving: 1. the processes underlying an individual’s capacity to generate new ideas, 2. an individual’s characteristics facilitating process operation, 3. an individual’s characteristics facilitating translating ideas into action, 4. the attributes of a situation effecting an individual’s willingness to engage in creative behaviour, and 5. the attributes of the situation influencing evaluation of an individual’s productive efforts”.

The measurement used in the current research is consistent with creativity involving the generation of new ideas (self-reported Fluency is measured) and the characteristics of the individual as regards process operation and implementing ideas (self-reported Implementing is measured). Mumford and Gustafson (1988) also argue that creativity involves considering the “attributes of a situation”. In an organisational context, this arguably refers to Creative and Innovative Climate, which the current research addresses as a separate construct. However, Mumford and Gustafson’s (1988) definition of creativity does not make reference to the levels at which creativity can occur. Other definitions, such as that proposed by Plucker et al. (2004), specifically make reference to “an individual or group”, and as the current research takes a multilevel approach it was appropriate to integrate this consideration into the definition of creativity used in the current research.

Therefore, an adapted version of Mumford and Gustafson’s (1988) definition may be most appropriate for the current research: a syndrome at the individual or team level involving: 1. the processes underlying an individual or team’s capacity to generate new ideas, 2. an individual or team’s characteristics facilitating process operation, and 3. an individual or team’s characteristics facilitating translating ideas into action.
2.3 Theories of creativity

As with definitions of creativity, there is no consensual theory of creativity (Karwowski, 2009). Componential, stage, systems and psychometric theories of creativity will be outlined here as they are the primary genres of creativity theory (Batey & Furnham, 2006). It is pertinent to briefly consider theories of creativity because they influence the approach taken in the current research and also how the findings from extant empirical creativity research are interpreted, although theories of creativity are not directly relevant to the formation of research aims and hypotheses in the current research. See Runco (2014) for a thorough exposition of creativity theories.

2.3.1 Componential theories

Componential theories of creativity provide “a comprehensive model of the social and psychological components necessary for an individual to produce creative work” (Amabile, 2012, p.2). Typically, there is an underlying assumption that the components are related to one another but the order in which the components occur is not hypothesised (Runco, 2014).

Amabile’s (1983) Componential Model of Creativity is arguably the most well-known and influential componential model of creativity (Judge & Hurst, 2007). Amabile’s (1983) Componential Model of Creativity posits three contributors to creativity: domain-specific skills relevant to creativity (e.g. knowledge, technical skills), domain-relevant skills to creativity (e.g. an advantageous cognitive style) and Intrinsic Motivation. Later, work environment was added as an additional component (Amabile et al., 1996).

An alternative componential theory of creativity was proposed by Runco and Chand (1995). They developed a ‘two tiered model’ of creativity. One tier consists of motivation (both Intrinsic and Extrinsic) and knowledge, and the other tier consists of problem finding (in particular identifying and defining problems), idea generation (including Fluency, Flexibility and Originality) and evaluation skills (critical thinking giving the individual the ability to judge generated ideas) (Elliot & Dweck, 2005).

Sternberg and Lubart (1996) proposed an ‘investment’ theory of creativity comprising six components. First, intellectual ability. This refers to the ability to synthesise information in new ways in order to see problems in a new way, and the ability to recognise which ideas should be pursued further and persuade others of the value of an idea. Second, knowledge. This refers to having sufficient existing knowledge of a field to analyse whether an idea is new for a field.
Third, cognitive style. This refers to a preferred way of thinking that allows an individual to think broadly as well as narrowly about a topic. Fourth, Intrinsic Motivation. Fifth, personality. Specifically, a preference for taking risks, overcoming obstacles and tolerance of ambiguity. Lastly, environment. This refers to operating within an environment which provides sufficient resources and encouragement for creativity (Sternberg, 2006).

In summary, componential theories of creativity seek to explain what factors are important for creativity to occur. However, they are not tailored to the measurement of creativity, nor do they focus on the sequence in which the components of creativity should occur. Moreover, they are unclear as to whether they are single or multilevel theories. Both Amabile’s (1983) (after the extension to include work environment) and Sternberg and Lubart’s (1996) theories may be considered multilevel as both consider the role of the environment in addition to a primary focus on the individual. Conversely, despite being called a ‘two tiered’ model, Runco and Chand’s (1995) theory of creativity is solely focussed at the individual level and therefore is not multilevel.

Componential theories of creativity also differ in their treatment of motivation. Whilst all three theories include motivation as an important component of creativity, Amabile’s (1983) and Sternberg and Lubart’s (1996) theories specifically refer to Intrinsic, task-oriented motivation, whilst Runco and Chand (1995) refer to both Intrinsic and Extrinsic Motivation.

### 2.3.2 Stage theories

Stage theories consider creativity to be a process that occurs through a series of stages. Stage theories extend componential theories of creativity as they hypothesise an order in which the stages occur whereas componential theories do not (Lubart, 1999; Runco, 2014). Stages may occur linearly or recursively (Kozbelt, Beghetto & Runco, 2010).

An early stage theory of creativity was proposed by Wallas (1926), who proposed four sequential stages. First, Preparation. This involves gathering information, problem identification and problem definition. Second, Incubation. This refers to not consciously working on a problem after a period of initial preliminary work. Third, Illumination. This refers to ideas coming to a person suddenly, commonly referred to as light bulb moments. Fourth, Verification. Verification allows the idea or solution to be tested (Gilhooly, Georgiou & Devery, 2013; Newman, 2013).

More recently, Basadur, Pringle, Speranzini and Bacot (2000) proposed an eight stage theory of creativity that extends Wallas’ (1926) contribution. Basadur et al. (2000) divide the
Preparation stage into three sub stages: Problem Finding, Fact Finding and Problem Definition. Incubation and Illumination are combined into a single idea finding stage, whilst Verification has been relabelled ‘evaluate and select’. Basadur et al. (2000) also proposed three additional stages of plan, acceptance, and action. Together, these may also be considered an implementation stage (Howard, Culley & Dekonick, 2008).

Overall, stage theories remain popular (Haner, 2005; Howard et al., 2008), perhaps due to the perceived simplicity of creativity following a clear, linear process. However, linearity may be overly rigid and restrictive as stages may not always occur in the same order and may be repeated (Howard et al., 2008; Runco, 2014), and linearity does not account for teams in which members may be at different stages of the creative process at different times. However, in their reference to Incubation and Illumination, stage theories introduce concepts that componential theories do not address, and it has been argued that this is a strength of stage theories and a weakness of componential theories (Runco, 2014).

### 2.3.3 Systems theories

In addition to componential and stage theories, creativity may be approached from a systems theory perspective. Systems theories argue that creativity emerges from the interaction between multiple components in a complex system of interrelated factors (Czikszentmihalyi, 1996; Kozbelt et al., 2010). In the same way that stage theories arguably extend componential theories, systems theories arguably integrate component and stage theories, as they consider the different components involved in creativity and the direction of influence between components (Runco & Pritzker, 1999).

One systems theory of creativity was developed by Csikszentmihalyi (1996), which emphasises how individuals other than the creator contribute to the emergence of creativity. Specifically, that creativity emerges from the interaction between three systems. First, the individual. The individual is influenced by their genetic makeup and personal experiences. They receive domain-related information, change it, and as a result produce change in the domain (the body of knowledge existing in an area). Second, culture. Culture influences the domain and the information that is transmitted to the individual. Third, the social system. Society governs the social organisation of the domain, and influences the domain that is located within the culture (Csikszentmihalyi, 1996; Kozbelt et al., 2010; Weisberg, 2006).
An alternative systems theory of creativity was proposed by Woodman, Sawyer and Griffin (1993), which consists of factors at the individual, group and organisational levels. At the individual level, cognitive style, personality, Intrinsic Motivation and knowledge are most relevant to creativity. At the group level, the composition and characteristics of the group, in addition to the processes they follow, determines the resultant creativity. Processes followed at the organisational level influence whether creativity occur. Additionally, Woodman et al. (1993) consider contextual influences on creativity, such as the organisational culture, resource availability and the reward system an organisation uses.

Overall, systems theories of creativity take a broad view of creativity and include many factors at multiple levels of analysis which arguably affect creativity. Whilst both Czikszentmihalyi’s (1996) and Woodman et al.’s (1993) systems theories of creativity have been similarly influential (Shalley & Zhou, 2008; Unsworth, 2001), they differ regarding whether they focus on creativity across domains (e.g. Czikszentmihalyi, 1996) or specifically focus on organisational creativity (e.g. Woodman et al., 1993).

Czikszentmihalyi (1996) and Woodman et al. (1993) also differ in their treatment of creativity as an individual level variable. Czikszentmihalyi (1996) focuses on one ‘creator’, whilst other systems theories of creativity are not as explicit in their consideration of creativity as an individual activity (Pope, 2005). Czikszentmihalyi (1996) has been further criticised for advocating reliance on the subjective opinion of a judge as to whether something is creative or not, without meaningful discussion of potential limitations, such as a judge considering something a threat to their own work and therefore not judging it as creative (Pope, 2005).

2.3.4 Critique of componential, stage and systems theories

Componential, stage and systems theories are broad enough that they allow different manifestations of creativity to be explained, however their broadness has been criticised as lacking parsimony (Lubart, 1999). The lack of distinction between different types of creativity may limit their utility, although their recommended use as the basis for creativity training suggests they may be practically applicable (Baer & Kaufman, 2005).

It has been argued that componential, stage and systems theories may be used to explain whether someone is highly creative or not, as a highly creative individual would have higher levels of the components required, and/or may transition through the required stages more successfully than a less creative person. However, the premise that an individual either is or is not
creative is not helpful for organisations seeking to encourage creativity across their employees (Robledo et al., 2012). Moreover, theories of creativity seem to focus almost exclusively on the individual, overlooking the role of the team and how multiple people can be creative together. When the role of the environment is made reference to, it is usually as a single construct ignoring the multifaceted nature of a climate supportive of creativity and innovation.

Componential, stage and systems theories can be criticised as regards measurement, as they were not developed with measurement in mind (Lubart, 1999). Measuring, and subsequently statistically modelling, data based on componential, stage or systems theories would involve measuring each of the components and mathematically estimating the relationships between all of those components. To comprehensively measure all of these factors a battery of creativity measures would be required, which would severely limit the feasibility of conducting this research and also assumes that these components can be adequately measured. As a result, many componential, stage and systems theories of creativity are limited in their discussion of measurement. A fourth type of creativity theory is dedicated to the measurement of creativity: psychometric theories.

2.3.5 Psychometric theories

This section outlines a psychometric approach to creativity. A psychometric approach is concerned with the scientific measurement of psychological constructs (Furr & Bacharach, 2008; Kline, 2000), and therefore a psychometric approach to creativity focuses on creativity measurement. There has been some debate regarding whether this approach can be considered a theory, given that theory is defined as “a collection of concepts, together with rules expressing relationships between such concepts, which account for empirical data and make predictions about future observations” (Richards, 2011, p.473), and discussion of a psychometric approach to creativity often focuses on empirical creativity research and creativity measurement. However, a psychometric approach to creativity can be considered a theory in which measurement is central, and that aims to provide models of the creative person, process or press that can be empirically tested (Plucker & Renzulli, 1999). Indeed, it is this focus on measurement that distinguishes psychometric approaches to componential, stage and systems theories of creativity, and allows a psychometric approach to inform other theories of creativity (Kozbelt et al., 2010). Moreover, focus on measurement has arguably led to the psychometric approach being relatively dominant, especially for studies of Individual Creativity (Plucker & Renzulli, 1999).
Psychometric approaches to creativity are interested in three main areas. First, reliability. This refers to how consistently a measure measures a construct (Franzen, 2000). For example, if the same individual in the same emotional state and physical situation completed a creativity assessment on two consecutive days, a reliable measure would produce the same results.

Second, validity. This refers to the accuracy of a measure (Markus & Borsboom, 2013). There are many forms of validity, with discriminant validity being the most important for psychometric theories of creativity. Discriminant validity refers to the extent to which two constructs are different from one another. In the context of creativity, discriminant validity may be used to indicate that creativity is a different construct to intelligence, for example. Threshold theory, which argues that the relationship between creativity and intelligence is prominent only up to an IQ of 120 (Preckel, Holling & Wiese, 2006), stems from this.

Third, domain specificity. This refers to whether creativity, and aspects thereof, are generalisable or differ depending on what they are being applied to (Baer, 1999). The psychometric approach allows the consideration of multiple creativities, i.e. that creativity may be domain specific, with some creativity skills being domain general, and some creativity relevant skills being domain specific (Amabile, 1983). However, domain specificity is a controversial topic in the creativity literature (Baer, 2012; Dow & Mayer, 2004; Simonton, 2012; Sternberg, 2005), and although there is no consensus, two prominent researchers in this area publicly debated this issue and both adopted a middle ground as a result (Baer, 1998; Plucker, 1998).

One psychometric theory of creativity was developed by Batey, with a research programme starting in 2004 (as presented in Table 2). This research led to the development of a creativity measure known as the me² (Batey, 2004; e-metrixx, 2014, p.5). The me² posits that Individual Creativity comprises four dimensions, each of which contains a number of measurable components. First, idea generation. This comprises Fluency, Originality, Illumination and Incubation. Fluency is defined as “the extent to which a person easily produces many ideas”, and is the factor of creativity most likely to be considered synonymous with creativity. Originality is defined as “the extent to which a person produces unusual ideas”. Illumination is defined as “the extent to which a person experiences flashes of insight or inspiration”, and Incubation is defined as “the extent to which a person makes time for the non-conscious processing of ideas”.

The second of the four dimensions comprising me² is personality. This comprises Curiosity and Tolerance for Ambiguity. Curiosity is defined as “the extent to which a person engages with the external world and their own internal thoughts, and is similar to the Openness to
Experience construct found in the Five Factor Model (Costa & McCrae, 1992), for example. Tolerance for Ambiguity is defined as “the extent to which a person is comfortable with uncertainty”.

The third of the four dimensions comprising me$^2$ is motivation. This comprises Intrinsic Motivation, Competitive Motivation and Achievement Motivation. Intrinsic Motivation is defined as “the extent to which a person has a tendency to derive pleasure from working on personal challenges”, and is a construct often found in creativity work such as Amabile’s (e.g. 1996). Competitive Motivation is defined as “the extent to which a person is motivated to compete”, and Achievement Motivation is defined as “the extent to which a person is hard-working and strives for excellence”. Both Competitive Motivation and Achievement Motivation have similarities with Extrinsic Motivation, in that an individual high in both could be externally focused.

The fourth dimension comprising me$^2$ refers to confidence, and comprises Confidence Producing Ideas, Confidence Sharing Ideas and Confidence Implementing Ideas. Confidence Producing Ideas is defined as “the extent to which a person feels confident generating and working with ideas”. Confidence Sharing Ideas is defined as “the extent to which a person feels confident exposing their initial ideas” and Confidence Implementing Ideas is defined as “the extent to which a person is confident turning a creative ideas into reality”. Taken together, these three factors form a construct similar to Creative Self-Efficacy (Tierney & Farmer, 2002).

Overall, the amalgamation of these dimensions form a single General Factor of Creativity.
### Table 2. Psychometric Model of Creativity Proposed by Batey (2004)

<table>
<thead>
<tr>
<th>Broad construct</th>
<th>Narrow construct</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idea Generation</td>
<td>Fluency</td>
<td>The extent to which a person easily produces many ideas</td>
</tr>
<tr>
<td></td>
<td>Originality</td>
<td>The extent to which a person produces unusual ideas</td>
</tr>
<tr>
<td></td>
<td>Incubation</td>
<td>The extent to which a person makes time for the non-conscious processing of ideas</td>
</tr>
<tr>
<td></td>
<td>Illumination</td>
<td>The extent to which a person experiences flashes of inspiration or insight</td>
</tr>
<tr>
<td>Motivation</td>
<td>Intrinsic</td>
<td>The extent to which a person has a tendency to derive pleasure from working on personal challenges</td>
</tr>
<tr>
<td></td>
<td>Competitive</td>
<td>The extent to which a person is motivated to compete</td>
</tr>
<tr>
<td></td>
<td>Achievement</td>
<td>The extent to which a person is hard-working and strives for excellence</td>
</tr>
<tr>
<td>Personality</td>
<td>Curiosity</td>
<td>The extent to which a person engages with the external world and their own internal thoughts</td>
</tr>
<tr>
<td></td>
<td>Ambiguity</td>
<td>The extent to which a person is comfortable with uncertainty</td>
</tr>
<tr>
<td>Confidence</td>
<td>Producing</td>
<td>The extent to which a person feels confident generating and working with ideas</td>
</tr>
<tr>
<td></td>
<td>Sharing</td>
<td>The extent to which a person feels confident exposing their initial ideas</td>
</tr>
<tr>
<td></td>
<td>Implementing</td>
<td>The extent to which a person is confident turning a creative idea into reality</td>
</tr>
</tbody>
</table>

Psychometric theories of creativity are unique among creativity theories due to their focus on measurement. In order for a theory to be easily measurable, the components should be clearly defined and distinct from one another. Batey’s (2004) theory, for example, has twelve distinct concepts, each of which can be quantitatively measured. Therefore, whilst non-psychometric theories may be praised for their broadness (e.g. Csikszentmihalyi, 1996), they are not as appropriate for supporting the measurement of creativity as a psychometric approach.
2.4 Interim summary

The preceding sections discussed the variety of approaches to defining creativity and the componential, stage and systems perspectives in creativity theory, in addition to the psychometric approach that informs the current research. The following discusses everyday and eminent creativity and presents the case for focusing on everyday creativity in the current research.

2.5 Everyday and eminent creativity

Creativity can be conceptualised as ‘everyday’ or ‘eminent’. To aid interpretation of the existing literature, and locate this thesis within the literature, the concepts of everyday and eminent creativity are introduced. Everyday creativity is also referred to as ‘little-c’ creativity, whilst eminent creativity can be referred to as ‘Big-C’ creativity (Kaufman & Beghetto, 2009). In addition to little-c and Big-C creativity, Kaufman and Beghetto (2009) argue that creativity may also take the form of ‘Pro-c’, referring to individuals who would be considered creative but have not achieved eminence yet, or ‘mini-c’, referring to the creativity that is inherent in, and produced as a result of, learning something new. Table 3 presents the definitions of each of these forms of creativity.

Table 3. Kaufman and Beghetto’s (2009) Four Cs: Types of Creativity

<table>
<thead>
<tr>
<th>Type of creativity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Big-C</td>
<td>Eminent creative contributions; creative genius</td>
</tr>
<tr>
<td>little-c</td>
<td>Everyday creativity; creative actions in which non-experts may participate in every day</td>
</tr>
<tr>
<td>Pro-c</td>
<td>Professional creators (such as a chef or musician) who have not yet achieved an eminent contribution</td>
</tr>
<tr>
<td>mini-c</td>
<td>Creativity inherent in the learning process; creative insights inspired by learning something new</td>
</tr>
</tbody>
</table>

Through the inclusion of Pro-c and mini-c, the Four C approach extends the everyday versus eminent creativity debate. Pro-c is arguably highly related to, if not part of, eminent creativity. Use of the word ‘yet’ (“professional creators who have not yet achieved an eminent contribution”) suggests this type of creativity belongs to those who will be considered eminently creative in the future. The Four Cs also introduces chronology. Mini-c, the creativity involved in
the learning process, is arguably also a potential precursor to both eminent/Big-C (and Pro-c) and everyday/little-c creativity, as learning and the resultant creativity is an aspect of both these types of creativity. Finally, mini-c introduces the idea of ‘Illumination’ (“Inspiration”) into the everyday/eminent debate.

Overall, it suggests there is still confusion surrounding how creativity occurs, regarding both chronology and what is involved in creativity, for example, the role of Illumination. Although not explicitly stated, both the chronology and the reference to Illumination suggest a stage/componential/process approach taken by Kaufman and Beghetto (2009).

2.5.1 Distinguishing everyday and eminent creativity

Empirical research has differentiated everyday creativity and eminent creativity in both American university students (Ivcevic & Mayer, 2009) and a representative sample of Polish adults (Karwowski, 2009). However, debate has ensued regarding the extent to which everyday and eminent creativity are distinct constructs, with some arguing that the distinction is too divisive (Kozbelt et al., 2010), and that it may be more beneficial as a framework rather than a rigidly enforced division (Shalley & Zhou, 2008).

2.5.2 Everyday creativity

The current research fits within the little-c paradigm and focuses on everyday creativity. Everyday creativity can be defined as exhibiting originality during work and leisure time, across diverse everyday activities, and is something that everyone can exhibit to some extent (Richards, 2011). By its nature, everyday creativity is likely to occur more frequently than eminent creativity, and therefore most creativity is likely to be of the ‘everyday’ variety (Pachucki, Lena & Tepper, 2010).

The current research focuses on everyday creativity for three reasons. First, due to the nature of everyday creativity it is applicable to everyone, in contrast to the limited generalisability of eminent creativity research. Second, the current research follows the recent trend in the literature to focus on creativity using ‘ordinary’ participants (Shalley & Zhou, 2008), moving away from eminent creativity and towards everyday creativity (Montuori, 2011; Richards, 2011). Third, the current research takes place within the context of the organisation. As organisations increasingly recognise the need for their employees to be more creative it is of greater importance
to understand how to increase everyday creativity within a large portion of the population, as opposed to arguing that only a select few are able to be creative (Friesike & Gassmann, 2014).

2.6 Interim summary

The preceding sections discussed various definitions and theories of creativity, and presented the case for focusing on everyday creativity in the current research. The following section provides an overview of the measurement of creativity. Whilst many of the issues regarding the definition of creativity are mirrored in the measurement of creativity, it is relevant to briefly consider the measurement of creativity before reviewing empirical creativity literature and introducing research aims and hypotheses.

2.7 Measurement of creativity

This section provides an overview of approaches to measuring creativity as they are important for interpreting the empirical creativity research reviewed later in this chapter (c.f. Batey (2012) for a thorough exposition of this topic).

As stated, there are parallels between the issues faced in the definition and measurement of creativity. First, there is a lack of consensus regarding how best to measure creativity. The lack of consensus is a direct result of the lack of a consensual definition of creativity and also the many ways in which the term is used. That is, ‘creativity’ may be used to distinguish people (high/low levels of), describe an object or a process made up of a number of steps (e.g. creative problem solving), or an environment for creativity. It is challenging, if not impossible, to develop a single measure that is applicable in all these instances (Clapham, 2001).

Second, the issue of judgement occurs in relation to both the definition and measurement of creativity. As discussed in section 2.2.2, definitions of creativity often require an individual or individuals to make a judgement as to whether something is ‘creative’ or not. Similarly, some measures of creativity are focused on a judgement of something as ‘creative’ or not. However, there are difficulties identifying an appropriate judge of creativity (Kaufman & Baer, 2012), and identifying appropriate judges of the initial judge (Runco & Jaeger, 2012), and compensating for their biases regarding a propensity to suppress creative work that disagrees or competes with theirs.

Self-rated measures of creativity can avoid the issue of biased judgement. Whilst self-rated measures are prone to an individual seeking to present themselves in a certain way
(Paulhus, Lysy & Yik, 1998), they are not prone to the unknown biases of an external judge. External judges are used with the aim of introducing objectivity, however, judgement is subjective whether an individual rates themselves or someone else rates them.

2.7.1 Types of creativity measure

Guilford (1950) is often credited with inspiring the beginning of the scientific study of creativity in earnest, although Hargreaves (1927) was arguably the earliest creativity researcher. However, it was Guilford’s (1950) Structure of Intellect (SOI) model that had a substantial impact on the measurement of creativity, as it popularised the idea of Convergent Thinking and Divergent Thinking. Convergent Thinking is “a mental process that focuses an individual on one correct response” (Clapham, 2001, p.459), whilst Divergent Thinking is “a mental process that results in a wide range of potential responses” (p.459). These concepts form the basis of many extant creativity measures.

There are many types of creativity measure. Hocevar and Bachelor (1989) developed a taxonomy of creativity assessment and argued that there are eight main types of creativity measure. These are presented in Table 4; note that measurement methods for children’s creativity and eminent creativity are often different, with the latter tending to utilise case studies of eminently creative individuals or historiometrics (quantitatively analysing historical data) (Clapham, 2001).
Table 4. Types of Creativity Assessment, a Description, Their Application to Everyday or Eminent Creativity and an Example
Adapted from Clapham (2001) and Hocevar and Bachelor (1989)

<table>
<thead>
<tr>
<th>Type of creativity assessment</th>
<th>Everyday or eminent</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Divergent Thinking tests</td>
<td>Everyday</td>
<td>Participants produce multiple ideas in response to a stimuli (e.g. listing possible uses for an object)</td>
<td>Torrance Test of Creative Thinking</td>
</tr>
<tr>
<td>Attitude and interest inventories</td>
<td>Everyday</td>
<td>Participants indicate their attitudes and interests using a rating scale or checklist, for example their preference for risk taking and interest in new hobbies</td>
<td>Creative Attitude Survey</td>
</tr>
<tr>
<td>Biographical inventories</td>
<td>Everyday</td>
<td>Participants indicate their activities and experiences on a rating scale or checklist that are hypothesised to relate to creativity/creative performance. May include some interest/attitude questions</td>
<td>ALPHA Biographical Inventory</td>
</tr>
<tr>
<td>Self-report creative activities</td>
<td>Everyday</td>
<td>Participants indicate the quantity and/or quality of their creative activities. Similar to biographical inventories because they focus on previous activities and accomplishments.</td>
<td>Creative Achievement Questionnaire (CAQ)</td>
</tr>
<tr>
<td>Personality inventories</td>
<td>Everyday</td>
<td>Assess an individual’s typical pattern of responding to stimuli/situations</td>
<td>NEO Personality Inventory</td>
</tr>
<tr>
<td>Ratings by others (e.g. peers, teachers, co-workers)</td>
<td>Everyday</td>
<td>A rater who knows the ratee well either provides a global rating of their creativity (i.e. one number) or provides ratings on a number of creativity-related dimensions</td>
<td>Teachers’ Evaluation of Students’ Creativity (TESC), Consensual Assessment Technique (CAT) Goertzel, Goertzel &amp; Goertzel (1978)</td>
</tr>
<tr>
<td>Ratings of eminence</td>
<td>Eminent</td>
<td>An expert nominates an individual who they believe has made a significant creative contribution, or an expert rates/ranks the creative contributions of a list of individuals</td>
<td>Goertzel, Goertzel &amp; Goertzel (1978)</td>
</tr>
<tr>
<td>Judgements of products</td>
<td>Everyday</td>
<td>One or many experts rates a product, idea or artifact on its level of creativity.</td>
<td>Consensual Assessment Technique (CAT)</td>
</tr>
</tbody>
</table>
It is clear from Table 4 that there are numerous ways to approach creativity measurement. Most of these measurement methods apply to the individual creative person practicing everyday creativity. However, a unifying creativity measurement model may benefit literature on creativity measurement, and such a model was introduced by Batey (2012) (presented previously in Figure 1). Batey’s (2012) framework represents the confluence of the four Ps, extending previous work that treated each P as independent, and provides a way for researchers to meaningfully think about creativity measurement. For example, if the focus is the environment for creativity (Press), consideration should be given to whether measurement should lie at the individual, team, organisational or culture levels, and whether objective measurement or self- or other-ratings are most appropriate.

2.7.2 Summary of table and section

This section introduced the various approaches to measuring creativity and highlighted the issues surrounding creativity measurement. These are summarised here: first, many of the measurement methods outlined in Table 4 do not consider the environment in which they are administered. For example, research using Divergent Thinking tests are often conducted in a laboratory setting, which allows control of influencing factors but limits the extent to which the findings can be generalised outside the laboratory (Weisberg, 2006).

Second, existing empirical creativity research does not consistently yield the same results, indicating that the various creativity measures may not be assessing the same construct (Clapham, 2001). For example, research may use the Torrance Test of Creative Thinking (TTCT), the most widely used creativity measure (Kim, 2006), which is in fact a measure of ideational fluency. Despite research showing some educators believe ideational fluency to be synonymous with creativity (Sarsani, 2006), they are different constructs (Runco, 2008; Sternberg, 2005). Resultantly, empirical creativity research using the TTCT may not yield the same results as creativity research using a different measure of creativity, and thus their results are not directly comparable.

Despite the many creativity assessment techniques, there is still no consensus regarding how best to measure creativity. However, there is a slow migration towards measuring many components of creativity (Villalba, 2012), and this is reflected in the use of me2 to measure creativity in the current research. An alternative to measuring multiple components using one assessment tool is to use multiple assessment tools, with one tool measuring each component.
Amabile (1983) advises a battery of creativity measures could be used to assess her componential theory of creativity, and Clapham (2001) argues that self-reported creative activities can be particularly useful for comparing with other ratings of creativity, particularly those that rely on other-ratings. However, using a battery of measures for one construct is often impractical, especially when multiple constructs are being measured, as is the case in the current research. Therefore, a single, reliable measure that assesses multiple components of creativity is most appropriate for the current research.

2.8 Interim summary

The preceding section introduced various approaches to measuring creativity. This, along with the definition of creativity, is one of the biggest outstanding issues in creativity research. The following section reviews the literature on creative performance, distinguishing it from creativity, and introduces Hypotheses 1 and 2.

2.9 Creative performance

Creativity and creative performance are often used synonymously, however this section argues that confounding these terms is neither accurate nor helpful for increasing our understanding of these topics. Therefore, this section seeks to differentiate creativity and creative performance as two similar yet distinct constructs. Secondly, this section reviews empirical literature investigating individual facilitators (leading to Hypothesis 1), and contextual facilitators (leading to Hypothesis 2) of creative performance.

2.9.1 Distinguishing creativity and creative performance

Many authors continue to use creativity and creative performance synonymously (e.g. Bissola et al., 2014; Carmeli, Gelbard & Reiter-Palmon, 2013; Collins & Cooke, 2013), despite arguments that they are distinct concepts (Montag et al., 2012).

Creative performance can be defined as an activity, observable or unobservable, that occurs in response to a stimulus or task. It produces new and useful ideas, and involves problem identification, idea generation and information searching (Gupta & Singh, 2014; Montag et al., 2012; Zhou & Oldham, 2001). This definition of creative performance is both similar and different to the definition of creativity used in the current research, and focuses on the creative product.
Historically, creativity research has focused on idea generation, either as an antecedent to or as a result of the popularity of Divergent Thinking creativity measures, and therefore an implicit assumption may have occurred by which creativity was equated with idea generation. Idea generation is the main similarity between definitions of creativity and creative performance. However, other aspects of creativity and creative performance definitions are distinct from one another. Specifically, creativity is considered to be idea generation plus an individual’s characteristics, the creative process and environment, whereas creative performance is considered to be idea generation plus an activity, stimuli response, and producing something judged as new and useful, i.e. the ‘Product’ dimension of the four Ps. Reference to ‘new and useful’ is also found in some creativity definitions (e.g. Plucker et al., 2004), although not in the definition of creativity used in the current research. Moreover, reference to the idea generation process, including information search and problem identification, may stem from stage theories of creativity suggesting a theoretical overlap between creativity and creative performance.

Overall, the synonymous use of creativity and creative performance by some authors, and the partial overlap between definitions of creativity and creative performance, indicate a lack of clarity regarding the distinctness of the two constructs. Hypothesis 1 has two aims, one of which is to explore the extent to which these are two genuinely different constructs. Literature leading to the second aim of Hypothesis 1 is reviewed below.

2.9.2 Facilitators of creative performance

It has been argued that a variety of factors facilitate Individual Creative Performance. These facilitators can be individual or contextual. Individual facilitators include personality, motivation and confidence. Contextual facilitators can include the expectation of creative behaviour and time.

2.9.3 Individual facilitators

Three potential individual facilitators of creative performance will be explored in detail herein: personality, Creative Self-Efficacy and Intrinsic Motivation. Although initial searches for relevant literature indicated multiple studies investigating individual facilitators of creative performance, closer inspection revealed most of these studies focused on creativity rather than creative performance, and therefore were not relevant here.
2.9.4 Personality-creative performance literature

Previous research has sought to identify relationships between aspects of personality and creative performance. An early study of creative performance and personality sought to examine creative performance objectively, using supervisor ratings and a patent count as measures of creative performance (Oldham & Cummings, 1996). Only patent count was significantly and positively related to creative personality ($r=.27$, $p<.05$), suggesting that, to some extent, creative performance may be related to personality. However, this study did not elucidate which aspects of personality may be related to creative performance, as the composite score of ‘creativity-relevant personal characteristics’ was calculated based on the adjective checklist Creative Personality Scale (Gough, 1979). This measure seems to have fallen out of favour; its reduced use perhaps due to limited generalisability (across cultures, for example) of words such as ‘sexy’ and ‘snobbish’ to describe creative personality.

Regarding specific personality traits, Collins and Cooke (2013) examined Openness to Change, Boldness and Dominance in relation to supervisor-rated creative performance in 133 employees from a single pharmaceutical organisation, and found that there were no significant direct relationships between the personality traits, as measured by the Openness to Change, Boldness and Dominance scales from the 16PF ($5^{th}$ edition, Cattell, Cattell & Cattell, 1994) and creative performance. However, a significant moderated relationship was found between the presence of creative supervisors, as measured by a five item scale developed for this study, and creative performance, with those low on Dominance exhibiting greater creative performance when creative supervisors were present ($\beta=.04$, $p<.10$). In addition to the small sample and questionable assumption that supervisors can accurately rate employee creativity (as Collins and Cooke (2013) note), this study is limited by the synonymous use of creativity and creative performance in the second half of the paper, and the lack of detail regarding the measurement of supervisor-rated creative performance, despite discussion of the other existing measures (Openness to Experience, Dominance and Boldness) and newly developed measures (presence of creative supervisors) that were used. The confusion regarding creativity and creative performance severely hinders interpretation of the findings.

Overall, the extant empirical findings regarding creative performance and personality suggest that further research would be beneficial to elucidate the relationships between specific personality variables and creative performance, although the existing findings suggest these relationships may not be particularly strong or significant.
2.9.5 Creative Self-Efficacy-creative performance literature

Confidence can be defined as a person’s expectations of achieving future success (Burton & Raedeke, 2008). Confidence is also commonly referred to as ‘self-efficacy’ (Bandura, 1997), with the creativity-specific form of self-efficacy referred to as ‘creative self-efficacy’ (Feist, 2010).

Creative performance may be facilitated by confidence. As part of a study into psychological capital (comprising self-efficacy, optimism, perseverance and psychological resilience), Sweetman, Avey, Luthans and Luthans (2011) found that self-efficacy, measured as part of psychological capital using the Psychological Capital Questionnaire (Luthans, Youssef & Avolio, 2007), was positively and significantly related to creative performance \( \left( r = .21, p < .001 \right) \) in a sample of 899 working adults, suggesting confidence may be important for creative performance. However, although Sweetman et al. (2011) claimed to measure creative performance, they used a variant of an ‘unusual uses’ exercise (developed by Harrison, Mohammed, McGrath, Florey & Vanderstoep, 2003), which is commonly used in creativity research and focuses on ideational Fluency and Originality.

Creative Self-Efficacy (CSE), a domain-specific version of self-efficacy, may also facilitate creative performance. CSE is “the belief one has the ability to produce creative outcomes” (Tierney & Farmer, 2002, p.1138), and first appeared in the academic literature in 2002 when Tierney and Farmer extended earlier work on self-efficacy. In addition to exploring the antecedents of CSE, the authors found that CSE was positively and significantly related to creative performance \( \left( r = .17, p < .01 \right) \) in a sample of 158 white-collar employees from a single high-technology American firm, with creative performance measured using an existing 6 item supervisor-rated creative performance scale (Tierney, Farmer & Graen, 1999) and CSE measured using the Creative Self-Efficacy Instrument developed for this study. This was the earliest indication that creativity-related confidence may be important for creative performance.

This study was extended by the same authors in 2011, taking a longitudinal approach with a sample of 503 employees from an American state-sponsored social services provider. CSE (time 1) was found to positively and significantly relate to CSE (time 2), as measured by the Creative Self-Efficacy Instrument (Tierney & Farmer, 2002) \( \left( r = .56, p < .01 \right) \), and in both data collection phases, CSE was positively and significantly related to creative performance, as measured by four items from Tierney et al. (1999) \( \left( r = .26, p < .01; r = .29, p < .01 \right) \). However, time 1 CSE was not significantly related to time 2 creative performance, whereas time 2 CSE was
positively and significantly related to time 1 creative performance ($r=.23$, $p<.01$). These findings suggest that ratings of creativity-related confidence are relatively consistent over time, but its relationship with creative performance is not consistent.

Alternatively, the relationship between CSE and Individual Creative Performance has also been approached from a multilevel perspective. Richter, Hirst, van Knippenberg and Baer (2012) studied a sample of 176 employees in 34 research and development teams in a single multinational organisation, examining the relationship between individual CSE, measured by the Creative Self-Efficacy Instrument (Tierney & Farmer, 2002) completed by team leaders, and Individual Creative Performance, measured by supervisor ratings of Ideation (Tierney et al., 1999). Team members Knowledge of Who Knows What, measured by a three item scale developed for this study, and the team diversity in relation to professional specialism mediated the relationship between individual creative self-efficacy and Individual Creative Performance. That is, team members are rated as more creative when they have self-belief in their creativity, they know what their other team members do and they work within a professionally diverse team.

Overall, the extant empirical findings regarding creative performance, CSE and self-efficacy suggest that further research would be beneficial to elucidate the relationships between specific aspects of creative performance and confidence as it relates to creativity.

2.9.6 Intrinsic motivation-creative performance literature

Previous research has sought to understand whether motivation is related to creative performance, and has typically focused on Intrinsic and/or Extrinsic Motivation. This focus may stem from Amabile’s (1983) influential componential theory of creativity, which posited that Intrinsic Motivation is essential for creativity and Extrinsic Motivation either has a neutral or negative effect on creativity. Intrinsically motivated individuals may spend longer working on a task and become more deeply involved in it, producing more favourable results (Weisberg, 2006).

Intrinsic Motivation can be defined as “the degree to which creators engage in their work for the sake of the process itself” (Forgeard & Mecklenburg, 2013, p.255), and relates to an individual carrying out a task because they are inherently interested in it. Extrinsic Motivation can be defined as “the degree to which creators engage in their work for the sake of outcomes external to the process” (Forgeard & Mecklenburg, 2013, p.255), and relates to an individual carrying out a task because it allows them to achieve a benefit or reward such as status or money.
It has been argued that Intrinsic Motivation may be important for creative performance (Collins & Cooke, 2013). Tierney et al. (1999) studied this relationship in 191 employees within the research and development function of an American chemical corporation, and found a positive and significant relationship between supervisor-rated creativity and Intrinsic Motivation, as measured by five items developed for this study \((r=.28, p<.01)\), but no significant relationship between patent proposals and intrinsic motivation, suggesting when employees are intrinsically motivated they may perform more creatively, although it is not conclusive. This study claims to focus on creativity, however the use of patent proposals as the measure of creativity is aligned with other creative performance research that has used similar measures (e.g. Oldham & Cummings, 1996).

Conversely, Shalley and Perry-Smith (2001) studied the relationship between motivation, measured by five items adapted from Herman (1970), and creative performance, measured using a Consensual Assessment Technique (Amabile, 1983), in 81 American university students and found no significant relationship. However, this study is limited by its use of a Consensual Assessment Technique to measure creative performance as this is generally considered a creativity measure, suggesting confounding of terms. Moreover, the sample characteristics (small, graduate students as judges) limit this study.

Amabile’s (1983) componential theory of creativity hypothesises that being motivated by rewards and status can have a negative effect on creative performance. Byron and Khazanchi (2012) explored this relationship empirically by meta-analysing 60 relevant studies. Rewards contingent on creativity tended to increase creative performance \((\beta=.31, z=3.65, p<.001)\), whilst rewards contingent on completion of a task was not significantly related to creative performance. This suggests that people respond better to rewards that are clearly related to the task, as this potentially clarifies the goals they are aiming to achieve.

Alternatively, one study explored the relationship between team-level learning orientation (similar to Intrinsic Motivation), measured by the misleadingly-named Psychological Safety Scale which includes items on learning orientation (Edmondson, 1999), and Individual Creative Performance, measured by supervisor-ratings on four creative problem solving performance items (developed by Farmer, Tierney & Kung-McIntyre, 2003), thus taking a multilevel approach. In a sample of 198 employees nested within 25 research and development teams from a single multinational pharmaceutical organisation, Hirst, van Knippenberg and Zhou (2009) found that there was a weak positive \((r=.25, p<.01)\) relationship between learning orientation (a
preference for learning and taking on new challenges) and creative performance. The authors contend that when the team context is supportive of learning, individual learning orientation leads to higher Individual Creative Performance.

Overall, the extant empirical findings regarding creative performance and motivation suggest that further research is required to elucidate the relationships between specific motivation variables and creative performance, as much of the existing literature has focused on Intrinsic and Extrinsic Motivation as a result of Amabile's (1983) influential componential theory of creativity. Moreover, existing evidence suggests relationships between motivation and creative performance may not be particularly strong or significant.

2.9.7 Hypothesis 1

The empirical research discussed in this section covers a variety of individual facilitators and their relationships with creative performance. There is surprisingly little ‘true’ creative performance research, as close inspection of potentially relevant research often revealed a focus on creativity as opposed to creative performance. This exemplifies the terminological confusion surrounding creativity and creative performance highlighted previously.

Generally, there is little consistency regarding strength and consistency of findings, and the existing literature suggests that future research exploring individual variables and creative performance may not find strong or significant relationships. This may be due to the strong influence of other factors such as organisational climate. Moreover, the extant research typically focuses on one or two specific individual differences, as opposed to considering the roles of confidence, motivation and personality in the same measurement model, and thus increasing the likelihood of a Type 1 error.

Hypothesis 1 serves three purposes. First, it elucidates the relationship between confidence, motivation and personality and creative performance. Second, it explores the extent to which creativity and creative performance are distinct constructs as there are both similarities and differences in the definitions of the two constructs, with some using these terms synonymously and others arguing that this is inappropriate. The distinction between these concepts underlies all of the creative performance research discussed, however it is currently unclear. Hypothesis 1 will elucidate whether creativity and creative performance should be considered synonymous (this would be indicated by a perfect correlation). Given the relatively weak relationships evidenced in the literature between creative performance and personality-
related aspects of creativity, such as motivation and Openness to Experience, it is expected that the current research will also identify a weak relationship between creativity and Individual Creative Performance. Finally, Hypothesis 1 addresses calls to investigate the relationship between creativity and performance (of any variety) (Shalley & Gilson, 2004).

Hypothesis 1: Individual Creativity will have a significant but weak relationship with Individual Creative Performance

2.9.8 Contextual facilitators

In addition to individual facilitators of creative performance, research has sought to identify relationships between contextual variables, i.e. variables related to the context an individual or team is in, and creative performance. Empirical studies relating to four potential contextual facilitators of creative performance were identified: team cohesion, networks, autonomy and time. As with searches for literature on individual facilitators of creative performance, initial searches for relevant contextual facilitators of creative performance indicated multiple studies on contextual facilitators of creative performance, closer inspection revealed most of these studies focused on creativity rather than creative performance, and therefore were not relevant here.

2.9.9 Team cohesion-creative performance literature

One possible contextual facilitator of creative performance is psychological safety, defined as a team’s shared belief regarding the consequences of risk taking, psychological safety is believed to encourage trust and confidence within a team (Edmondson, 1999; Kessel, Kratzer & Schultz, 2012), and has been identified as a facilitator of job performance (Dirks, 1999).

Kessel et al. (2012) studied the relationship between psychological safety and creative performance in a sample of 149 healthcare professionals comprising 73 teams. Creative performance, measured using three items adapted from Zhou and George (2001), was significantly and positively correlated with the four item Psychological Safety Scale (Edmondson, 1999) \( (r=.25, \ p<.05) \), and with ratings of how frequently information was exchanged within the team (weekly, monthly, daily, never) \( (r=.32, \ p<.01) \). This suggests that when team members trust each other and share information with each other, it benefits creative performance. Clearly, the comparability of this research to other studies discussed in this section is limited by the measurement of all variables at the team level. Moreover, this study uses the
term creativity as if it were synonymous with creative performance, including, worryingly, when
describing the measure of creative performance used.

Team cohesion, a similar construct, has also been examined in relation to creative
performance, in a sample of 63 three-person groups of university students. The technical quality
and originality of the drawings were evaluated by independent judges as the measure of creative
performance, and team members rated the cohesion of their group, with each group assigned as
high or low cohesion (‘cohesive’ groups had time to acquaint themselves with their group
members prior to the task, whereas non cohesive groups commenced with the task immediately).
Craig and Kelly (1999) found that the interaction between team cohesion (task and interpersonal
cohesion) and creative performance was significant, even after controlling for Individual
Creativity ($F(1, 52)=6.71, p<.01$).

Overall, the extant empirical findings regarding creative performance and trust suggest
that further research is required to elucidate the role of trust (and related factors, such as team
cohesion) for creative performance within an organisational context.

### 2.9.10 Networks-creative performance literature

Another possible contextual facilitator of creative performance is a person’s networks. Klep, Wisse and van der Flier (2013) identified a relationship between this contextual facilitator
and creative performance, as they found a positive and significant relationship between creative
performance and future interaction expectation when team members had experienced emotion
sharing ($F(1, 64) = 4.10, p<.05$). That is, individuals who indicated that they expected to see
members of their team again, i.e. those who had or were going to incorporate the team members
into their network, performed more creatively in the teams constructed to resemble ‘real’ teams
through priming members by watching an emotional film clip together prior to the idea
generation exercise. However, despite an adequate sample size (66 three-person teams), the study
relied on university students in a laboratory context, limiting the generalisability of these findings
to an organisational context. Moreover, the measures used were relatively crude, for example
creative performance was measured by counting the number of unique solutions to a problem (i.e.
Fluency), relatively basic statistical analyses were conducted and no correlation matrix was
presented.

The relationship between social networks and creative performance has also been
examined within the context of the 2,137 crew members from eight major film studios in
Hollywood between 1992 and 2003 (Cattani & Ferriani, 2008). Creative performance was measured using the awards and nominations the professionals had received, which was examined in conjunction with a structural analysis of social networks (‘structural holes’) following a social network approach, which identified a significant relationship between social networks and creative performance (p<.001). However, the context specific nature of this study limits its relevance to other industries.

Overall, the extant empirical findings regarding creative performance and networks suggest that further research is required to elucidate this relationship, as much of the existing literature has been conducted in unique contexts or using artificially constructed workgroups, and often with relatively basic measures of creative performance focused on Fluency (e.g. Cattani & Ferriani, 2008; Klep et al., 2013).

### 2.9.11 Autonomy-creative performance literature

Autonomy has previously been cited as important for job performance (e.g. Barrick & Mount, 1993), however it may act as a contextual facilitator for creative performance too. In a study reviewed previously, Oldham and Cummings (1996) also considered the role of ‘non-controlling supervision’ as measured by twelve items developed for this study, and found no relationship with patent count but a significant and positive relationship with supervisor-rated creative performance, as measured by three items developed for this study (r=.28, p<.05). This suggests that creative performance may be related to autonomy to an extent, although the results are inconclusive.

To clarify these results, Grawitch, Munz, Elliott and Mathis (2003) placed 51 university students into groups of three. They hypothesised that groups with high autonomy, with level of autonomy determined by how prescriptive the task instructions were, would generate more ideas in both the positive and neutral mood conditions. However, their findings did not support this hypothesis, as groups with high autonomy produced fewer ideas than groups with low autonomy (positive mood M=7.38, SD=3.97 versus M=9.77, SD=3.22; neutral mood M=6.86, SD=2.25 versus M=8.14, SD=3.18). There was no significant relationship between autonomy and originality. The newness (originality) of the ideas generated by one group was judged by the members of the other groups, although their status as appropriate judges is questionable. Moreover, usefulness of the ideas was not considered, and as with previous research using
student groups, the group size may be considerably smaller than many ‘real’ teams. The use of student groups also limits the generalisability to an organisational context.

Overall, the extant empirical findings regarding creative performance and autonomy suggest that further research is required to elucidate this relationship, as much of the existing literature has produced inconclusive results and relied on non-representative student samples.

2.9.12 Time-creative performance literature

Creative performance may also be facilitated by time. Having sufficient and uninterrupted time to work on a project is an important resource for creativity and creative performance, partially due to encouraging Incubation, and may provide a mechanism through which an organisation can demonstrate that they value creativity (Alder, 1994; Whitelock, Faulkner & Miell, 2008).

Pressure to perform creatively within a specific time period may lead employees to disengage with creative thinking, and focus solely on completing the task to the detriment of creative performance (Amabile, Hadley & Kramer, 2002; Unsworth & Clegg, 2010). This may be because it can be perceived as difficult to be creative, and therefore creative performance is perceived as a time consuming activity (Shalley, 2008).

Baer and Oldham (2006) explored the relationship between time pressure and creative performance in a sample of 170 employees from an American manufacturing organisation, and identified a significant and negative relationship between supervisor-rated creative performance (measured using four items from Zhou and George (2001)) and time pressure, measured by items from the Innovation Climate Questionnaire (Innovation Centre Europe, 2000) \((r=-.24, p<.01)\). However, when controlling for Openness to Experience, measured by Goldberg’s (1999) Openness to Experience scale, and perceived Support for Creativity, measured by an adaptation of Madjar, Oldham and Pratt’s (2002) Support for Creativity scale, the relationship was curvilinear. This suggests that generally, time is an important resource for organisations wanting creative performance, although some personalities may respond positively to a degree of time pressure.

Baer and Oldham’s (2006) study was subsequently extended within a Taiwanese setting, to investigate whether the strength of an organisation’s innovation climate influenced the relationship between creative performance and time pressure, with all constructs measured using components of Amabile et al.’s (1996) KEYS. Hsu and Fan (2010) found that the interaction
between innovation climate, time pressure and creative performance was significant ($\beta=-.26$, $p<.05$), in a sample of 2,250 research and development employees from four research institutions. They then divided the sample using mean scores for innovation climate into perceived high and low innovation climate, and found that time pressure enhanced creative performance when innovation climate was perceived to be low, and time pressure hindered creative performance when innovation climate was perceived as high.

Overall, the extant empirical findings regarding creative performance and time/resources suggest that further research is required to elucidate this relationship, as much of the existing literature has had inconclusive results and relied on non-representative student samples.

2.9.13 Hypothesis 2

The empirical research discussed in this section covers a variety of contextual facilitators and their relationships with creative performance. As noted in the earlier discussion of individual facilitators of creative performance, there is surprisingly little ‘true’ creative performance research, with close inspection of potentially relevant research revealing a common focus on creativity as opposed to creative performance.

Generally, there is little consistency regarding the measurement of creative performance at either the individual or team levels, or the identification of significant relationships, and previous research has often relied on university students in unrealistically small groups completing an arbitrary task. As a result, the task by which creative performance is measured, the type of sample and the group size renders the findings ungeneralisable to an organisational context. Moreover, the extant research typically focuses on one or two specific factors, as opposed to considering the roles of many of the variables discussed in the same measurement model, which increases the likelihood of a Type 1 error.

The contextual factors reviewed in this section are arguably aspects of organisational climate, and Baer and Oldham’s (2006) and Hsu and Fan’s (2010) use of climate measure items to assess time pressure supports this. As climate is domain-referenced, it is appropriate to refer to Creative and Innovative Climate. It seems that no existing research has examined the relationships between a comprehensive set of Creative and Innovative Climate factors and creative performance. As such, the purpose of Hypothesis 2 is to address this gap and elucidate which dimensions of Creative and Innovative Climate may facilitate creative performance.
Hypothesis 2: Creative and Innovative Climate will have a significant and moderate relationship with Individual Creative Performance

2.10 Interim summary

The preceding section reviewed existing creative performance literature as it relates to Hypotheses 1 and 2. The following section reviews existing Individual Creativity literature as it relates to Hypothesis 3.

2.11 Individual Creativity empirical research

This section reviews empirical literature investigating the relationship between the organisational climate an individual works in and their creativity. Much has been written about correlates of Individual Creativity, including intelligence (e.g. Batey, Chamorro-Premuzic & Furnham, 2010; Furnham et al., 2009; Furnham & Nederstrom, 2010), Big Five personality traits (e.g. Furnham, Zhang & Chamorro-Premuzic, 2006; Furnham & Bachtiar, 2008), Eysenckian personality traits (e.g. Booker, Fearn & Francis, 2001; Grosul & Feist, 2014) and Creative Self-Efficacy (e.g. Lemons, 2010; Richter et al., 2012; Wang, Tsai & Tsai, 2014). These studies are primarily located within the individual differences literature, which seeks to explore how individuals differ from one another as regards emotion, cognition, motivation and behaviour (Revelle, Wilt & Condon, 2011). More recently, empirical creativity research has begun to investigate the environmental context in which organisational creativity occurs, and how organisational climate can support creativity (Kurtzberg & Amabile, 2001). The following section reviews empirical literature regarding Individual Creativity and organisational climate, and introduces Hypothesis 3.

2.11.1 Organisational climate

Put briefly, organisational climate can be defined as “an attribute or set of attributes of the work environment” (Guion, 1973, p.120). Organisational climate is a “domain referenced phenomenon” (Hunter et al., 2007, p.70), meaning it is specific to a context and the particular climate of interest should be clearly delineated (Carr, Schmidt, Ford & Deshon, 2003). The implication is that previous research conducted in contexts such as schools (e.g. Ma, 2009) has limited value for informing discussion regarding creativity in other contexts.
The context of the current research is organisational creativity and innovation, and therefore the current research focuses on Creative and Innovative Climate. Empirical literature examining the climate-Individual Creativity relationship is now reviewed, beginning with studies that have investigated a single dimension of climate and its relationship with Individual Creativity. Second, studies that have investigated the relationship between multiple climate dimensions and Individual Creativity are reviewed. Much of the literature has argued that various dimensions of climate, or climate as a whole, are important for Individual Creativity. For example, Klotz, Wheeler, Halbesleben, Brock & Buckley (2012) discuss strategies whereby organisations can implement reward systems to stimulate creativity. Similarly, an organisation’s approach to risk taking has been discussed in relation to creativity (Bazerman, 1994; Shalley, 2008), however these publications are not empirical.

Overall, identifying literature that empirically and unambiguously explores Individual Creativity was difficult. Moreover, the relatively frequent synonymous use of creativity and creative performance makes the identification of literature specifically exploring climate and Individual Creativity more difficult.

2.11.2 Resources-Individual Creativity literature

One aspect of Creative and Innovative Climate that has been explored in relation to Individual Creativity is the extent to which an organisation provides resources. Resources can take many forms, including financial resources, knowledge and facilities.

One study focused on a supply chain context, exploring the relationship between Individual Creativity, complementary resources (i.e. the extent to which the climate encourages buyers and sellers to combine resources, particularly if one party possesses a resource that the other party lacks) and knowledge sharing resources (i.e. the extent to the climate encourages buyers and sellers to share knowledge) in a sample of 262 purchasing managers across various industries (Wang, Bradford, Xu & Weitz, 2008). The relationship between complementary resources, as measured by two items from Jap (1999), and three Individual Creativity items developed for this study was not significant. Knowledge sharing resources, measured by three items informed by Dyer and Singh’s (1998) conceptual framework, exhibited a positive and significant relationship with Individual Creativity ($r=.31$, $p<.01$). These findings highlight that different types of resource may affect Individual Creativity differently. However, further research is required to understand whether this is unique to a supply chain context, as this context has...
received limited attention in the creativity literature. Moreover, interpretation of the findings is limited by the lack of information on the authors’ development of the Individual Creativity measure, with analysis such as an Exploratory Factor Analysis neither presented nor alluded to in the paper. The measure is further limited by focusing solely on the generation of new and useful approaches to the buyer-seller relationship, thus overlooking other aspects of Individual Creativity such as confidence or motivation.

Another type of resource, facilities and physical environment, has been explored by Oksanen and Stahle (2013). They gathered information on existing ‘innovative spaces’ (namely the libraries of various universities in The Netherlands and Finland and the offices of American organisations such as IDEO) and conducted interviews to identify the attributes of an ‘innovative space’, which is important because organisations can encourage creativity through provision of appropriate facilities. These should be based around team work, encouraging communication and collaboration, and reflect the personality and values of the user (potentially drawing on the personalisation literature within environmental psychology). However, this study is limited by its synonymous use of creativity and innovation, and lack of definition of creativity, which introduces ambiguity as to the true focus of the research. Also, the very small sample of interviewees \( n=7 \) from Finish universities limits the generalisability to private sector organisations and non-Nordic countries.

Overall, the extant empirical research on resources and Individual Creativity has focused on various aspects of resources with varying ambiguity surrounding their definition and the measurement of creativity. Further research is required to elucidate the relationship between resources and Individual Creativity, to expand the small amount of existing literature and utilise a multifaceted conceptualisation of creativity with larger, more generalisable samples.

### 2.11.3 Networks-Individual Creativity literature

A second aspect of climate that has been explored in relation to Individual Creativity is networks. Conceptual work suggests that social relationships play an important role in Individual Creativity (Perry-Smith & Shalley, 2003). There have been a number of empirical studies examining social networks and their relationship with creativity from network analysis (e.g. Dokko, Kane & Tortoriello, 2014) and social capital perspectives (e.g. Liu, 2013), that indicate social networks are important for creativity. However, these studies sit on the periphery of the current research as they do not focus on climate.
Baer (2010) studied 216 employees from a large agricultural processing firm to examine the relationship between internal networks (each participant provided a list of their closest network for creativity) and supervisor-rated creativity, using three items adapted from Subramaniam and Youndt (2005). Baer (2010) found that individuals were most creative when they had networks of a moderate size, weak strength and high diversity (i.e. representation from a high number of different parts of the organisation), indicated by a significant interaction term ($\beta= -.43$, $p<.05$). These findings imply internal networks are important for creativity, and organisational climate should support employees networking. In particular, the role of weak networks suggests creativity benefits from knowing who to approach for information (Knowledge of Who Knows What (Richter et al., 2012)) as opposed to having many strong ties. However, this study focuses solely on idea generation, predominantly Originality, and is narrowly focused on networks within an organisation.

In contrast to Baer (2010), Sosa (2011) used a similar methodological approach in a sample of 58 employees from a German software development firm, yet found that strong connections were positively and significantly related to a single item measure of idea generation ($r=.24$, $p<.01$), which contrasts Baer’s (2010) findings. Sosa (2011) also found that how long members of the network had known each other (‘tie duration’) was not significantly related to Individual Creativity. Like Baer (2010), Sosa (2011) used a narrow conceptualisation of creativity. However, Baer (2010) emphasised Originality whilst Sosa (2011) emphasised Fluency, limiting the extent to which these studies can be compared. These conceptual and methodological differences may explain why these authors found contrasting results for the networks-creativity relationship.

Overall, the extant empirical findings regarding Individual Creativity and networks has taken a social networks perspective and focused on a narrow conceptualisation of Individual Creativity based solely on idea generation (originality or fluency). Further research is required to elucidate this relationship and clarify existing inconsistent findings, as these make it difficult to draw a parsimonious conclusion. However, although there is currently no consensus regarding how close a network should be to have the greatest influence on creativity, there is arguably consensus surrounding the importance of having a network. Finally, further research is required that utilises a multifaceted conceptualisation of creativity in a larger sample.
2.11.4 Autonomy-Individual Creativity literature

A third aspect of climate that has been explored in relation to Individual Creativity is autonomy. In a large multilevel study, Liu, Chen and Yao (2011) studied 856 individuals in 111 teams from a porous metal firm, seeking to understand the relationship between Individual Creativity, autonomy and harmonious passion (an activity a person has internalised and chooses to engage in, as opposed to feeling compelled to do it (Vallerand et al., 2003), a construct arguably similar to Intrinsic Motivation). Self-reported autonomy was measured at the team level with four items (Deci, Connell & Ryan, 1989), supervisor-rated Individual Creativity was measured using Zhou and George’s (2001) 13 item scale and harmonious passion was measured using Vallerand et al.’s (2003) seven item scale.

Both autonomy ($r=.15$, $p<.01$) and harmonious passion ($r=.40$, $p<.01$) were directly, positively and significantly related to Individual Creativity. This suggests that choosing to engage in creativity, and having the autonomy to do so, could lead to creativity. However, despite a large sample size and multilevel study design, Liu et al. (2011) repeated a mistake of other extant literature in approaching Individual Creativity as a unidimensional construct. Therefore, further research is required to elucidate the autonomy-Individual Creativity relationship utilising a multifaceted conceptualisation of creativity in a similarly large sample.

2.11.5 Multiple climate dimensions-Individual Creativity literature

In contrast to empirical research that has investigated the relationship between Individual Creativity and a single dimension of Creative and Innovative Climate, a small number of recent studies have investigated multiple climate dimensions simultaneously. These studies often purport to consider the role of innovation too.

Wang et al. (2014) studied 586 employees from various service industry organisations in Taiwan, and found that resources (measured using the Sufficient Resources and Workload Pressure scales from Amabile et al.’s. (1996) KEYS), management practices (measured using the Challenging Work, Work Group Support, Supervisory Encouragement and Freedom KEYS scales) and organisational motivation (measured using the Organizational Encouragement and Organizational Impediments KEYS scales) were significantly related to both Individual Creativity and innovation. Resources were more strongly related to creativity ($r=.53$, $p<.05$) than innovation ($r=.46$, $p<.05$). Management practices were more strongly related to innovation ($r=.57$, $p<.05$) than creativity ($r=.49$, $p<.05$), and organisational motivation was also more strongly
related to innovation \( (r=0.27, p<0.05) \) than creativity \( (r=0.23, p<0.05) \). This suggests that whilst these three variables are important for both creativity and innovation, resources are more important for creativity, whilst innovation benefits more from an organisation that is motivated towards creativity and innovation, and encourages autonomy, team cohesion and challenging work.

However, many of the measures used in this study are problematic. First, the supervisor-rated creativity measure does not reflect the multidimensional nature of Individual Creativity. Second, the items comprising the innovation measure focus on processes, administrative systems and strategies for innovation, but do not explicitly refer to innovation or the specific part of the innovation process they should be answered in relation to. This calls into question whether the participants responded to the items appropriately and thus the accuracy of the findings. Lastly, although the KEYS measure was used, the management practices construct was explored as a higher level variable which meant relationships between Individual Creativity and the specific climate dimensions comprising management practices could not be elucidated.

A second study, located within the knowledge management literature, used a mixed methods approach to investigate the relationship between multiple climate dimensions, creativity and innovation in a German manufacturing organisation (Auernhammer & Hall, 2013). The quantitative portion of the research surveyed 201 employees and highlighted the climate dimensions correlated with creativity and innovation, as measured by ten items developed for this study. Specifically, leadership \( (r=0.49) \), organisational behaviour (encompassing Openness to ideas and consistent values, \( r=0.48 \)), interdisciplinary working \( (r=0.48) \), having ‘innovation information’ \( (r=0.41) \) (no significance values were provided by the authors and thus cannot be provided here). The qualitative portion of the research extended these quantitative findings through 46 employee interviews, developing the concept of a space in which to explore new ideas, labelled ‘Freiraum’.

However, there are a number of limitations of this study. First, there is no clear rationale for the selection of which climate variables were studied, and latterly how these were grouped together when presented in the paper. Also, insufficient detail regarding the measures was provided. For example, it is not explicitly stated whether the climate dimensions were measured using a new or existing culture scale, and no reliability information was provided for any measures. Second, correlational data was discussed as if it implies causality in their Results section, although some argue that this can be acceptable (Constantine, 2012). Specifically, they discuss which climate factors have the greatest impact on innovation based solely on correlation.
coefficients that were presented without significance values. A third limitation of this study is that creativity and innovation are consistently used synonymously. This is particularly pertinent in the quantitative portion of the study, where 10 items were used to measure a factor labeled ‘creativity routines’ but then frequently referred to as measuring ‘innovation performance’ or ‘innovation’.

Overall, it is promising that research is beginning to investigate multiple climate dimensions, and the moderate correlations identified between creativity, innovation and the majority of the climate variables investigated thus far suggest that organisational climate is important for both creativity and innovation. However, the quality of some studies is questionable due to substantial measurement difficulties, inconsistent use of terminology and small samples. Moreover, unidimensional conceptualisations of Individual Creativity have been used.

More broadly, the empirical research reviewed in relation to the organisational climate-Individual Creativity relationship supports theoretical assertions that various dimensions of organisational climate are important for creativity, and organisations should be taking steps to appropriately enhance their climate (Klotz et al., 2012; Shalley, 2008). Specifically, individuals who perceive there to be sufficient resources (financial, facilities and physical environment), social networks, autonomy and motivation seem to consider themselves creative, or be rated as such, compared to those who perceive the climate of their organisation to lack these characteristics.

2.11.6 Hypothesis 3

The extant literature investigating Creative and Innovative Climate and Individual Creativity can be furthered through the current research. First, there seems to be relatively little research on climate and Individual Creativity, potentially less so than exploring climate and creative performance, and the extant literature is piecemeal regarding which climate dimensions are measured. Moreover, focusing on one or two factors, as opposed to considering the roles of many factors, increases the likelihood of a Type 1 error. Research that systematically investigates the relationship between a comprehensive set of climate factors and a comprehensive set of Individual Creativity dimensions is required (Hunter et al., 2007; Mumford & Hunter, 2005); the most recent state-of-the-science creativity review calls for research that explores the ‘facet-specific’ climate for creativity and innovation (Anderson et al., 2014). Hypothesis 3 addresses this.
Second, the majority of the existing climate-Individual Creativity literature has measured Individual Creativity as a unidimensional variable, usually focusing on idea generation (e.g. Baer, 2010; Hirst, van Knippenberg, Chen & Sacramento, 2011; Sosa, 2011) with other aspects of creativity largely ignored (Anderson et al., 2014). Hypothesis 3 conceptualises Individual Creativity as a multidimensional construct.

Third, Hypothesis 3 seeks to add clarity to much of the existing climate-Individual Creativity literature by using a clear and distinct conceptualisation of creativity, distinguishing it from both creative performance and innovation. This would improve upon many existing studies (e.g. Auernhammer & Hall, 2013; Wang & Ma, 2013), and may reduce the likelihood of obtaining inconclusive results, such as Hirst et al.’s (2011) multilevel investigation of formalisation and Individual Creativity produced.

Given that Individual Creativity is measured as a personality-type variable in the current research (as opposed to an ‘objective’ divergent thinking measure, for example), it is argued that the relationship between Individual Creativity and perceptions of Creative and Innovative Climate will be relatively weak, albeit significant.

Hypothesis 3: Creative and Innovative Climate will have a significant but weak relationship with Individual Creativity

2.12 Interim summary

The preceding section reviewed existing Individual Creativity literature in relation to Creative and Innovative Climate and the development of Hypothesis 3. The following section reviews Team Creativity literature, particularly in relation to Creative and Innovative Climate, and presents Hypothesis 4.

2.13 Team Creativity

Organisational work is frequently carried out in or by teams (Gajdzik, 2013; Paulus, 2008), and most new products could not have been developed by a single person (Dougherty & Tolboom, 2008). However, despite the importance of the team for both creativity and innovation, previous research has tended to focus at the individual level, with Team Creativity somewhat overlooked (Kurtzberg & Amabile, 2001; Locke & Latham, 2013), or studies do not specify whether creativity is an individual or team level construct (Pope, 2005). The bias towards
Individual Creativity is reflected in, and perhaps stems from, creativity theories that focus on one ‘creator’ (e.g. Czikszentmihalyi, 1996), which is the foundation of creativity studies in the individual differences paradigm (Batey & Furnham, 2006).

### 2.13.1 Definition and basic concepts

A team can be defined as a group of individuals who work together to produce products or services for which they are mutually accountable, and team members are interdependent in the accomplishment of successful outcomes (Paulus, 2000). A team is more than the sum of its parts; Individual Creativity and Team Creativity are distinct constructs and thus Team Creativity cannot be measured solely as an aggregation of Individual Creativity scores (Agrell & Gustafson, 1994; Bharadwaj & Menon, 2000). Team Creativity is influenced by interaction and collaboration within the team, the complexity of which cannot be understood through aggregation of Individual Creativity (Chen, 2006; Isaksen & Lauer, 2002; Kratzer, Leenders & van Engelen, 2003; Kurtzberg & Amabile, 2001; Leenders, van Engelen & Kratzer, 2003).

Team Creativity and group creativity are sometimes used synonymously (Paulus, 2000). However, a group may be a less cohesive, trusting, interdependent entity than a team (Ghuman & Aswathappa, 2010). For this reason, some research refers to group creativity when sampling students that have formed temporary groups for the purpose of a study (Paulus & van der Zee, 2004). This approach produces poor generalisability to real world settings, as members typically do not know each other, the group has an unrealistically short life span and the tasks being worked on are not meaningful to members (Kozlowski & Ilgen, 2006; Paulus, 2008). Moreover, temporary groups are often much smaller than organisational teams could be. The current research sampled pre-existing, established teams within an organisation and therefore refers to Team Creativity.

Before considering the relationship between Team Creativity and Creative and Innovative Climate, it is useful to briefly outline the areas in which Team Creativity research has focused to date. Extant Team Creativity literature has primarily concentrated on the relationships between Team Creativity and three areas (West, 2002). First, type of task. This includes task difficulty and structure (Higgs, Plewnia & Ploch, 2005; Leenders et al., 2003). The existing literature indicates that teams seeking to be creative benefit from having a structure that enables the team to be composed of diverse individuals (in this case, following Belbin’s Team Roles model (Belbin, 2000)). This is true when the task is complex, however simple tasks do not benefit from a diverse...
team structure (Higgs et al., 2005). Such studies have also led to recommendations of taking short breaks with Divergent Thinking exercises during brainstorming, as teams allowed to take short breaks were more creative (Fluent) than teams who did not take breaks, although Paulus, Nakui, Putman and Brown (2006) found this was only the case when the team operated face to face, not virtually (Coskun, 2005; Paulus et al., 2006).

The second main focus of existing Team Creativity research has been diversity. Some of this research is similar to that exploring team structure, with the terms used synonymously. A number of forms of diversity have been explored, including diversity in knowledge and skills. This research has consistently recommended greater diversity to achieve Team Creativity, both theoretically (Stahl, Makela, Zander & Maznevski, 2010; West, 2002) and using quantitative (Kearney & Gebert, 2009) and qualitative data (Egan, 2005). Gender has also been explored as a source of diversity. Using faultline theory (Lau and Murnighan’s (1998) theory of demographic subgroup formation), Pearsall, Ellis and Evans (2008) sought to explore whether gender positively related to Team Creativity. They found that when gender faultlines were activated, this negatively affected Team Creativity (conceptualised as team fluency) ($\beta=-.20$, $p<.05$), however gender faultlines had no effect when they were not activated ($\beta=.04$, ns). Gender faultlines were activated by asking teams to complete a gender-specific task, and this was compared with teams completing a gender neutral task. Pearsall et al.’s (2008) study suggests that gender diversity may impede creativity when the gender diversity of the team is made explicit and the task being completed is biased towards one gender.

The third primary focus of existing Team Creativity research has been the integration of knowledge and skills within the group. This refers to capitalising on employees’ knowledge and skills through making employees feel valued (Barczak & Wilemon, 2003), and led to recommendations that team members should attend to one another during ideation as this allows ideas to be built upon by others (Paulus, 2008; West et al., 2003), with a focus on how integrated the team is (Baiden, Price & Dainty, 2006).

Some extant literature has sought to highlight the potentially negative aspects of Team Creativity. This has highlighted social and cognitive inhibitors, including social loafing (Paulus, Dugosh, Dzindolet, Coskun & Putman, 2002; Paulus, 2008), production blocking (Paulus, 2000) and groupthink (Bissola et al., 2014; Brockman, Rawlston, Jones & Halstead, 2010; Janis, 1972), and negative ramifications of diversity such as conflict and communication issues (Bowers, Pharmer & Salas, 2000; Earley & Mosakowski, 2000; Webber & Donahue, 2001).
However, the literature seeking to understand correlates of Team Creativity, such as diversity and task type, and the literature seeking to identify inhibitors of Team Creativity, overlook the organisational context in which creativity occurs and there have been calls for greater consideration to be given to the climate that stimulates creativity (Paulus, 2008; West, 2002), particularly at the less-explored team level (Batey, 2012). The following section reviews empirical literature regarding Team Creativity and organisational climate, and introduces Hypothesis 4.

### 2.13.2 Resources-Team Creativity literature

One aspect of Creative and Innovative Climate that has been explored in relation to Team Creativity is the extent to which an organisation provides resources. Resources can take many forms, including financial resources and facilities. There seems to have been less interest in the role of resources for Team Creativity than for Individual Creativity, which may reflect the complexity of analysing cross-level relationships and also explain anecdotal assumptions that the perception of limited time inhibits Team Creativity (Gilson, Mathieu, Shalley & Ruddy, 2005).

Qualitative research has found time pressure inhibits Team Creativity. Amabile et al. (2002) analysed diary entries from 177 employees across seven American organisations, coding references to time pressure when employees wrote about working on creative tasks in their project team. This provided substantial qualitative evidence of the negative, stress-related feelings evoked when put under time pressure, and how this inhibited Team Creativity and led to individuals having heightened turnover intention. Although the sample spanned a number of organisations, the qualitative nature of the work distinguishes it from the majority of Team Creativity studies meaning the findings are difficult to compare. Also, although the espoused level of analysis was the team, the research design limits how confidently it can be assumed that the diary studies really reflect Team Creativity as opposed to Individual Creativity.

Overall, there has been relatively little empirical research considering resources as an aspect of the organisational climate-Team Creativity relationship. Further empirical, quantitative research is required that allows statistical estimation of this cross-level relationship.

### 2.13.3 Team cohesion-Team Creativity literature

A second aspect of Creative and Innovative Climate that has been explored in relation to Team Creativity is team cohesion (and similar constructs). Fairchild and Hunter (2014) formed 55
design teams from 161 engineering university students to study the relationship between team cohesion, task conflict (measured using four items from Jehn (1995)) and Team Creativity. Team cohesion was measured using the Participative Safety scale from Anderson and West’s (1998) Team Climate Inventory, and the originality and usefulness of each team’s output was rated by three researchers using an adaptation of the Consensual Assessment Technique (Amabile, 1983). Team cohesion had no significant relationship with either usefulness or originality. However, when entered into a regression alongside task conflict, a significant interaction was identified between task conflict and team cohesion on Originality, and this model accounted for 17% of the variance in Originality. No similar significant interaction was found for usefulness. This suggests that both task conflict and team cohesion should occur together to encourage Originality in Team Creativity, however these factors appear unrelated to whether teams generate useful ideas.

In a similar study using real organisational teams (228 individuals from 6 Korean organisations), Joo, Song, Lim and Yoon (2012) also examined the relationship between team cohesion and Team Creativity, using a 6 item team cohesion scale (Podsakoff & MacKenzie, 1994) and five item Team Creativity scale (Zhou & George, 2001). They found a moderate and significant relationship between Team Creativity and team cohesion \((r=.50, p<.01)\), although their measurement model exhibited relatively poor fit \((\text{RMSEA} = .11)\). When team cohesion was combined with a climate that encouraged learning and developmental feedback, their model explained 41% of the variance in Team Creativity, which is a very large amount of variance to be explained (Miles & Shevlin, 2001).

Overall, the extant empirical findings suggest that Team Creativity and team cohesion are positively related, and that this relationships holds across Western and Eastern cultures. However, existing research is inconsistent regarding the strength of the relationship. Moreover, climate consists of many factors, and both Fairchild and Hunter (2014) and Joo et al. (2012) focused solely on team cohesion. Further research is required to elucidate this relationship within a broader spectrum of climate variables, and clarify existing inconsistent findings in ‘real’ organisational teams.

### 2.13.4 Trust and collaboration-Team Creativity literature

Trust, a dimension of team cohesion, has also been explored in relation to Team Creativity. Barczak, Lassk and Mulki (2010) explored the relationships between Team Creativity and team emotional intelligence, team trust and collaborative culture in a sample of 82
undergraduate student teams from an American university. Team Creativity and collaborative culture were both measured using 8 item scales from previous empirical research (Rego, Sousa, Pina e Cunha, Correia & Saur-Amaral, 2007; Lopez, Peon & Ordas, 2004). Trust was measured using an 11 item ‘interpersonal trust’ scale that covered cognitive trust and affective trust (McAllister, 1995), and team emotional intelligence was measured using the 16 item Workgroup Emotional Intelligence Profile (Jordan & Lawrence, 2009). Responses were then aggregated to the team level. They found that aspects of team emotional intelligence (team norms for managing emotional processes) relates to trust. Specifically, awareness of own emotions ($r=.26$, $p<.01$) and management of others’ emotions ($r=.34$, $p<.01$) were significantly related to Team Creativity. They also found that both collaborative culture (i.e. a culture of employees that support discussion and respect, team working, diversity and risk) ($r=.84$, $p<.01$) and cognitive trust (i.e. relying on team members due to their experience and reliability) ($r=.24$, $p<.01$) were significantly and positively related to Team Creativity. Feeling confident in team members because of positive feelings towards them (affective trust) was not significantly related to Team Creativity.

However, there are a number of limitations of this study. First, the statistical methodologies used to do not allow the authors to imply causation and therefore do not support their claims of having identified antecedents of Team Creativity. Second, the use of a student sample limits the ecological validity of this study. Third, the correlation coefficients and other parameters estimated may have been artificially inflated because of aggregation from the individual to the team level (Byrne, 2012), and also because they include items that relate to team cohesion in the collaborative culture measure, when trust (another aspect of team cohesion) is measured separately. Finally, the measurement of collaborative culture was very broad, encompassing aspects of climate that may relate to creativity in their own right. For example, some of the items used pertain to risk, collaboration and team cohesion. These may all have different relationships with Team Creativity, and including all of these within one construct may overlook differences between the aspects of collaborative culture.

Overall, Barczak et al.’s (2010) study supports previous extant literature suggesting team cohesion and Team Creativity are positively related. However, further research is required to elucidate this relationship within ‘real’ organisational teams using statistical analysis techniques that bypass aggregation and its associated issues.
2.13.5 Networks-Team Creativity literature

In addition to resources and aspects of team cohesion, empirical Team Creativity research has also explored the role of networks, predominantly from a social network perspective. One approach is to examine the frequency of interaction within a team, and whether this is related to Team Creativity. Leenders et al. (2003) studied 243 individuals in 44 new product development teams from 11 electronics companies. Each participant indicated the extent to which they communicated with others in their team in a typical week, and team tenure was also recorded. The relationship between self-rated Team Creativity (using a measure developed for this study) and frequency of communication was inversely U shaped, as both linear and quadratic terms were significant (p<.01) and the quadratic term was negative (-1.24). Team tenure was significantly and negatively related to Team Creativity (r=−0.40, p<.01). This suggests that moderate levels of communication frequency are most beneficial for Team Creativity and that as teams are together for longer they become less creative.

The authors focused on virtual teams, limiting generalisability to the current research and the majority of organisational teams. However, the teams studied were not explicitly virtual teams but teams that maintained a high level of electronic communication. The type of sample is very similar to that used in the current research, as it was almost exclusively educated males with an engineering specialism. Overall, Leenders et al. (2003) offer an interesting insight into the role of networks for Team Creativity on which future research can build.

2.13.6 Multiple climate dimensions-Team Creativity literature

Some research has taken a broader scope to conceptualising climate when examining Team Creativity. For example, Somech and Drach-Zahavy (2013) studied Team Creativity in relation to team cohesion, support for innovation (how much an organisation values innovation), goal awareness and task orientation (related to team cohesion; whether team members share a desire to perform well). Using a sample of 997 individuals from a large Israeli healthcare organisation, it was found that a lack of supportive climate hinders a team’s ability to create and innovate; Team Creativity enhances innovation only when organisational climate is supportive (the relationship between Team Creativity and climate was non significant). Modeling climate as a mediator of the Team Creativity-innovation relationship explained 53% of the variance in innovation implementation.
Innovation climate was measured using a short form of the Team Climate Inventory (Anderson & West, 1998), measuring team cohesion, support for innovation, vision (goal awareness) and task orientation (i.e. team members share a desire to perform well). However, their Confirmatory Factor Analysis showed a one factor model had the best fit (as opposed to a four factor model) and they therefore considered climate for innovation as one construct. Team Creativity was measured using team leader ratings of “the creative ideas raised by the team” (p. 693) (obtained monthly for six months), in addition to the researchers reviewing six months’ worth of meeting minutes to count the number of creative ideas discussed by the team. Innovation implementation was measured one year after the initial measurement, asking two managers per team to rate the extent to which each idea that was captured in the meeting minutes had been implemented.

This study seems to confirm that there is a positive relationship between climate and Team Creativity. However, it does not tell us which aspects of climate are most related to Team Creativity as climate was analysed as a single variable combining various scales from the Team Climate Inventory. Therefore, this study only slightly extends previous work that narrowly focuses on a single aspect of climate.

Others have extended previous literature by focusing on two aspects of climate. Gilson and Shalley (2004) explored Team Creativity and two aspects of climate: goal awareness and socialising with coworkers. Team leaders rated each team’s creativity using six items adapted from Jabri (1991), and team members rated goal awareness (agreement as to a shared vision) and how often they socialised with others in the organisation (measured using two items developed for this study). Goal awareness was positively and significantly correlated with Team Creativity ($r=.18$, $p<.05$) although socialising was not significantly related to Team Creativity. This contradicts other research that has found networks are important for Team Creativity, and suggests further research is needed to elucidate the relationship. One explanation for the difference in findings may be that this study used the word ‘socialising’ in the questionnaire items, and participants may be less likely to consider socialising important whereas items worded more in relation to networks within the organisation may be interpreted differently.

Overall, Team Creativity research that investigates multiple climate dimensions exemplifies the inconsistency as regards which climate factors should be investigated, how these should be modeled (a single climate factor or multiple climate factors) and how these should be measured (for example, measuring socialising or interdepartmental networks).
Greater consideration should be given to the climate that encourages creativity (Paulus, 2008; West, 2002), particularly at the under-explored team level (Batey, 2012). The extant literature investigating Creative and Innovative Climate and Team Creativity can be furthered through the current research. First, there seems to be relatively little research on climate and Team Creativity, arguably less than climate-Individual Creativity or climate-creative performance, and the extant literature is piecemeal regarding which climate dimensions are measured. Focusing on one or two factors (e.g. Barczak et al., 2010; Somech & Drach-Zahavy, 2013), as opposed to considering the roles of many factors, increases the likelihood of a Type I error. Therefore, research that systematically investigates the relationship between a comprehensive set of climate factors and Team Creativity is required (Hunter et al., 2007; Mumford & Hunter, 2005). Indeed, Mathiesen & Einarsen (2004) conclude their review of creative climate and innovative climate measures with a call for research that explores the relationships between the specific dimensions of Creative and Innovative Climate and Team Creativity. Others have called for research that explores the ‘facet-specific’ climate necessary for creativity and innovation (Anderson et al., 2014). Hypothesis 4, presented below, goes some way to addressing these concerns.

Second, the majority of the existing climate-Team Creativity literature has not taken a multilevel approach in the statistical estimation of the relationship between these two constructs. As a result, the level of analysis has either been somewhat unclear (e.g. Amabile et al., 2002) or researchers have relied on aggregation (e.g. Barczak et al., 2010), which is both statistically problematic (due to the artificial inflation of estimates) and theoretically problematic (due to Team Creativity not simply being the aggregation of team members‘ Individual Creativity (Taggar, 2002)). Hypothesis 4 is designed for a multilevel approach, and therefore can provide a more accurate estimation of cross-level relationships that avoids the atomistic fallacy, whereby inferences about one level of analysis are made based on data relating to a different level of analysis (c.f. Kozwolski & Klein, 2000).

Third, Hypothesis 4 seeks to extend the existing climate-Team Creativity literature, the findings of which have been somewhat inconsistent, by using ‘real’ organisational teams and clear measurement of the climate dimensions. Given the inconsistency in the approaches taken to assessing the climate-Team Creativity relationship, and therefore the inconsistent results obtained, it is difficult to identify specific aspects of Creative and Innovative Climate that will
positively relate to Team Creativity in the current research. However the extant literature, primarily focused on a broader construct of organisational climate, has identified moderate, or in some cases strong, relationships. This suggests that Creative and Innovative Climate may have a moderate relationship with Team Creativity.

Hypothesis 4: Creative and Innovative Climate will have a significant and moderate relationship with Team Creativity.

2.14 Summary

This chapter has reviewed the creativity literature relevant to the current research. Definitions and measurement issues surrounding creativity were discussed, followed by theories of creativity and empirical creativity and creative performance research. Discussion of empirical creativity research considered three areas: individual differences, Individual Creative Performance and Team Creativity. Hypotheses 1 to 4 were introduced.
3 FRONT END INNOVATION LITERATURE REVIEW

3.1 Chapter overview

This chapter reviews the Front End Innovation literature relevant to the current research. Definitions and the factors comprising Front End Innovation are discussed, followed by empirical research exploring the relationship between Front End Innovation and Creative and Innovative Climate, culminating in the introduction of Hypothesis 5.

3.2 Defining and conceptualising Front End Innovation

This section provides an overview of the main approaches to defining and conceptualising Front End Innovation, including the definition of Front End Innovation used in the current research.

The first stage of the innovation process has been referred to as the “Front End of Innovation” (FEI) (Gaubinger & Rabl, 2014, p.15; Poskela & Martinsuo, 2009, p.671), the “Fuzzy Front End” (FFE) (Gassmann & Schweitzer, 2014, p.3; Zien & Buckler, 1997, p.274), the “early innovation phase” (Enkel & Heil, 2014, p.109; Perez-Freije, 2014, p.263) and “upfront’ innovation” (Kim & Wilemon, 2002b, p.269). FEI and FFE appear to be the most commonly used terms, and the present research uses FEI. This is because the “fuzzy” moniker suggests that this stage of the innovation process is less standardised, structured and understood than the subsequent stages of the innovation process (Reid & de Brentani, 2004), and characterised by uncertainty (Kim & Wilemon, 2002b; Van den Ende, Frederiksen & Precipe, 2014). Whilst this may be true, referring to this stage as “fuzzy” arguably discourages accountability and management responsibility for decision making during this crucial part of the innovation process (Koen et al., 2001). Therefore, the present research uses the term Front End of Innovation (FEI) and avoids the term “fuzzy”.

There is no unequivocal definition of FEI (Koen & Bertels, 2010). Definitions of FEI focus on the activities that lead to a decision to initiate formal development (Reid & de Brentani, 2004) or the activity that occurs before development is authorised and significant resources are allocated (Smith & Reinertsen, 1992). It is a process that can start with idea generation (Murphy & Kumar, 1997) and end with a concept ready for further development (Elmqquist & Segrestin, 2007). Kim and Wilemon (2002a, p.270) proposed that FEI be defined as “the period between
when an opportunity is first considered and when an idea is judged ready for development”. A consensual definition also appears to be absent in management practice; Koen et al. (2001) studied eight organisations and found each had a different understanding of FEI.

Equally, definitions of Front End Innovation are not clear regarding the level at which they focus. They do not explicitly refer to Front End Innovation as an individual, team or organisational level activity. However, the tasks comprising FEI are arguably likely to be conducted by a team, or at a minimum by a series of individuals, and therefore FEI is unlikely to be an individual-level construct.

FEI is important for a number of reasons. First, it has been argued that improved performance during FEI is where organisations stand to make the greatest gains in terms of market success (Brem & Voigt, 2009; Zhang & Doll, 2001), largely due to its position at the beginning of the innovation process (Bertels, Kleinschmidt & Koen, 2011). Second, effective FEI has been related to improved performance of new product innovations (Cao et al., 2011) and has both a direct effect on eventual project success and an indirect effect on project success through its impact on the later stages of the innovation process (Gassmann & Schweitzer, 2014; Verworn, 2009). This is often most pertinent in the ‘go/no go’ decision for progression to the development stage (Cooper et al., 2004). Third, FEI is important as it offers the largest opportunity to shorten the new product development process (Eling, Langerak & Griffin, 2013), allowing savings on time and cost and accelerating time-to-market. Again, this is largely due to its position at the beginning of the innovation process (Bertels et al., 2011).

The preceding section introduced the concept of FEI, focusing on definitional issues and the importance of FEI research. The following section reviews theories of FEI and their consideration of the role of climate in FEI.

3.3 Theories of Front End Innovation

FEI has been the subject of considerable research interest (de Bretani & Reid, 2012; Khurana & Rosenthal, 1997; Kim & Wilemon, 2002a; 2002b; Reid and de Bretani, 2004; Verworn, 2009), some of which has sought to provide the theoretical underpinning of FEI. Before reviewing empirical research it is pertinent to consider theoretical representations of FEI, and whether these consider the context in which FEI occurs.
Using the “stage gate” model proposed by Cooper (1988), the stages relating to FEI equate to the Predevelopment Steps in the New Product Process: Idea, Preliminary Assessment and Concept, which then leads into the Development stage. This model is outlined in Figure 2.

However, Cooper’s (1988) conceptualisation of FEI does not account for the context in which FEI occurs. The most context-relevant consideration is acknowledging the existence of “market activities” during the first Idea stage.

Koen et al. (2001) produced the New Concept Development model (NCD) (c.f. Figure 3). They treat NCD as synonymous with FEI, arguing that “the New Concept Development (NCD) model provides a common language and definition of the key dimensions of the Front End of Innovation” (p.47). The dimensions of the NCD model are presented in Table 5.
Figure 3. New Concept Development Framework Proposed by Koen et al. (2001)

Table 5. Front End Innovation Dimension Descriptions
Adapted from Koen et al. (2001)

<table>
<thead>
<tr>
<th>FEI dimension</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunity Identification</td>
<td>Identifying potential business and technology opportunities using methods which are formal (e.g. problem solving techniques) or informal (e.g. informal discussions)</td>
</tr>
<tr>
<td>Opportunity Analysis</td>
<td>Gathering additional information through desk research to evaluate an identified opportunity. May also include market research or focus group research</td>
</tr>
<tr>
<td>Idea Genesis</td>
<td>Maturation of an opportunity into an idea. May also lead to identification of additional opportunities</td>
</tr>
<tr>
<td>Idea Selection</td>
<td>Identifying which ideas would provide the highest return on investment (time and money)</td>
</tr>
<tr>
<td>Concept and Technology Development</td>
<td>Exploring the conceptual and technical feasibility of an idea, and developing the business case for further, more formalised, development</td>
</tr>
</tbody>
</table>
Like Cooper (1988), Koen et al.’s (2001) conceptualisation of FEI does not explicitly consider the context in which FEI occurs; Koen and colleagues (e.g. Bertels et al., 2011; Koen et al., 2001; Koen, Bertels & Kleinschmidt, 2014) have variously argued that a ‘supportive climate’ is important for FEI, and Koen et al.’s (2001) conceptualisation of FEI posits that climate influences all FEI activities. However, this claim is not explicitly made, with neither ‘climate’ or ‘culture’ featuring in the pictorial representation of Koen et al.’s (2001) framework.

In Brem and Voigt’s (2009) review of FEI models they conclude by proposing their amalgamative model, in which they suggest one key additional feature: ‘creativity and innovation culture’. This model is unusual in its acknowledgment of the context in which FEI occurs and the influencing role of an appropriate culture. Their model extends the idea funnel, which proposes that ideas may originate from within or outside of the project team, or outside the organisation (Gassmann, Enkel & Chesborough, 2010), and are gradually screened and filtered (Brem & Voigt, 2009). Figure 4 shows Brem and Voigt’s (2009) amalgamative model of FEI.

![Figure 4. Brem and Voigt's (2009) Model of Front End Innovation and the Influence of Creativity and Innovation Culture](image)

Figure 4. Brem and Voigt’s (2009) Model of Front End Innovation and the Influence of Creativity and Innovation Culture
Reproduced from Brem and Voigt (2009, p.365)

Brem and Voigt (2009) go some way to considering the effect of the context in which FEI occurs, and may be praised for considering both creative culture and innovative culture as opposed to solely focusing on innovative culture, due to the location of their work within the innovation management literature. However, no rationale is provided for why creative and
innovative culture is hypothesised to influence “idea collecting” and “idea creating” only, as the context in which FEI occurs is arguably relevant to every aspect of FEI (Koen et al., 2001).

None of the extant theories and models of FEI agree on the specific dimensions comprising FEI. Koen et al. (2001) offer the largest, and thus potentially the most comprehensive, model of FEI. However, none of the FEI models have been rigorously tested as regards their accuracy, and therefore it is difficult to speculate whether in this instance size equates comprehensiveness. This lack of validation may explain why these models appear to have had minimal influence upon the measurement of FEI, with only one of the measures discussed in section 7.2 based on an FEI model (Koen et al., 2001, Figure 3). A second explanation is that they do not reflect recent empirical work, such as Gaubinger and Rabl’s (2014) assertion that processes for FEI should be both formal and flexible. Aside from Koen et al. (2001), other FEI models presented herein do not seem to have directly informed a measure of FEI, although they may have provided inspiration.

Overall, this section reviewed the few existing theories of FEI and their consideration of the context in which FEI occurs. It was demonstrated that most conceptualisations of FEI do not explicitly consider the context in which FEI occurs, although the most recent conceptualisation of FEI does acknowledge the role of the context. This indicates a development within the discipline towards consideration of context. In accordance with this theme, the following section reviews empirical literature exploring the relationship between the context of Creative and Innovative Climate and Front End Innovation.

3.4 Climate-innovation literature

Koen et al. (2001) claim they were not able to identify any study that systematically explored the relationship between organisational climate and FEI, leading to the conclusion that there is a dearth of empirical research exploring the role of Creative and Innovative Climate in FEI. Therefore, before examining the minimal extant climate-FEI literature, it may be beneficial to briefly explore the larger body of climate-innovation literature.

There is little debate surrounding the importance of climate for innovation. Multiple authors have argued that climate is important for innovation (e.g. Cooper et al., 2004; Ederer & Manso, 2013; Damanpour, 1991; Hunter et al., 2007; Kanter, 1982; Rasulzada & Dackert, 2009; West, 1990), with some going as far as to say that climate is the strongest driver of product innovation success (Cooper, 2011). Theoretical work argues that there are multiple aspects of
climate which should be considered in relation to innovation, including the availability of resources, transformational leadership and institutional and interpersonal trust (Luoma-Aho et al., 2012). Others have discussed a climate that encourages formalisation, arguing that evaluating ideas during FEI should take either a formal but flexible approach (e.g. Gaubinger & Rabl, 2014; Koen et al., 2002; Montoya-Weiss & O’Driscoll, 2000), or should be completely flexible (Martinsuo & Poskela, 2011).

Empirical research supports the presence of a relationship between climate and innovation. Three meta-analyses have investigated the climate-innovation relationship as part of wider analyses, and have found that climate (investigated as a unidimensional construct) was positively and significantly related to innovation, with two of the three meta-analyses identifying a $r=.25$ ($p<.05$) relationship (Buschgens, Bausch and Balkin, 2013; Evanschitzky et al., 2012). However, in the only team-focussed meta-analysis of innovation antecedents, the results of 104 studies were examined and only low correlations between a series of climate variables (resources, practical support for implementing ideas, goal awareness and external communication) and innovation were identified, with all correlations ranging between $r=.04$ and $r=.05$ (all $p<.05$) (Hulsheger, Anderson & Salgado, 2009). Moreover, no generalisable positive relationship between Team Creativity and team cohesion could be identified, leading Hulsheger et al. (2009) to speculate that highly cohesive teams may avoid disagreements or conflict during creative tasks for fear of disrupting the cohesive environment.

Whilst meta-analyses benefit from larger sample sizes than most non meta-analytic studies, these meta-analyses may be negatively affected by the measurement and definitional issues pervasive in this research field. It is possible that the constituent studies utilised differing definitions and measurement approaches, leading the reader to question how comparable the studies are if they define and measure innovation differently. Further, the studies included in the Hulsheger et al. (2009) meta-analysis did not specify which part of the innovation process they focused on. This is despite an expectation that each stage of the innovation process, particularly FEI, may have different characteristics and thus respond differently to variables such as organisational climate (Markham, 2013).

A newer approach to examining the climate-innovation relationship is offered by statistical and computational advances in multilevel modeling. Multilevel research has identified further support for a relationship between innovation and various dimensions of climate, such as decentralised processes for innovation ($r=.35$, $p<.05$ in a sample of 902 individuals from the
United Arab Emirates; Mohamed, 2002), and the extent to which an organisation values and thus rewards innovation ($r=.48$, $p<.05$; Un, 2010). A multilevel approach has also been taken to explore the a broad construct labelled “support for innovation climate” (p.1023) and team innovation, also identifying a weak-moderate relationship in a sample of 428 individuals from 33 Chinese organisations ($r=.29$, $p<.05$) (Chen, Farh, Campbell-Bush, Wu & Wu, 2013). However, in the case of Un (2010), although they explored 202 innovation projects in 42 large American technology firms, they adopted an unusual design by using a sample of only 42, single item measurement and no clear rationale for how variables were entered into the regression. Thus, although a multilevel design can provide more accurate estimations of cross level relationships, of which the climate-innovation relationship may be one, these studies are not immune to criticism.

Finally, a single empirical study has directly compared whether some climate variables have a stronger relationship with either creativity or innovation (Wang et al., 2014) (details of which were discussed earlier in this Literature Review). It was found that resources were more strongly related to creativity ($r=.53$, $p<.05$) than innovation ($r=.46$, $p<.05$). Management practices were more strongly related to innovation ($r=.57$, $p<.05$) than creativity ($r=.49$, $p<.05$), and organisational motivation was also more strongly related to innovation ($r=.27$, $p<.05$) than creativity ($r=.23$, $p<.05$). Note that one additional study that posited to explore climate, creativity and innovation was reviewed earlier in this Literature Review (Auernhammer & Hall, 2013), but is not included here because the measure of creativity/innovation did not have a distinct focus and therefore this study did not compare the climates necessary for creativity and/or innovation.

### 3.5 Interim summary

Overall, it seems that climate is posited as important for innovation, and there is empirical evidence confirming the existence of a relationship between these two variables. Extrapolating this finding, it is possible to argue that a relationship between climate and FEI may also exist. However, the extant climate-innovation research focuses on innovation as a whole and therefore has limited applicability to FEI, due to FEI being a substantively different and discrete part of the innovation process that contributes uniquely to new product development performance, for example (Markham, 2013). Earlier in this section it was stated that recent theoretical models of FEI refer to the context in which FEI occurs. The following section reviews the few extant empirical studies exploring a climate-FEI relationship.
3.6 Climate-FEI literature

One of the studies that investigated the relationship between climate and FEI focused on whether a supportive climate had a stronger relationship with FEI than communities of practice (Bertels et al., 2011). Communities of practice are informal groupings of individuals who come together to share information and experience (Koen et al., 2014), on which there is a vast literature (e.g. Pattinson & Preece, 2014; Swan, Scarbrough & Robertson, 2002; Wenger, McDermott & Snyder, 2002). The context of FEI studied by Bertels et al. (2011) was very specific; FEI under condition of dispersed (virtual) collaboration. Bertels et al. (2011) measured 116 teams from organisations across a wide range of industries such as telecommunications and chemicals. They found a moderate relationship between supportiveness of climate and FEI (measured by six self-report ‘Front End Innovation performance’ items developed for this study) \( (r = .42, p < .001) \) and a slightly weaker relationship between communities of practice and FEI \( (r = .40, p < .001). \) They also tested indirect effects, however found no support for these. This suggests both a supportive climate and communities of practice are important for FEI, with the former slightly more important than the latter.

However, there are three issues regarding the measurement of supportive climate. First, Bertels et al. (2011) measured climate using the Situational Outlook Questionnaire (SOQ), despite Mathisen and Einarsen (2004) recommending only the KEYS or TCI in their review of existing climate measures. Moreover, the researchers shortened the SOQ from 53 to 11 items, although provided no rationale as to how this was done, or only 7 items were used for the analyses. Second, the 7 items used to measure climate formed a single ‘supportiveness of climate’ factor. However, upon examination of the items they appear to measure various aspects of climate, including trust within the team, whether the organisation seems to value new ideas and taking risks. Modelling these as one factor limits the comprehensiveness of this study. Third, the items themselves are problematic as they do not adhere to good practice of asking one question per item, for example. For example, “most people in our business unit have fun doing work. There is a great deal of good-natured joking and laughter” (p.772) arguably should form two items.

A second study investigated the relationship between climate and creativity within the context of FEI (Im, Montoya & Workman, 2013). They matched responses from senior managers and team leaders of 206 American product innovation in high technology manufacturing organisations. They developed a structural equation model to examine the relationships between
five aspects of climate (social cohesion, superordinate identity, reward systems, planning process formalisation and risk taking), each measured by an adaptation of up to five items from previous studies (Andrews & Smith, 1996; Joworski & Kohli, 1993; Sethi, Smith & Park, 2001), and two types of creativity: creativity of the new product itself and creativity of the marketing elements surrounding the new product, as measured by an eight item scale developed for this study completed by managers and 29 customers.

Each type of creativity comprised two aspects, novelty and meaningfulness (i.e. new and useful). Marketing creativity was significantly weakly or moderately positively related to all climate variables, with the weakest relationship between marketing novelty and social cohesion \((r=0.21, p<0.01)\) and the strongest relationship between marketing meaningfulness and formalisation \((r=0.39, p<0.01)\). New product creativity was significantly weakly to moderately related to all climate variables except for formalisation, with the weakest significant relationships between new product novelty and social cohesion and new product novelty and risk taking (both \(r=0.15, p<0.05\), and the strongest relationship between new product meaningfulness and superordinate identity (i.e. goal awareness) \((r=0.39, p<0.01)\). Formalisation was negatively related to new product novelty \((r=-0.16, p<0.05)\), but not new product meaningfulness. Overall, Im et al. (2013) argue that all the climate factors they measured had a positive effect on creativity as part of FEI, with the exception of formalisation, which was positively related to marketing creativity but negatively related to new product novelty.

However, this study is limited in its unusual conceptualisation of FEI as creativity, and measured using items which focus solely on Originality and meeting customer needs, neither of which constitute creativity or FEI. Moreover, there is no justification provided for the selection of climate measures used, particularly given the criticism noted previously of most climate measures (c.f. Mathisen & Einarsen, 2004). Therefore, whilst this study is unique in its consideration of a variety of climate variables in relation to FEI, it is characterised by inadequate conceptualisation and measurement of these variables and is limited to a new product development context, as many of the items referred specifically to this context.

### 3.7 Hypothesis 5

Existing research on climate and FEI has a number of limitations which will be addressed by Hypothesis 5. At the beginning of this section, we considered Koen et al.’s (2001) statement that they could not identify any study that systematically explored the relationship between
organisational climate and FEI. Whilst there has been some progress in this regard since 2001, further research is needed. In particular, research that systematically investigates the relationship between a comprehensive set of climate factors and FEI (Anderson et al., 2014). Hypothesis 5, presented below, addresses this requirement in relation to FEI and the associated gap in the literature. Specifically, previous investigation of, and finding no evidence for, indirect relationships between climate and FEI (e.g. Bertels et al., 2011) led to Hypothesis 5 postulating a direct relationship.

Second, Hypothesis 5 reflects the consensus that FEI should be explored as a distinct part of the innovation process and requires specific research as opposed to making generalisations from innovation research (Markham, 2013). Moreover, existing innovation research has tended to focus on later aspects of the innovation process and has somewhat ignored FEI, particularly in relation to climate.

Third, the current research addresses calls for empirical research investigating the climate-FEI relationship from a multilevel perspective (Buschgens et al., 2013; Markham, 2013). One of the few such studies by Im et al. (2013) claimed to focus on FEI, however the focus is more accurately described as creativity within the context of FEI. Whilst creativity is part of the FEI process, it is not the sole activity required during FEI. Therefore, multilevel research is required that considers all aspects of FEI. The current research, through Hypothesis 5, addresses this gap in the literature.

Given the inconsistency in the approaches taken to assessing the relationship between climate and FEI, and therefore the inconsistent results obtained, it is difficult to identify specific aspects of Creative and Innovative Climate that will positively relate to FEI in the current research. However the extant literature, primarily focused on a broader construct of organisational climate, has primarily identified weak and moderate relationships. The majority of the extant literature identified moderate relationships, and therefore it is argued that the current research will replicate this finding. This suggests that Creative and Innovative Climate may have a moderate relationship with Team Creativity.

Hypothesis 5: Creative and Innovative Climate will have a significant and moderate relationship with Team Front End Innovation
3.8 Summary

This chapter reviewed the Front End Innovation literature relevant to the current research. Definitions and measurement issues surrounding Front End Innovation were discussed, followed by theoretical conceptualisations of Front End Innovation and empirical Front End Innovation-climate research. Hypothesis 5 was introduced.

The following chapter reviews the Creative and Innovative Climate literature relevant to the current research.
4 CREATIVE AND INNOVATIVE CLIMATE LITERATURE REVIEW

4.1 Chapter overview

This chapter introduces the concept of Creative and Innovative Climate and seeks to understand how it may be defined and the dimensions that comprise it. Clarifying what constitutes Creative and Innovative Climate is critical as it underpins Research Aims 2, 3 and 4, and Hypotheses 2 to 5 proposed in the current research, and thus also has implications for interpreting the findings. Moreover, a key criticism of the existing literature is that there is often a lack of clarity regarding and inconsistency regarding the conceptualisation Creative and Innovative Climate (for a comprehensive evaluation of extant measures of Creative and Innovative Climate see page 90 onwards).

4.2 Organisational culture and climate

Organisational culture can be defined as the values, norms, attitudes and behaviour patterns that a group of people have in common (Herzog, 2011). Organisational culture is also often referred to as “how we do things round here” (Schein, 2010, p.15), and it involves all members of an organisation, originating and developing throughout all hierarchical levels of an organisation. Organisational culture is realised through the material aspects such as an organisation’s buildings, products and logos (Hatch & Schultz, 1997).

Organisational culture is believed to be extremely influential upon how an organisation approaches innovation and their success in doing so (Ahmed, 1998). Organisational culture, in addition to strategic alignment, has also been identified as the most crucial factor for innovation (Jaruzelski et al., 2011). Buckler (1997) argues that innovation “is an environment, a culture”, and having a culture that is conducive to innovation is widely considered as essential (Kanter, 1985).

Distinct from organisational culture is the concept of organisational climate (Kuenzi & Schminke, 2009; McLean, 2005; Schneider & Barbera, 2014). Organisational climate is the observable and measurable manifestation of culture (Hennessey, 2003; McLean, 2005). This implies that organisational culture is not easily measurable, and may not be measurable at all. Therefore, organisational culture is said to exist at a more abstract level and due to measurement difficulty cannot be related to tangible results in the same way that organisational climate can (Baer & Frese, 2003; Reichers & Schneider, 1990). Given this distinction it is surprising that
some research, particularly from Denison and colleagues, continues to discuss organisational culture as a measurable construct (e.g. Denison, Nieminen & Kotrba, 2014), although this may be due to terminological differences between research streams, with psychology preferring ‘climate’ and anthropology and sociology preferring ‘culture’ (Denison, 1996).

Organisational climate is arguably one of the most important aspect of an organisation’s context. Given the importance of climate and the fact that the current research seeks to empirically measure climate and is primarily situated within psychology, it seems appropriate to further explore organisational climate as opposed to organisational culture.

A more detailed definition of organisational climate states that it is “an attribute or set of attributes of the work environment” (Guion, 1973, p.120), which are reflected in individuals’ perceptions and beliefs about their working environment, particularly regarding outcomes, contingencies, requirements and social interactions (Hunter et al., 2007; James, James & Ashe, 1990; Schneider & Reichers, 1983). Organisational climate is considered important due to its direct relationship with organisational performance (Marcoulides & Heck, 1993; Schulte, Ostroff, Shmulyian & Kinicki, 2009; Denison et al., 2014) and workplace creativity (Amabile et al., 1996; Fleith, 2000; Rasulzada & Dackert, 2009; Schepers & Berg, 2007; Woodman et al., 1993), particularly when the climate is consistent (Rahn, 2014). That is, when an organisation has “a shared set of core values, and a high level of agreement and normative integration” (Kotrba et al., 2012, p.242). Analysing Interclass Correlations (ICCs) from 137 organisations, Kotrba et al. (2012) found that consistency of climate was positively related to sales growth. There has been a dearth of research exploring the role of consistency in climate, despite definitions of culture and climate referring to consistency. For example, by referring to shared perceptions and beliefs (Day, Griffin & Louw, 2014).

There has been some attempt to differentiate levels of climate, arguing that climate can be at the individual level (‘psychological climate’), the team level (‘team climate’) or the organisational level (‘organisational climate’) (Wang & Ma, 2013). Others have argued that there are two forms of climate at the individual level: ‘organisational referent’ (whereby the individual’s perceptions of the organisation are measured) or ‘individual referent’ (whereby the individual’s perceptions of their experiences within an organisation are measured) (Baltes, Zhdanova & Parker, 2009). However, the current research is consistent with the majority of climate literature in not distinguishing within and between levels of climate. This is because the theoretical claims of Wang and Ma (2013) and Baltes et al. (2009) arguably require further
development before being adopted by researchers. This is partially due to the unclear differentiation between the forms of psychological climate (which would be one of the levels of climate applicable to the current research); it is arguably not possible to distinguish whether an individual is providing their perception of their experience (individual referent psychological climate), or their perception of the organisation (organisational referent psychological climate), as their perception of the organisation will comprise a number of perceptions of different experiences within the organisation. Further evidence of the need for distinction between different levels of climate comes from Wang and Ma’s (2013) use an organisational climate scale to measure psychological climate.

4.3 Generic and domain specific organisational climate

Given that organisational climate is a focus of the current research, the next consideration is which context is of interest. Organisational climate is specific to a context as it is a “domain referenced phenomenon” (Hunter et al., 2007, p.70). Examples of domain-specific climate research include empowerment climate (e.g. Chen, Lam & Zhong, 2007; Maynard, Mathieu, Marsh & Ruddy, 2007), ethical climate (e.g. Ambrose, Arnaud & Schminke, 2008; Neubaum, Mitchell & Schminke, 2004), diversity climate (e.g. Kossek & Zonia, 1993; McKay, Avery & Morris, 2008), justice climate (e.g. Colquitt, Noe & Jackson, 2002; Mayer, Nishii, Schneider & Goldstein, 2007), leadership climate (e.g. Chen, Kirkman, Kanfer, Allen & Rosen, 2007; Liu & DeFrank, 2013), political climate (e.g. Darr & Johns, 2004; Landells & Albrecht, 2013) and safety climate (e.g. Hofmann & Mark, 2006; Neal & Griffin, 2006).

The current research focuses on creativity and innovation, and therefore Creative and Innovative Climate. Here it is argued that it is not currently possible to be more specific as regards the type of climate. This is for two reasons.

4.4 Differentiation of creative climate and innovative climate

First, there is no consensus as to which factors comprise creative climate and which comprise innovative climate. In 2004, Rank and colleagues argued that differentiation between factors that influence creativity and those that influence innovation is one of the three most pertinent issues in the fields of creativity and innovation. Today, the situation does not seem to have changed; examination of the dimensions comprising both constructs reveals little difference
between their content. Indeed, their overlap is such that Hsu and Fan (2010) argue that creative climate and innovative climate are synonymous terms.

Adding to the confusion are those who use the term ‘organisational innovativeness’ to describe a construct synonymous with innovative climate (despite then arguing organisational innovativeness is in fact synonymous with organisational climate) (e.g. Ruvio, Shoham, Vigoda-Gadot & Schwabsky, 2014). This exemplifies the importance of the current research clearly identifying which terms are used and why.

Second, there seems to have been no empirical investigation into the extent to which the factors comprising creative climate are different to those constituting innovative climate. Therefore, there is insufficient empirical evidence to justify distinguishing them. Moreover, there is insufficient theoretical support for differentiating creative climate and innovative climate, as evidenced by previous research using many of the same dimensions regardless of whether the research purports to focus on creative climate or innovative climate. This may reflect an issue within the wider literatures, which has also not been able to identify a clear boundary between creativity and innovation (Anderson et al., 2014). For these reasons, the current research considers a single, multidimensional construct labelled ‘Creative and Innovative Climate’.

4.4.1 Differentiation of creative climate and innovative climate factors

This section provides a detailed exposition of which factors comprise creative climate and which comprise innovative climate, providing justification for the argument that there is insufficient evidence to distinguish these two constructs.

Hunter et al. (2005) sought to amalgamate existing literature on the dimensions of creative climate, analysing forty-four extant climate taxonomies to develop a fourteen dimension creative climate taxonomy. These taxonomies are presented in Table 6 and Hunter et al.’s (2005) fourteen dimension taxonomy is presented in Table 7. Initially, they analysed the literature to identify relevant taxonomies, which identified the forty-four taxonomies. Two psychologists then coded each dimension from the forty-four original taxonomies into one or more of the proposed fourteen factor taxonomy. Consensus was achieved on 95% of the codings, and the other 5% were discussed until an agreement was reached.
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<th>Author/s</th>
<th>Taxonomy dimensions</th>
<th>From the creativity or innovation literature?</th>
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<td>McCarrey &amp; Edwards</td>
<td>1. Ease of written communication and frequent management contact</td>
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<td>(1973)</td>
<td>2. Autonomous team atmosphere</td>
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<td>3. Lack of customer contact</td>
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<td>4. Global supervisory planning and scientist achievement orientation</td>
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<td>Siegal &amp; Kaemmerer</td>
<td>1. Leadership</td>
<td>Creativity</td>
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<td>(1978)</td>
<td>2. Ownership</td>
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<td>3. Diversity norms</td>
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<td>5. Consistency</td>
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<td>Mossholder (1980)</td>
<td>1. Warmth and consideration</td>
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<td>2. Task structure</td>
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<td>3. Pressure</td>
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<td>Abbey &amp; Dickson</td>
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<td>(1983)</td>
<td>2. Cooperation</td>
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<td>10. Decision centralisation</td>
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<td>Ettlie (1983)</td>
<td>1. Technology policy</td>
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<td>Wallach (1983)</td>
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<td>Porter (1985)</td>
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<td>8. Feedback and reward</td>
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| Van Gundy (1985) | 1. Autonomy  
2. Rewards linked to performance  
3. Propensity for risk  
4. Support for creativity  
5. Tolerance of individual differences  
6. Personal commitment of organisation’s members  
7. Top management support and involvement  
8. Responsibility to initiate new ideas  
9. Job security  
10. Moderate level of job ambiguity | Both |
| Amabile (1997)    | 1. Organizational encouragement  
2. Supervisory encouragement  
3. Work group encouragement  
4. Autonomy  
5. Resources  
6. Pressures  
7. Organisational impediments to creativity | Creativity |
| Ekvall (1996)     | 1. Challenge  
2. Freedom  
3. Trust  
4. Idea support  
5. Playfulness  
6. Conflict  
7. Idea time  
8. Debate  
9. Risk taking  
10. Dynamism | Creativity |
| Hisrich (1990)    | 1. Frontier of technology  
2. Encourage ideas  
3. Encourage experimentation  
4. Opportunity parameters  
5. Resources  
6. Multidisciplinary teams  
7. Reward  
8. Champions  
9. Top management support | Creativity |
| Isaksen & Kaufman (1990) | 1. Challenge  
2. Freedom  
3. Idea support  
4. Playfulness  
5. Debate  
6. Trust  
7. Risk taking  
8. Idea time  
9. Conflict | Creativity |
| Nystrom (1990)    | 1. Support for new ideas  
2. Encourage freedom  
3. Challenge  
4. Risk  
5. Assumption  
6. Debate | Both |
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<td>Scott &amp; Bruce (1994)</td>
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<td>Tannenbaum &amp; Dupree-Bruno (1994)</td>
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<td>2. External favourability</td>
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<td>Kitchell (1995)</td>
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<td>4. Stimulating co-workers</td>
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<td>1. End user performance</td>
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<td>Alencar &amp; Bruno-Faria (1997)</td>
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<tr>
<td>Arad, Hanson &amp; Schneider (1997)</td>
<td>1. People orientation</td>
<td>Creativity</td>
</tr>
<tr>
<td></td>
<td>2. Innovation</td>
<td></td>
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<tr>
<td></td>
<td>3. Attention to detail</td>
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<tr>
<td></td>
<td>4. Stability</td>
<td></td>
</tr>
<tr>
<td>Tesluk, Farr &amp; Klein (1997)</td>
<td>1. Goal emphasis</td>
<td>Creativity</td>
</tr>
<tr>
<td></td>
<td>2. Means emphasis</td>
<td></td>
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<tr>
<td></td>
<td>3. Reward orientation</td>
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<td></td>
<td>4. Task support</td>
<td></td>
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<td></td>
<td>5. Socioemotional support</td>
<td></td>
</tr>
<tr>
<td>Author/s</td>
<td>Taxonomy dimensions</td>
<td>From the creativity or innovation literature?</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------</td>
<td>-----------------------------------------------</td>
</tr>
</tbody>
</table>
| Hurley & Hutt (1998)     | 1. Innovativeness  
2. Participative decision making  
3. Power sharing  
4. Support and collaboration  
5. Learning and development | Innovation                                     |
| Robben (1998)            | 1. Resource supply  
2. Support for innovation | Innovation                                     |
| Hashem (1999)            | 1. Competition with others  
2. Concern for others  
3. Peer support  
4. Managerial support  
5. Involvement  
6. Inter-departmental coordination  
7. Autonomy  
8. Innovation supporting climate | Innovation                                     |
| Ramus & Steger (2000)    | 1. Innovation  
2. Competence building  
3. Communication  
4. Information dissemination  
5. Reward  
6. Management of goals | Creativity                                     |
| Damanpour (2001)         | 1. Specialisation  
2. Functional differentiation  
3. Professionalism  
4. Formalisation  
5. Centralisation  
6. Management attitude towards change  
7. Managerial tenure  
8. Technical knowledge resources  
9. Administrative intensity  
10. Slack resources  
11. External communication  
12. Internal communication  
13. Vertical differentiation | Creativity                                     |
| Phelan (2001)            | 1. Creative super leadership  
2. Constructive feedback  
3. Creative self leadership training | Creativity                                     |
2. Attitude formation  
3. Innovation decision process  
4. Implementation | Both                                           |
| Sethi & Nicholson (2001) | 1. Senior management encouragement to take risk  
2. Quality orientation  
3. Extent of competition  
4. Team behaviour | Innovation                                     |
<table>
<thead>
<tr>
<th>Author/s</th>
<th>Taxonomy dimensions</th>
<th>From the creativity or innovation literature?</th>
</tr>
</thead>
</table>
| Suliman (2001)           | 1. Employee-supervisor relationships  
2. Distributive justice  
3. Psychological contract  
4. Innovation climate  
5. Coworker relationships  
6. Supervisory style  
7. Performance-reward relationship  
8. Decision making policy  
9. Employee competence  
10. Task characteristics  
11. Pressure to produce | Innovation                                                                      |
| Szymanski & Varadarajan (2001) | 1. Open communication  
2. Support for search for new ways to carry out a task | Innovation                                      |
| Troy, Szymanski & Varadarajan (2001) | 1. Open mindedness  
2. Openness to communication  
3. Formalisation | Innovation                                      |
| Zhou & George (2001)     | 1. Useful feedback from coworkers  
2. Coworker helping and support  
3. Perceived organisational support for creativity | Creativity                                      |
2. External orientation  
3. Achievement orientation | Innovation                                      |
| Baer & Frese (2003)      | 1. Climate for initiative  
2. Psychological safety | Innovation                                      |
2. Teamwork  
3. Speed of action  
4. Tolerance for mistakes | Innovation                                      |
| Lapierre & Giroux (2003) | 1. Work atmosphere  
2. Vertical collaboration  
3. Autonomy  
4. Respect  
5. Alignment  
6. Lateral collaboration | Creativity                                      |
| Thamhain (2003)          | 1. Interesting and stimulating work  
2. Accomplishment and recognition  
3. Low conflict and prompt resolution  
4. Clear organisational objectives  
5. Direction and leadership  
6. Trust, respect, credibility  
7. Cross functional cooperation  
8. Effective communications  
9. Clear project plan and support system  
10. Autonomy  
11. Career development and advancement  
12. Stable long term goals and priorities | Innovation                                      |
<table>
<thead>
<tr>
<th>Author/s</th>
<th>Taxonomy dimensions</th>
<th>From the creativity or innovation literature?</th>
</tr>
</thead>
</table>
2. Good communication  
3. Excessive control  
4. Resources | Creativity |
| Miron, Erez & Naveh (2004) | 1. Innovation  
2. Attention to detail  
3. Outcome orientation | Innovation |

Table 7. Hunter et al.’s (2005) 14 Areas of Creative and Innovative Climate

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Areas comprising dimension</th>
</tr>
</thead>
</table>
| Exposure to novel problems or situations | Challenging work  
Intellectually stimulating work |
| Goal awareness | Mission clarity  
Product emphasis |
| Freedom | Autonomy  
Top management support  
Flexible and supportive of risk taking |
| Reason to be creative | Reward orientation |
| Resource availability | Resources |
| Idea exchange | Participation  
Positive peer group  
Positive interpersonal exchange  
Organisational integration  
Positive supervisor relations |

Although Hunter et al. (2005) purport to examine creative climate, seventeen of the forty-four extant taxonomies the authors examined were taxonomies of innovative climate, nineteen were taxonomies of creative climate and for eight of the taxonomies it was unclear whether they pertained to creative or innovative climate. As the proportion of creative and innovative taxonomies examined were roughly equal, it suggests that Hunter et al.’s (2005) general taxonomy is arguably one of Creative and Innovative Climate. Their decision to only use the term
‘creative climate’ exemplifies the terminological inconsistency and lack of clarity within this research stream, and there seems to be no empirical justification for this choice either.

Thirteen of the fourteen dimensions can be found in taxonomies of both creative climate and innovative climate. The dimension Organisational Integration was identified only in innovative climate taxonomies. Despite this substantial overlap between creative climate and innovative climate dimensions, they may appear less similar due to the inconsistent terminology used. For example, both Ekvall (1996) and Isaksen and Kaufman (1990) refer to Challenging Work, whilst Thamhain (2003) refers to Intellectually Stimulating Work. The same logic applies to Goal Awareness, comprising Mission Clarity and Product Emphasis. This suggests these could be compounded into one dimension.

However, some terminological differences represent genuinely different constructs. For example, Freedom and Idea Exchange are considered substantially different from one another to warrant separate dimensions. Hunter et al. (2005) argue that Freedom comprises Autonomy, Top Management Support and Risk Taking. However, Ekvall (1996) considers Autonomy and Risk Taking to be separate dimensions, as does Nystrom (1990).

Four features of the idea exchange dimension are related to the team (Hunter et al., 2005): (1) participation; (2) positive peer group; (3) positive interpersonal exchange; (4) positive supervisor relations. Moreover, these have the common theme of trust. Feelings of cohesion and collaboration have been found to enhance Team Creativity (Amabile & Gryskiewicz, 1989; Munoz-Doyague & Nieto, 2012), including in a product development environment (Brattstrom, Lofsten & Richtner, 2012). It therefore seems logical that these may comprise one dimension. This concept has received various labels, including Psychological Safety, Participative Safety, Intragroup Safety and Team Cohesion (Fairchild & Hunter, 2014).

4.5 Interim summary

Overall, Creative and Innovative Climate comprises many dimensions (Ahmed, 1998), and analysis of the dimensions in the existing literature indicates a substantial overlap between the dimensions constituting creative climate and innovative climate. This supports the earlier argument that the current body of knowledge does not allow for a division between creative climate and innovative climate, and therefore the current research considers Creative and Innovative Climate.
4.6 Summary

This chapter introduced Creative and Innovative Climate and sought to understand how it may be defined and the dimensions that comprise it. Seeking clarity regarding Creative and Innovative Climate is important as it underpins Research Aims 2, 3 and 4, and Hypotheses 2 to 5 proposed in the current research, and thus also has implications for interpreting the findings.

The following chapter presents the argument for taking an interdisciplinary, multilevel approach to the current research.
5 AN INTERDISCIPLINARY MULTILEVEL APPROACH

5.1 Chapter overview

This chapter introduces an interdisciplinary, multilevel approach, and presents the argument for its application to the current research. In the first section, the disparate nature and fit between the creativity and innovation literatures is discussed and the appropriateness of applying an interdisciplinary approach to the current research is presented. The second section presents the case for applying a multilevel approach to the current research.

The hypotheses and research aims addressed in the current research are then presented. These hypotheses and research aims explore the relationships between Individual Creativity, Individual Creative Performance, Creative and Innovative Climate, team Front End Innovation and Team Creativity. These relationships are represented in Figure 9.

5.2 An interdisciplinary approach

There is increasing emphasis on interdisciplinarity. University structures have typically promoted a monodisciplinary approach, however there are a number of advantages of interdisciplinarity, including as a means of extending the boundaries of academic knowledge, solving complex problems and creating new networks of experts on a particular topic (Antonacopoulou, 2011; Starkey & Madan, 2001). It is argued that in the same way as diversity and divergence are considered beneficial for ideation (Harvey, 2014), disciplinary diversity is important for creativity research (Klausen, 2014). In turn, the advantages of interdisciplinarity benefit practitioners too (Starkey & Madan, 2001).

Despite the advantages of interdisciplinarity, most research to date has been located within a single discipline (Knights & Willmott, 1997). This may be due to the perceived complexity of interdisciplinary research which limits the number of researchers who engage with it (Baer, 2012), a situation mirrored in multilevel research. However, multilevel and interdisciplinary approaches are complex in different ways; multilevel research is considered technically complex, whereas interdisciplinary research is theoretically and practically complex.
5.3 The case for interdisciplinary creativity and innovation research

The current research is interested in creativity and innovation in an organisational context. Creativity and innovation have historically been studied in different disciplines, with psychology research tending to focus on creativity and innovation management research tending to focus on innovation. However, the contextual overlap suggests interdisciplinary research could be beneficial, and interdisciplinarity is increasingly called for in organisational research (Agarwal & Hoetker, 2007; Hitt et al., 2007).

Creativity and innovation share an interest in organisational factors and organisational attributes (Yang and Tao, 2012), and as such it is pertinent to increase interaction between the two disciplines so each can learn from the other (Zhou & Shalley, 2008). This has been called for as early as 1990 (e.g. West, 1990) and continues to be called for (e.g. Anderson et al., 2014).

Focussing on the front end of the innovation process supports an interdisciplinary approach integrating insights from organisational psychology and innovation, something which is increasingly called for in innovation research (Kessel, Rosenfield & Anderson, 2003; McMeekin, Green, Tomlinson & Walsh, 2002; Rennings, 2000), and in FEI research (Van den Ende et al., 2014). Later stages of the innovation process can also benefit from an interdisciplinary approach, and research in vein has already begun (for example combining innovation and marketing, see Reid and de Bretani (2004)). Applying psychology to innovation in the front end is less common, and allows exploration of potentially important psychological components such as creativity and organisational climate (Adams et al., 2006).

Taking an interdisciplinary approach is consistent with the interdisciplinary definition of innovation used in this research. Moreover, exploring the definitional difficulties in both the creativity and innovation literatures highlights a similarity between these disciplines, as definitions of both have common features yet both suffer from a lack of definitional consensus. Definitions of innovation (e.g. Baregheh, Rowley & Sambrook, 2009) and creativity (e.g. Boden, 2004) commonly refer to novelty and usefulness, and the issue of who judges something to be creative or innovative is also common to both fields (e.g. Czikszentmihalyi, 1996; Johannessen, Olsen & Lumpkin, 2001). Moreover, Anderson et al. (2014) propose a single combinatory definition of creativity and innovation. These commonalities suggest creativity and innovation are compatible as regards interdisciplinary research.

The current research addresses calls for interdisciplinary research that combines both creativity and innovation, as these disciplines “remain doggedly disconnected from one
another” (Anderson et al., 2014, p.21). Six directions for future creativity and innovation research have been outlined by Anderson et al. (2014), and two of these are addressed in the current research. First, there has been an “unambiguous call” (p.21) for the two disparate fields of creativity and innovation to be combined through interdisciplinary research, as existing research of this kind has been theoretical (e.g. Luoma-Aho et al., 2012). Second, the investigation of specific facets of climate and their relationships with creativity and innovation, as opposed to treating climate as a unidimensional construct, or only investigation one or two climate dimensions per study (Anderson et al., 2014).

5.4 Interim summary

The preceding section presented the argument for the current research taking an interdisciplinary approach. The following section argues that in addition to interdisciplinarity, the current research should take a multilevel approach. This would enhance the contribution of the present research (in comparison to taking a single level approach) and addresses calls for researchers to utilise statistical advances to explore previously un-explorable research aims and hypotheses.

The following section presents some important issues in multilevel research and presents calls for multilevel research.

5.5 A multilevel approach

Early creativity and innovation studies focused on the individual (e.g. Guilford, 1950), with attention then turning to team and organisational factors (e.g. Anderson et al., 2004). These individual, team and organisational factors have often been studied in isolation. Recent advances in statistics and computational modelling mean that these factors can be considered more holistically. A multilevel approach may be adopted.

Moreover, interdisciplinarity has been lauded as a way to advance multilevel research (Mathieu & Chen, 2011). An interdisciplinary multilevel approach has also been proposed as a more comprehensive way of understanding real-world management challenges than current approaches provide (Hitt et al., 2007), and has been considered contributory to the advancement of knowledge (Elliot & Nakata, 2013; Yadav, 2010).
5.6 Definitions and benefits of multilevel research

The term ‘multilevel’ is used to denote a phenomenon with two or more levels (Costa et al., 2013). Multilevel research is conducted when investigating the relationships between variables characterising lower levels, such as individuals, and higher-level variables, such as groups or teams. In much organisational research, ‘level one’ or the ‘micro’ level usually refers to individual variables, ‘level two’ or the ‘meso’ level refers to team variables, and ‘level three’ or the ‘macro’ level refers to organisational variables (Hox, 2010). It is common for multilevel conceptualisations to refer to hierarchical ‘nesting’ or ‘clustering’ of levels. For example, individuals are nested within a team, which is in turn nested within an organisation (Mehta & Neale, 2005; Nielsen, 2010). A multilevel approach allows for a more integrated understanding of phenomena that unfold across levels in organisations.

Much has been written about the nature and types of multilevel research. While it is outside the scope of this chapter to provide a thorough exposition of these issues, it is appropriate to address the fundamental consideration as to whether a model is top-down or bottom-up in orientation.

Bottom-up multilevel models focus on the effects of a lower-level variable on a higher-level variable, such as the effects an individual has on their team. Top-down multilevel models focus on the effects of a higher-level variable on lower-level variables. For example, the effect organisational climate has on an individual employee. Whilst many models do not explicitly state whether they are bottom-up or top-down, the majority of multilevel models are top-down (Kozwolski & Klein, 2000).

Once a model has been determined as bottom-up or top-down in nature, there are then further considerations. Put briefly, bottom-up models attempt to describe how lower-level constructs emerge to form higher-level phenomena. The emergence can be in terms of a composition model or a compilation model. In composition models, the phenomena observed in the lower-level remains fundamentally the same when observed at the higher level. For example, organisational climate emerges compositionally, because an individual’s perception of climate at the micro level is in effect the same as the macro manifestation of climate at the organizational level, where many individual perceptions are aggregated. Compilation models examine phenomena that are similar but not identical when observed at different levels. Team Creativity is an example of a compilational model, because Team Creativity is not simply the aggregation of
Individual Creativity. The distinction between whether a model is compilational or compositional is not necessarily always clear; in some circumstances some constructs may be either.

There are three types of top-down multilevel models (Klein & Kozwolski, 2000). First, direct effects models. These predict the direct effect of higher-level variables on a lower-level variable. For example, the effect of organisational climate on Individual Creativity. Second, moderator models. These suggest that the relationship between two variables at the same level, such as Individual Creativity and individual creative self-efficacy, are moderated by a higher-level variable, such as organisational climate. Third, frog pond models. These show the complex interactions between lower and higher-level variables. For example, a frog pond model could show the effect of Individual Creativity on team creative performance, relative to the creativity of each member of the team.

There are benefits to be gained from the adoption of a multilevel approach to the current research. First, combing micro and macro levels in research allows for a more complete, integrated, holistic understanding of the interplay between complex variables that cannot be yielded from a single level research (Nielsen, 2010) and can make for more accurate estimates of variance (Brass, 2000).

Second, multilevel research increases the level of application-relevance, as it allows managers and practitioners to make conclusions based on the appropriate level of analysis (Kozwolski & Klein, 2000). For example, decisions about the most appropriate approach to take for an individual can be derived from individual level data, while decisions about teams can be taken from team level data. This avoids the danger of extrapolating to the level of the team on the basis of individual level data; the atomistic fallacy.

Given that creativity and innovation are complex phenomena that operate at the level of the individual, team and organisation, they would appear to be appropriate for multilevel research (Anderson et al., 2004). Despite the evidence that there is growing consensus as to how creativity and innovation should be defined, in practice multilevel research often fails to start with unequivocal definition. As a result, inconsistent definition leads to inconsistent measurement, which in turn leads to incomparable findings. Similarly, despite it being possible to identify a multilevel model as top-down or bottom up, compilational or compositional, or assessing direct effects, meditational effects or take a frog pond perspective, rarely do multilevel models in creativity and innovation research provide this level of clarity (the current research utilises two bottom-up models in Hypotheses 4 and 5).
5.7 Interim summary

The preceding section argued that in addition to interdisciplinarity, the current research should take a multilevel approach. Definitions, key considerations and calls for multilevel research were outlined. The following section discusses relevant theoretical multilevel models of creativity and innovation. Given the confusion surrounding what constitutes a multilevel model or approach (Hitt et al. (2007) note that following a request for multilevel empirical research for a special issue of the *Academy of Management Journal*, several submissions were in fact not multilevel) it was considered pertinent to discuss theoretical multilevel models of creativity and innovation.

5.8 Theoretical multilevel models of creativity and innovation

Early theoretical multilevel models of creativity were expanded from models that sought to explain Individual Creativity, often with some reference to situational variables (e.g. Ford, 1996; Mumford & Gustafson, 1988; Woodman & Schoenfeldt, 1989, 1990). The first multilevel model of creativity was developed by Woodman et al. (1993).
The authors contend that “an understanding of organizational creativity will necessarily involve understanding (a) the creative process, (b) the creative product, (c) the creative person, (d) the creative situation, and (e) the way in which each of these components interacts with the others” (p.294). This central tenet still holds true for multilevel models of creativity and innovation, and accords with attempts to provide a comprehensive and parsimonious coverage of creativity measurement (Batey, 2012).

Woodman et al. (1993) proposed that a combination of specific individual difference antecedents, such as cognitive ability, lead to Individual Creativity, which interact with group characteristics, such as group norms and then interact with organisational characteristics like culture (c.f. Figure 5). Together these individual, group and organisational characteristics interact
to produce creative behaviour and the creative situation, which in turn lead to a creative product. In effect, this model recognises the nesting of individual factors within group factors within organisational factors and that the interactions between the levels are not unidirectional.

The multilevel model of Woodman et al. (1993) accords with the definition of creativity outlined at the beginning of this chapter and each part of the interactionist model lists a specific characteristic which means the model could be measured and tested empirically. An empirical test has yet to be conducted.

Some theories of Individual Creativity make reference to multiple levels. Ford (1996), in his model of Individual Creative Action in Multiple Social Domains, briefly highlights the interplay between groups, organisations, institutional environments and markets. Similarly, the Propulsion Model of Creativity proposed by Sternberg, Kaufman and Pretz (2002) introduced a conceptualisation of how different types of creative products can influence domains. The model also briefly explored common individual difference traits related to creative performance. Lastly, Drazin, Glynn and Kazanjian (1999) produced a model of creativity which they termed ‘multilevel’ but is focused at the individual level and therefore is not multilevel. However, Drazin et al. (1999) do consider the role of time in the development of creative products, which is often overlooked.

Csikszentmihalyi (1999) hypothesised that creativity exists in the interaction between the individual, domain and field (c.f. Figure 6). An individual draws information from a domain and alters the information through the use of their cognitive processes, motivation and personality traits. The field, which consists of people who have influence over or act as “gatekeepers” of a domain (e.g. academic journal editors, scientists who conduct peer-reviews, specialist publications) evaluate and either promote or discourage new ideas. The domain in turn preserves creative contributions and selects which ideas are passed onto other members of the field and future generations. As yet, there have been no empirical investigations of the theory. Further, from a practitioners’ perspective, the model does not provide significant insight as how best to develop creativity within an individual, team or organisation.
In their review of the creativity literature from 1998 to 2008, Hennessey and Amabile (2010) concluded that a systems perspective was necessary to understand the creativity construct. Though simplistic, the diagrammatic representation of creativity shown in Figure 7 illustrates that the nested multiple levels of creativity can be seen to start with intra-individual creative processes relating to neurology and cognition, through to culture/society. All of these elements can be incorporated within a systems approach to creativity. This is broad and comprehensive, however the relationships between the levels, the order in which the levels are nested and discriminant validity between each level has not been subjected to empirical investigation.
Sears and Baba (2011) proposed a recent theoretical multilevel model (c.f. Figure 8). For this model, the authors adopt language pertaining to innovation rather than creativity, although there is little discernible difference between how the terms are employed.

In addition to modeling innovation at the individual, team and organisational levels, Sears and Baba (2011) introduce a fourth level: societal innovation. This importantly acknowledges the impact of higher-level innovation drivers. Akin to the Propulsion Model of Creativity (Sternberg
et al. 2002), this model outlines how the progression through the levels of individual through to societal innovation leads to creativity, invention, adoption and change. Sears and Baba’s (2011) model highlights the continued interest in a multilevel approach, and, crucially, exemplifies the lack of progression. In particular, multilevel models are still rarely put to the test empirically.

Batey (2012) presented a multilevel model for the measurement of creativity. The multilevel measurement framework drew upon and synthesised previous efforts to develop taxonomies of creativity measurement, and has resulted in a three-dimensional matrix. The three axes are concerned with levels, facets and measurement approach (c.f. Figure 1). The level of creativity is concerned with who is to be the focal point of analysis. This is broken down into four categories: the individual, the team, the organization, and the (national, regional or societal) culture. These correspond to the micro, meso and macro levels of analysis commonly referred to in multilevel research. The facet of creativity is concerned with what is to be analysed. This comprises four categories approximately corresponding to the four Ps approach (Rhodes, 1961/1987); trait characteristics, process, press, and product.

To summarise, the fundamental aspects of each theoretical multilevel model of creativity and innovation are presented in Table 8.
<table>
<thead>
<tr>
<th>Author</th>
<th>Model name</th>
<th>Main focus</th>
<th>Key definitions</th>
<th>Individual level constructs</th>
<th>Team level constructs</th>
<th>Organisational level constructs</th>
<th>Main criticisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woodman, Sawyer &amp; Griffin (1993)</td>
<td>Interactionist model of organizational creativity</td>
<td>Predicting creative outcomes</td>
<td>Creativity = “creation of a valuable, useful new product, service, idea, procedure or process by individuals working together in a complex social system” (p.293)</td>
<td>Cognitive style, knowledge, personality, intrinsic motivation</td>
<td>Group composition, group characteristics, group processes</td>
<td>No direct constructs - contextual influence included</td>
<td>No clear operationalisation of creative outcomes. No definition or differentiation of creativity and innovation. No consideration of effects of leadership or culture/climate</td>
</tr>
<tr>
<td>Csikszentmihalyi (1999)</td>
<td>Systems model of creativity</td>
<td>The interaction between individual, domain and field</td>
<td>Creativity = an idea, act or product that changes an existing domain, or transforms an existing domain into a new one</td>
<td>Genetic makeup, talents, experience</td>
<td>Not team but ‘domain’. Domain is ‘cultural system’.</td>
<td>Not organizational, but cultural systems is community of practice, gatekeepers knowledge, tools, values, practices</td>
<td>Not specific to organisational creativity and innovation, not useful for practitioners, no empirical investigation</td>
</tr>
<tr>
<td>Hennessey &amp; Amabile of creativity (2010)</td>
<td>Systemic model of Creativity</td>
<td>Creativity= “the generation of products or ideas that are both novel and appropriate” (p.570)</td>
<td>Neurological, emotion, cognition, training, personality</td>
<td>Groups</td>
<td>Environment, culture, society</td>
<td>Not specific to organisational creativity. No discrimination between team and group level</td>
<td></td>
</tr>
</tbody>
</table>

Table 8. Fundamental Aspects of Theoretical Multilevel Models of Creativity and Innovation
<table>
<thead>
<tr>
<th>Author</th>
<th>Model name</th>
<th>Main focus</th>
<th>Key definitions</th>
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<th>Team level constructs</th>
<th>Organisational level constructs</th>
<th>Main criticisms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sears &amp; Baba (2011)</td>
<td>Multilevel model of innovation</td>
<td>Innovation</td>
<td>No specific definitions. View innovation as process not an outcome</td>
<td>Intrinsic motivation, work experience, knowledge, cognitive aptitude, cognitive style, biographical history, personality</td>
<td>Team climate, leader-member exchange, group norms, team member exchange, team size, resources, participative management, team leader support, constructive conflict, types, corporate boundary roles</td>
<td>Organisational strategy, Only theoretical, no empirical implementation climate, support absorptive capacity, diversity, resistance to change, knowledge management, synchronous adoption of different innovation</td>
<td></td>
</tr>
</tbody>
</table>
The different theoretical multilevel models of creativity and innovation share fundamental features. Many consider individual, team and organisational level factors and there is convergence regarding some of the key individual (e.g. personality) and team level factors (e.g. group diversity). However, there is also considerable divergence across the models. Overall, these different models may provide a broad and helpful multilevel visualisation of creativity and innovation. However, they remain hypothetical representations of creativity and innovation and little progression has been made regarding empirical testing or using them as a basis for empirical research (Chen et al., 2013; Richter et al., 2012; Sung, Cho & Choi, 2011). This may be due to the lack of agreement regarding the factors comprising a multilevel model of creativity and/or innovation, including a lack of agreement surrounding whether a model can be considered ‘multilevel’ and how many levels should be represented.

Moreover, the complexity of multilevel models may have hindered their application. As with models of FEI, multilevel models lack rigorous testing to confirm their accuracy. Such testing would also expose whether the added complexity of multilevel models increases their comprehensiveness. This lack of validation may explain why these models do not seem to have been wholeheartedly adopted by creativity and innovation researchers.

Overall, there has been increased interest in and publication of multilevel work in recent years (Costa et al., 2013), and the adoption of a multilevel paradigm has enabled researchers to consider the wider system of creativity and innovation, explore cross-level relationships and more accurately estimate those relationships. However, most organisational creativity research still occurs at the individual level (Batey & Furnham, 2006; Hui, Lee, Tinsley & Yang, 2007), and where there is empirical multilevel research on creativity and innovation there is arguably little in the way of definitional and measurement consistency, nor does the research stem from the theoretical multilevel models. The current research takes a multilevel approach, thereby responding to criticisms of the dearth of multilevel research (Klein, Tosi & Cannella, 1999; Hayes, 2006; Newman, Ucbasaran, Zhu & Hirst, 2014) and allowing cross-level relationships to be investigated. Indeed, two recent studies have called for more multilevel empirical research. First, Kuenzi and Schminke (2009) conducted an exhaustive review of the organisational climate literature, and recommend multilevel research as a primary focus for future climate research. Second, Buschgens et al. (2013) conducted a meta-analysis of culture, climate and innovation studies and concluded that multilevel climate and multilevel innovation research should be the direction of future research in this area. When applied in conjunction with interdisciplinarity, the
current research also answers calls for research that is both interdisciplinary and multilevel, as this provides a more comprehensive way of understanding real-world management challenges than current approaches provide (Hitt et al., 2007).

5.9 Research aims and hypotheses

The current research addresses four research aims and five hypotheses. These are represented in Figure 9.

![Figure 9. Schematic Representation of the Hypotheses Addressed in the Current Research](image)

Research Aim 1 seeks to develop a valid and reliable measure of Front End Innovation

Research Aim 2 seeks to develop a valid and reliable measure of Creative and Innovative Climate

Research Aim 3 seeks to explore Individual Creative Performance in relation to Creative and Innovative Climate and Individual Creativity. This will be addressed through two hypotheses.

Hypothesis 1 proposes that Individual Creativity will have a significant but weak relationship with Individual Creative Performance

Hypothesis 2 proposes that Creative and Innovative Climate will have a significant and moderate relationship with Individual Creative Performance
Research Aim 4 seeks to explore Creative and Innovative Climate in relation to Individual Creativity, Team Creativity and Team Front End Innovation. This will be addressed through three hypotheses.

Hypothesis 3 proposes that Creative and Innovative Climate will have a significant but weak relationship with Individual Creativity

Hypothesis 4 proposes that Creative and Innovative Climate will have a significant and moderate relationship with Team Creativity

Hypothesis 5 proposes that Creative and Innovative Climate will have a significant and moderate relationship with Team Front End Innovation

5.10 Summary

This chapter presented the argument for taking an interdisciplinary, multilevel approach to the current research, the research aims and hypotheses addressed in the current research and the gap in the literature they address. The following chapter presents the epistemological position and ethical considerations of the current research, and the context in which the current research was conducted.
6 EPISTEMOLOGY, ETHICS AND CONTEXT

6.1 Chapter overview

This chapter first describes the epistemology and ethics that guide the three studies comprising the current research. The main tenements of logical positivism are discussed, followed by the proposition of a combinatory approach with critical realism. Finally, the considerations taken to maintain a high ethical standard in the current research are outlined.

Second, this chapter provides an overview of the organisation in which the majority of the current research was conducted. This provides necessary context to the research and aids sense making and interpretation of the findings\(^1\). A general description of the organisation is provided, followed by more in depth discussion of key characteristics of the organisation.

6.2 Epistemology

Epistemology is one of main determinants of research strategy (Johnson & Duberley, 2000), i.e. of the overall methodology and approach taken to the research (Walsh & Wigens, 2003). However, epistemology and research strategy do not necessarily determine the specific methodologies used, as specific methodologies may be suitable for a variety of epistemologies and research strategies (Bryman, 1984).

The epistemology guiding the current research is a combination of logical positivism and critical realism. Historically, combinatory approaches have been criticised (Hathaway, 1995), however Van de Ven’s (2007) notion of ‘engaged scholarship’ challenged this argument, claiming that “there are significant benefits from adopting a more inclusive research philosophy that is open to and integrates some of the differences of alternative philosophies of science” (p.63).

Logical positivism argues that there is a ‘real’ world which is objective, and can be objectively observed and verified (Van de Ven, 2007). The aim of research guided by logical positivism is to uncover the laws that govern behaviour; to identify causal relationships that allow behaviour to be predicted (van Geenen, 2004). This is achieved through testing verifiable and testable propositions, which allows the demarcation of science and non-science (or ‘nonsense’) (Curd & Psillos, 2013).

\(^1\) MBDA provided funding for the current research, in addition to a smaller contribution from the Research and Development Management Association (RADMA)
Logical positivism is the dominant approach in the physical sciences (Friedman, 1999). Due to its affinity with physical science, a research strategy grounded in logical positivism may be advantageous for both management and psychology research which often strives to be seen as ‘scientific’ in the same way that physical sciences are (Whitley, 2000).

In the current research, the use of hypotheses (i.e. verifiable and testable propositions) and quantitative, survey-based data collection methods reflect the logical positivist approach taken (van Greenen, 2004). However, there are two limitations of applying logical positivism to the current research. First, the emphasis on causality can be problematic when applied to social science research. Difficulties arise when seeking to identify causality using either a cross sectional research design or statistical techniques based on correlations, from which causality cannot be inferred (Lazarus, 2003). Second, although the current research has hypotheses, the extent to which these can be considered verifiable and testable propositions is debatable. It has been argued that in order for a proposition to be meaningful, and therefore considered ‘science’, methods that can establish if a proposition is true or not must exist (Dahnke & Dreher, 2011; Gustavsson, 2007; Hempel, 1950). Statistical analysis of data provided by humans is fallible, and therefore the hypotheses used in the current research may not be considered wholly consistent with a logical positivist approach.

The two limitations discussed above call into question the appropriateness of taking a solely logical positivist approach to the current research. Whilst it provides useful guidelines, a combinatory approach may be appropriate. Critical realism may be a suitable partner.

Critical realism does not seek to imitate physical science, and argues that it is not always necessary to imitate physical science in order to be considered scientific (Siakantaris, 2000). Like logical positivism, critical realism argues that a ‘real’ world exists. However, logical positivism argues that this world can be objectively observed, whereas critical realism argues that the existence of the ‘real’ world and any subsequent beliefs cannot be proven or disproved. Critical realism also questions the objectivity and causality that is central to logical positivism. Objectivity is questioned because critical realism posits that our knowledge is fallible and theory-laden, and therefore subjective. This subjectivity makes it impossible to claim that the observation of a relationship allows a causal explanation of that relationship, as logical positivism suggests. Critical realism argues that investigating relationships, i.e. research, is a social practice and therefore subjective (Easton, 2010; Gorski, 2013).
In the current research, the use of research aims and quantitative methods reflect the critical realist approach taken (Easton, 2010). Although it is commonly assumed that quantitative research is grounded in logical positivism, critical realist research can also employ quantitative methods (Tsang & Kwan, 1999). Quantitative methods allow the current research to approximate reality in a way that is appropriate for the research aims and hypotheses posed, but not to make statements about causality as logical positivism would predicate (Danermark, Ekstrom, Jakobsen & Karlsson, 2002).

The current research also begins with the assumption that the data, and the analysis thereof, is subjective. This is consistent with one of the core arguments of the critical realist position. For example, the qualitative analysis conducted in Study 2 unavoidably involves the interpretation of raw data and decisions regarding the relevance of various quotes to this research, both of which are subjective acts. Moreover, whilst statistical analysis is generally considered more ‘scientific’ than qualitative analysis, it too implores researchers to use their reasoning to achieve an interpretable output (e.g. Tabachnick & Fidell, 2013; Worthington & Whittaker, 2006). As argued previously, interpretation is subjective.

Overall, the current research is guided by a combination of aspects of logical positivism and aspects of critical realism. Taking a combinatory approach addresses calls for management research to practice ‘engaged scholarship’ (Van de Ven, 2007). Accordingly, this study takes a quantitative approach with both research aims and hypotheses.

6.3 Ethics

Ethics are an important concern in psychological research. The current research maintained a high ethical standard by providing information regarding what participation would involve and explicitly seeking informed consent after presentation of this information, both through participants’ acknowledgement of the forematter provided and by their proceeding to the main body of the questionnaire. Participants were also advised of their right to withdraw from the research at any time, and assured that their responses could not be traced back to them. Their name/unique identifier was removed immediately after the data from the two questionnaires were paired, and the current research only presents quantitative data in aggregate form; an individual’s quantitative data would never be presented on its own nor would a participant be identifiable.

As referred to above, each participant was asked to complete two questionnaires and these questionnaires were later paired by the researcher. Due to this, it was necessary for each
participant to use a unique identifier. A name was used as the unique identifier because this was consistent with the setup of the me\(^2\), and the me\(^2\) could not be altered due to it being a commercial tool. Participants were advised, particularly in France to appease union concerns, that any name could be used as long as they provided the same name for both questionnaires. That is, participants did not have to use their real name if they were concerned about identification. Participants were informed that all data would be strictly confidential and only accessible by the researcher and supervisory team. It was also suggested that a fictional email address could be entered if participants did not wish to provide their real email address.

The approach taken to the current research complies with the British Psychological Society’s Code of Ethics and Conduct (British Psychological Society, 2009) and was approved by the University of Manchester Ethics Committee.

6.4 Context: History of MBDA

The current research was largely conducted within Matra BAE Dynamics Alenia (MBDA). MBDA operates within the defence industry and specialises in missiles and missile systems. They have approximately 10,000 employees operating in various sites across the UK, Germany, France, Italy, Spain and the USA. MBDA was formed in 2001 and is jointly owned by British Aeronautical Engineering Systems’ (BAE Systems) (who own 37.5%), EADS (a French-German organisation, who also own 37.5%) and Finmeccanica (an Italian organisation, who own 25%). The ownership structure is presented in Figure 10.

![MBDA Ownership Structure](www.mbda-systems.com/about-mbda/mbda-at-a-glance/ownership-structure/)

Figure 10. MBDA Ownership Structure
Reproduced from www.mbda-systems.com/about-mbda/mbda-at-a-glance/ownership-structure/
As can be seen in Figure 10, MBDA is primarily located in Germany, France, the UK and Italy, with smaller scale facilities in Spain and the USA. The sites in France, the UK and Italy operate as a fully integrated single organisation.

### 6.5 Relationship between MBDA and BAE Systems

BAE Systems is a joint owner of MBDA. BAE Systems is a global defence, aerospace and security organisation with approximately 90,000 employees. They are one of the world’s largest defence organisations; the biggest in Europe and second only to Lockheed Martin in the USA (BAE Systems Annual Report, 2010; 2011; Houldsworth & Jirasinghe, 2006). They were formed in 1999 from a merger between Marconi Electronic Systems (a General Electric subsidiary) and British Aerospace (Kuschel, 2008).

Although detailed analysis of the relationship between BAE Systems and MBDA is outside the scope of this chapter, it is pertinent to the nature of MBDA to briefly explore this relatively complex relationship.

It was initially unclear how the formation of MBDA fit with BAE Systems’ business model (BAE Systems Annual Report, 2001). Instead of developing technical capability they appeared to have distanced themselves from technical capability in missile systems. However, further investigation suggests that the formation of MBDA, and crucially the 37.5% ownership, allowed BAE Systems to retain technical capability, as MBDA is retained by BAE Systems as their missile supplier.

Moreover, the formation of MBDA was profitable. The reality of how MBDA was formed is relatively complex, involving segments and spinouts of many different defence organisations. BAE Systems’ Annual Report from 2001 states that BAE Systems swapped their interests in these spinouts for 37.5% in the newly formed MBDA, however on closer inspection they retained their 50% interest in Alenia Marconi Systems and effectively swapped a 50% interest in MBD for a 37.5% interest in MBDA. MBDA is the pooling of all the missiles business owned by BAE, EADS and Finmeccanica.

BAE Systems and EADS each received a cash injection from Finmeccanica. Due to the inter-linked nature of these organisations, it seems natural that they would combine their missile interests and form a pan-European missile organisation to complete with the USA and Lockheed Martin (Morningstar, 2010; Kuschel, 2008). This overview of the development of MBDA highlights the inter-connectedness of these organisations, arguably typical of the defence industry.
Government also plays a role in this complex industry. They act as regulator but also depend on the defence industry for national security, to provide employment and be lucrative for the economy. It is not unusual for a substantial portion of a defence organisation’s income to come from government (Barton, 2004).

As would be expected, in addition to benefitting financially from the development of MBDA (because they swapped a percentage of one organisation for a percentage of another organisation, they conducted a cash-free transaction and thus did not incur costs. Their 50% interest in MBD was worth £6M, whereas their 37.5% interest in MBDA was worth £251M), BAE Systems’ also benefit from MBDA as they provide revenue. Although it is a small percentage of BAE Systems’ total sales, the sums of money are large (see Table 9).

Table 9. BAE Systems and MBDA Sales Used to Calculate the Percentage of MBDA’s Contribution to BAE Systems’ Sales Revenue

<table>
<thead>
<tr>
<th>Year</th>
<th>BAE Systems’ sales (£billion)</th>
<th>MBDA sales (£billion)</th>
<th>% of BAE Systems’ attributed to MBDA</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>12.1</td>
<td>1.2</td>
<td>3%</td>
</tr>
<tr>
<td>2010</td>
<td>22.3</td>
<td>2.8</td>
<td>4%</td>
</tr>
<tr>
<td>2011</td>
<td>19.2</td>
<td>3.0</td>
<td>5%</td>
</tr>
</tbody>
</table>

Note: percentages calculated using current Euro-British Pound Sterling exchange rate, and without taking inflation into account. Therefore, these calculations provide an approximation only. BAE Systems’ sales figures taken from their Annual Reports of 2002; 2010; 2011. MBDA sales figures taken from [www.mbda-systems.com](http://www.mbda-systems.com)

6.6 Creativity and innovation at MBDA

The current research focuses on creativity and innovation, and the climate which encourages these. MBDA has had an innovation programme for the last 13 years, which indicates that innovation has long been recognised as important for MBDA (Walker, Shipway & Batey, 2013). Moreover, there is a dedicated multinational team working on innovation. Engagement with and support for the current research also exemplifies MBDA’s recognition of the importance of innovation.

6.7 Key organisational characteristics

One characteristic of MBDA that is relevant to the context of the current research is organisational politics. Organisational politics, i.e. attempts to influence and promote self-interest (Randall, Cropanzano, Bormann & Birjulin, 1999), is a characteristic of many if not most
organisations and therefore it is also a consideration for the current research. Qualitative data collected during Study 2 exemplifies organisational politics in MBDA. For example, one participant recounted the issues they faced when trying to formally map the internal network relevant for a particular project: “one [nationality] colleague took one look at it, and went you can’t possibly show that to anybody, to say that person can influence that person, you can’t possibly say that”.

Organisational politics may affect the current research, despite it not being directly measured in the research, because it may influence the data as it impacts the climate that people were asked their perceptions of.

A second characteristic of MBDA that is relevant to the context of the current research is the multinational, multi-site nature of the organisation. The impact of being a multinational multi-site organisation may be manifested through poorer perceptions of internal networking and collaboration across the organisation, as geographical dispersal of employees may negatively impact collaboration for creativity and innovation. Research on virtual teams has started to explore the impact of this characteristic (e.g. Leenders et al., 2003; Zakaria & Amelinckx & Wilemon, 2004). The fact that MBDA is a multinational organisation with multiple sites may influence participant responses as it impacts the climate that they were asked their perceptions of.

A third characteristic of MBDA that is relevant to the context of the current research is risk aversion. Risk aversion is a characteristic that may be typical of many corporations (Edwards & Bowen, 2010). Qualitative data collected during Study 2 exemplifies organisational politics in the organisation studied. For example, one participant recounted that they had to “convince” their manager to take risks. Risk aversion was directly measured in the current research, and it has been a relatively well-accepted inhibitor of creativity and innovation.

Finally, operating within the defence industry is relevant to the context of the current research, as this is interrelated with the current research being conducted within a risk averse, political organisation. Moreover, it means that the organisation will have heightened security concerns, particularly between nations, and this may impact internal collaboration, networking and open innovation. Thus, findings related to these factors should be viewed with this context in mind. Indeed, the qualitative data collected during Study 2 indicates that security concerns may be a barrier. However, as one participant described a particular programme encouraging trainees from one nation to do placements in other nations, the security concerns can be overcome: “even though we had the national security issues to overcome and there were some things they couldn’t
do, it was worth doing it and working round those issues...it really helps produce rounded people that you can see could be future managers”.

6.8 Summary

This chapter has outlined the epistemology and ethics that guide the three studies comprising the current research. The main tenements of logical positivism were discussed, followed by the proposition of a combinatory approach with critical realism. Finally, the steps taken to maintain a high ethical standard in the current research were outlined.

Second, this chapter has provided an overview of the organisation in which the majority of the current research was conducted. A general description of the organisation was provided, followed by more in depth discussion of key characteristics of the organisation. The following chapter presents Study 1, the development of the Front End Innovation Scale.
7 STUDY 1: DEVELOPMENT OF THE FRONT END INNOVATION SCALE
(RESEARCH AIM 1)

7.1 Chapter overview

Study 1 was conducted to address Research Aim 1, which sought to develop a valid and reliable measure of Front End Innovation. This chapter presents the development of the Front End Innovation Scale (FEIS), which extends the few existing FEI measures by contributing a measure focused on the people-related aspects of FEI developed using psychometric principles. FEIS is a 15 item measure comprising 5 factors (Idea Generation, Idea Selection, Evaluation, Problem Solving Techniques and Open Innovation), that improves upon existing measures due to its grounding in psychometric principles.

Comparable existing measures are discussed, followed by the results of the first \( n=117 \) and second \( n=841 \) development phases. Implications for academia and practitioners, limitations and suggestions for future development of FEIS will be then outlined.

7.2 Existing measures of Front End Innovation

Before discussing the development of FEIS, it is important to locate FEIS within the existing literature surrounding Front End Innovation measures. As discussed on page 75 onwards, there has been some debate regarding the dimensions that constitute Front End Innovation, leading to its “fuzzy” moniker (Kim & Wilemon, 2002a). It should be noted that there has been greater consensus regarding the dimensions comprising FEI than there has been regarding the dimensions that comprise Creative and Innovative Climate, however.

FEI has been characterised by inadequate measurement (Walker, James & Batey, 2013). Sometimes an objective approach is taken to measuring FEI. For example, inferring FEI performance based on the number of patents generated at the end of the complete innovation process (Hagedoorn & Cloodt, 2003). Objective measures are advantageous as they seem easily understandable and interpretable to those using them. However, they overlook the psychological, people-related aspects of FEI and an objective measure cannot take into account the nuances of context.

Subjective measures of FEI may also be adopted. For example, using a questionnaire to assess perceptions of the FEI process (Koen et al., 2001). Subjective measures are advantageous
as they take into consideration complexity, as well as the psychological, people-related aspects of FEI that objective measures overlook (Poskela & Martinsuo, 2009). Further, it may be contended that when the psychological aspects and complexity of FEI can be understood, an organisation is better placed to use that information to manage and improve FEI performance.

Complex multifaceted constructs, like FEI, are often best approached via subjective measurement (e.g. Bertrand & Mullainathan, 2001; Diener, Scollon & Lucas, 2003). Other examples include leadership, for which objective measurement has proven difficult; researchers could count the number of decisions made, or they could measure the number of promotions achieved by the followers. However, these objective methodological approaches would lose the complexities of leadership. Instead, leadership researchers turn to subjective assessment by asking leaders and followers their perceptions of the leaders’ behaviour and effectiveness (Werth, Markel & Forster, 2006). It is argued that this subjective methodological paradigm may be applied to FEI using psychometric principles. Thus, the aim of this chapter is to introduce a robust psychometric measure of perceptions of FEI.

A number of models have been proposed to describe FEI. Further to these models, a number of measurement models, or measurement approaches, have been proposed in the FEI literature. First, FEI may be inferred based on the measurement of overall innovation. Measuring the overall innovation process and drawing conclusions as to FEI is problematic as this assumes a direct relationship between FEI and overall innovation performance. Whilst the existence of a direct relationship has been examined (Akbar & Tzokas, 2013), FEI is considered substantively different to latter stages of the innovation process (Bertels et al., 2011; Markham, 2013). Moreover, measuring overall success and assuming it can be attributed to FEI is illogical as there are many activities that occur in the interim. Thus, whilst the quality of idea generation and selection during FEI may contribute to innovation outcomes (in terms of commercially successful new product launches), those outcomes are influenced by a variety of other factors related to the management of the innovation process of which the management of the development and marketing/commercialisation stages are but two.

Second, there is a growing argument that innovation be measured with consideration for subjective behavioural dimensions (Adams et al., 2006), even though subjective measurement is harder to define and operationalise. Subjective measures may include psychological aspects or perceptions of innovation. For example team collaboration and climate for creativity and
innovation (Hulsheger et al., 2009). The subjective, psychological approach to understanding FEI is the basis for the new measure of FEI presented herein.

Third, there are few studies that deal specifically with the discrete measurement of FEI and there have been calls to address this (Markham, 2013). Existing FEI measures have rarely been developed with adequate consideration of psychometric principles or to a statistically rigorous standard. For example, Murphy and Kumar (1997) surveyed 53 participants across 15 organisations within one industry. Participants were asked to rate the importance of a list of activities compiled by the authors proposed to comprise FEI. Qualitative comments by respondents given in the questionnaire were also taken into account. The result of the study was an outline of the key dimensions of FEI.

This study exemplifies many of the problems seen in the measurement of FEI. First, no clear rationale for the development of the list of activities was provided. Second, it is not clear how the qualitative comments were integrated with the quantitative ratings. Third, the sample size is small. Fourth, no statistical analyses were conducted to understand the reliability, validity or structure of the quantitative ratings. Fifth, a single industry focus limits generalisability.

Koen et al. (2001) operationalised their FEI model into a measurement tool, by generating one item for each aspect of their FEI model. Twenty three managers rated each element in relation to their organisation on a five point scale. Details of the small sample, item development and any analysis of item effectiveness were not included. Although the use of single items to measure constructs is attractive regarding brevity and participant fatigue (Nagy, 2002), it is considered best practice to use measures with more than one item to ensure reliability (Green, Gavin & Aiman-Smith, 1995).

Verworn, Herstatt and Nagahira (2008) conceptualised FEI as comprising reduction of market uncertainty, reduction of technical uncertainty and intensity of initial planning. The authors then developed items or adapted existing questionnaire items to measure these factors. However, no information as to the specific items was provided. The scales were not subjected to statistical analyses to determine scale structure. Further, it is not clear what level the measure is aimed at, as some items refer to ‘team member’ whilst others use ‘we’.

FEI research often uses a case study approach (e.g. Eling et al., 2013). However, this does not lend itself to a measurement method that is quick to administer and that can easily be used across different companies or industries.
In summary, a review of the literature shows that research attempting to measure FEI does not seem to adopt robust psychometric principles. The application of robust principles for the development and analyses of a measure specifically focussed on FEI will lead to improved, discrete measurement of FEI rather than making inferences about front end activities based on the measurement of the entire innovation process. Second, it addresses calls for quantitative-based FEI research (Verworn et al., 2008; Verworn, 2009).

7.3 Psychometric principles

Psychometric principles guided the development of FEIS. By using these principles, FEIS is also differentiated from previous FEI measures, none of which appear to have been developed following psychometric principles.

Psychometrics, concerned with the scientific measurement of psychological constructs, has a long-standing history in psychology and a wide application to the measurement of constructs of importance in the social sciences (Furr & Bacharach, 2008; Kline, 2000). Psychometric principles stipulate measures should be reliable (consistent), valid (measure what it purports to measure), standardised and unbiased (c.f. Rust & Golombok, 2009 for detailed exposition of the principles of psychometrics).

FEIS was developed in two phases, both of which used quantitative data. The first development phase is described below.

7.4 Phase 1: Method and participants

Psychometric principles were followed in this phase (c.f. Rust & Golombok, 2009). In particular, there was a focus on following a consistent methodology for measure construction, the use of an adequate sample size for the statistical methodology used and the employment of rigorous statistical analyses.

Suggestions as to the steps involved in constructing a psychometric measure are largely similar, although there is no absolute consensus (Furr & Bacharach, 2008). The methodology outlined by DeVellis (2012) is considered to be a good example of rigorous psychometric measure construction guidelines (Worthington & Whittaker, 2006). The psychometric measure construction stages proposed by DeVellis (2012) are presented here.
1. Establish what construct is trying to be measured
2. Generate items
3. Establish measure format
4. Ask experts to review items
5. Consider appropriateness of including validation items
6. Administer instrument
7. Analyse instrument responses
8. Optimise instrument length

Establishing which constructs to measure followed a thorough literature review of pertinent FEI studies and existing FEI measures. Thirty eight items were generated to measure FEI, which were developed from Koen et al.’s (2001) model of FEI and the information from the literature review, which suggested the inclusion of items relating to open and discontinuous innovation. Therefore, five items for open innovation and five items for discontinuous innovation were developed. The open innovation items were derived from relevant items of Hansen and Birkinshaw’s (2007) measure of the innovation value chain. Discontinuous innovation items were derived from Tidd and Bessant’s (2009) measure of innovation performance.

Psychometrics emphasises that items should be easily interpretable, distinct from one another and closely reflect the scale or dimension they are meant to measure (DeVellis, 2012). For these reasons, item wording is extremely important. For items that are interpretable, distinct from one another and closely reflect the scale or dimension they are measuring, the items were reviewed every two weeks over a period of six weeks with the aim of improving the clarity. Two academics specialising in creativity and innovation and four innovation practitioners also reviewed the items during this period.

The definition of each dimension was presented to each specialist, and they were asked for feedback on the appropriateness of the items regarding the dimension definition and item clarity. Suggestions were made regarding improving clarity of the wording of items. Specifically, their feedback was as follows.

First, if ‘always’ was used in some items it should be used in all items, otherwise the items may be unequally weighted regarding frequency of action. Second, the use of problem solving techniques is relevant to each dimension of FEI. Items pertaining to the use of problem solving
techniques were already represented in Opportunity Identification and Idea Genesis, so one item was added to each of the three remaining dimensions.

Practitioners and academic experts were consulted to give due consideration to how the questionnaire may be interpreted in an organisational context. This is good practice but often overlooked during measure development (Muchinsky, 2004).

Once the items were finalised, a questionnaire containing these items was constructed in order to test the robustness of this new measure (rather than examine FEI practices themselves). The questionnaire was constructed using the online survey software Qualtrics and comprised 38 FEI items and 15 demographic items (respondent’s role, age, gender and so forth). Prior to wide-scale dissemination, the questionnaire was piloted with five participants, which identified potential lack of clarity of instructions. A second stage of the pilot was conducted when these issues had been addressed and to assess technical operation in three popular web browsers (Chrome, Safari and Internet Explorer).

7.4.1 Method and Participants

The questionnaire was electronically distributed using relevant LinkedIn groups and personalised emails. Social media is increasingly considered a viable (DeLamater & Ward, 2013; Sappleton, 2013), and innovative (Soderman & Dolles, 2013), data collection method. Relevant LinkedIn groups were identified by entering certain keywords in the search function on the LinkedIn website. The keywords used were: psychology, new product development, innovation, psychometric.

Personalised emails were sent to 918 innovation and product managers whose email addresses were obtained from an electronic marketing company. In paper format, the questionnaire was distributed to staff at a large UK university with the additional incentive of a bar of chocolate. The offer of a low value reward to survey respondents is a commonly used as a tactic in research as a means of increasing response rates (Dillman, 2007; Edwards et al., 2002). The researcher approached staff and students in the communal areas of key university buildings in April 2013, briefly introducing the questionnaire and offering the incentive.

All participants were assured that their responses would be confidential and provided informed consent.
7.5 Phase 1: Data analysis

Following data collection, the paper questionnaires were entered into SPSS (version 20) and combined with the data collected through Qualtrics. The data could then be analysed.

7.5.1 Data checking

Ensuring suitability of the data involved checking for missing data and assessing normality assumptions, which must be met for the psychometric analyses to be performed (c.f. Tabachnick and Fidell (2013) for detailed exposition of normality assumptions).

7.5.2 Missing data

The issue of missing data, i.e. a partially incomplete data matrix (Lance & Vandenberg, 2009), is a common problem in research and should be addressed as the first point of any analysis (Tabachnick & Fidell, 2013). A Missing Value Analysis was conducted to assess the pattern of missingness in the data. 11.5% of the data were considered missing.

Little’s Missing Completely At Random test was not significant (.11), indicating data was Missing Completely At Random (MCAR). To address the issue of data MCAR, the imputation method Expectation Maximisation (EM) was used. EM is the most widely recommended for MCAR data (Martin, Marsh, McInerney, Green & Dowson, 2007) and has been used in innovation research previously (e.g. Singh & Smith, 2004). Following EM, a total of 117 participants responses were acceptable for analysis.

7.5.3 Normality assumptions

The sequence for establishing multivariate normality as outlined by Tabachnick and Fidell (2013) was followed:

1. Outliers: parcel zscores were calculated and values above 3.29 identified to establish the presence of outliers. .02% exceeded this level; some data exceeding 3.29 are to be expected in large data sets (Field, 2005), thus it was concluded that there were no significant outlier distortions in this data.
2. Skew and kurtosis: skew and kurtosis zscores were calculated and values above 1.96 identified, as this indicates the chance of achieving this value by chance is less than .05. No values above 1.96 were identified.

3. Linearity: the assumption of a straight-line relationship between two variables was assessed using bivariate scatterplots. These evidenced reasonable linearity in all cases.

4. Homoscedasticity: the assumption that the variability of data points is the same in two continuous variables (Tabachnick & Fidell, 2013) was tested using bivariate scatterplots. These evidenced acceptable homoscedasticity in all cases.

7.5.4 Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) was conducted on data from the 117 questionnaires to examine the factor structure of FEIS and identify the meaningful factors underlying the measure. One of the main uses of EFA is measure development, with EFA always preferred over Confirmatory Factor Analysis (Hayton, Allen & Scarpello, 2004; Kim, Atkinson & Yang, 1999; Worthington & Whittaker, 2006).

EFA was conducted using Maximum Likelihood Extraction and Direct Oblimin rotation. Maximum Likelihood Extraction was used, as it assumes some measurement error and optimally accounts for inter-variable correlation (Fabrigar, Wegener, MacCallum & Strahan, 1999), which is a common feature of subjective self-perception data. Factors were rotated to improve their psychological meaningfulness (Ford, MacCallum & Tait, 1986). An Oblique rotation method was chosen as it allows factors to correlate, which is appropriate when measuring psychological constructs (Field, 2005). Eigenvalues below 1 were suppressed in accordance with the Kaiser criterion (Kaiser, 1958).

Interpretation of the scree plot (Cattell, 1966) suggested a 4 or 5 factor solution (Figure 11). To identify the most appropriate solution, three factor solutions were examined adopting four criteria (Cooper, 2002; Worthington & Whittaker, 2006).

1. Each factor should have at least three loadings above $r=.3$
2. Each item should only load onto one factor above $r=.3$ (no crossloading)
3. Item communality should not be below $r=.2$
4. Each factor should be interpretable and theoretically coherent
The three factor solutions were: (1) a solution with no specified number of factors to extract that produced five interpretable factors, (2) a forced four factor solution that produced three interpretable factors, and (3) a forced five factor solution, with five interpretable factors. These solutions had some defensible Cronbach’s alphas (Cronbach, 1951), and comprised theoretically coherent factors.

As these solutions were based on $n=117$, there is a limit to the level of confidence with which the factor solutions can be judged. The factor solution used was based primarily on the solution where no factor extraction was specified, as this had the fewest items (which limits participant fatigue) and the factors were the most reliable, as all but one had Cronbach’s alpha of >.70. However, information from the other two factor solutions was also used. The other two factor solutions did not vary substantially in their content, with the exception of a potential Thoroughness factor. Items comprising the Thoroughness factor, which was found in second and third factor solutions, but not in the no forced extraction solution, were incorporated into the Thoroughness factor from the no forced extraction solution (with the exception of item 26, as this was already found in the Thoroughness factor). This factor was relabeled Evaluation. Item 26 was deleted due to a low loading.
As this work is exploratory, it was guided by the empirical data collected and integrated with the themes from the literature review. Exploratory Factor Analysis is a procedure that requires the researcher to “use inductive reasoning...subtly adjusting and readjusting their approach to produce the most meaningful results” (Worthington & Whittaker, 2006, p.808).

Overall, 38 items were written and tested in a sample of 117 innovation and product managers. All 38 items were entered into the factor analysis and 21 items remained. Discarded items did not meet the criteria for item retention detailed at the beginning of this section.

7.5.5 Additional item deletion and new items

Item deletion was based on how well the item loaded onto the factor (i.e. its contribution to that factor), and theoretical coherence (Sweeney & Soutar, 2001; Worthington & Whittaker, 2006). To assess the theoretical coherence of the items constituting each factor, the researcher, an academic specialising in creativity and an innovation practitioner each reviewed the items. They were presented with the dimension labels and asked to provide feedback on the appropriateness of the items as regards the dimension label. Five items were identified as inconsistent with the dimension label and therefore not supporting the theoretical coherence of their factor. These five items were removed.

Twelve additional items were generated to improve the reliability and cohesiveness of each factor following the item development guidelines presented in section 7.4. New items are indicated in Table 10 with an asterisk. This resulted in a 28 item measure.
Table 10. Final Factor Solution for FEIS

<table>
<thead>
<tr>
<th>Factor</th>
<th>Factor Label</th>
<th>Item</th>
<th>Factor Loading</th>
<th>Alpha (α)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Idea Generation (6 items)</td>
<td>My team does not develop many new ideas (r)</td>
<td>-0.71</td>
<td>0.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td>We always find time to make new ideas</td>
<td>0.40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team always has lots of ideas*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team does not have many new ideas (r)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team members all have similar ideas (r)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team can always see lots of options*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Idea Selection (7 items)</td>
<td>My team is good at making the business case for why an idea should be developed</td>
<td>0.66</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>We always look for lots of information to assess an opportunity</td>
<td>0.52</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team carefully explores the conceptual aspects of an idea</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team very carefully selects the best ideas to work on</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We know which ideas are best to work on*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team has a history of choosing good ideas*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We have always chosen winning ideas*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Evaluation (7 items)</td>
<td>We spend lots of time choosing the best idea</td>
<td>0.74</td>
<td>0.54</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Having the idea is more important than testing if it will work (r)</td>
<td>-0.47</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We use opinions to evaluate an opportunity</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We do not waste time casually talking about opportunities (r)</td>
<td>-0.33</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We wait before evaluating an idea*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>In team meetings people are upset when their ideas are evaluated (r)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team is excellent at evaluating ideas*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Problem Solving Techniques (3 items)</td>
<td>We use problem solving techniques to help us decide which ideas to work on</td>
<td>0.99</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td></td>
<td>We use problem solving techniques to assess opportunities</td>
<td>0.71</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We always use problem solving techniques to help us build a business case for further development work</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Open Innovation (5 items)</td>
<td>My team always looks outside our company for new ideas</td>
<td>0.66</td>
<td>0.70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team looks for ideas from outside our organisation to meet opportunities</td>
<td>0.53</td>
<td></td>
</tr>
</tbody>
</table>
My team believes ideas that come from within our organisation are always most valuable (r) 0.41
We always work with people outside our organisation to improve innovation*
We never talk about our ideas outside our organisation (r)*

(r) = reverse scored item

7.5.6 Factor labeling

Factor 1 was labeled Idea Generation as it concerns the ability of the team to generate new ideas. An example item is: “My team does not develop many new ideas”.

Factor 2 was labeled Idea Selection, as it concerns whether the team is perceived to recognise ideas and opportunities that could be valuable if developed. An example item is: “My team can see the most valuable ideas”.

Factor 3 was labeled Evaluation, and pertains to the careful consideration of ideas and opportunities before making a decision whether to proceed. An example item is: “We spend lots of time choosing the best idea”.

Factor 4 was labeled Problem Solving Techniques as it concerns the use of problem solving techniques to facilitate the assessment of new ideas and opportunities. An example item is: “We use problem solving techniques to help us decide which ideas to work on”.

Factor 5 was labeled Open Innovation, as it concerns the extent to which the team is willing to open their innovation process to encourage outside influence and look outside their organisation for ideas and opportunities. An example item is: “Our team always looks outside our company for new ideas”.

7.5.7 Scale reliability

Cronbach’s alpha (Cronbach, 1951) was calculated to estimate factor reliability. Reliability refers to the internal consistency of a measure, and of the scores obtained (Anastasi & Urbina, 1997). The cutoff for an acceptable Cronbach’s alpha value is typically .70 (Tavakol & Dennick, 2011). With the exception of Evaluation, all factors had Cronbach’s alpha of .70 or above, although measures with Cronbach’s alpha below .70 are often used in research (e.g. Charlesworth, Hart, Burts & Hernandez, 1991; Fenwick, Costa, Sohal & D’Netto, 2011; Hochwalder & Brucefors, 2005; Kober & Eggleton, 2005; Sivanathan & Fekken, 2002).
Moreover, by introducing new items, future research will allow the reliability of this factor to be improved.

7.6 Interim summary

The preceding section presented the first phase in the development of FEIS. Using a sample of working adults from various organisations, a 28 item, 5 factor measure was produced. To add rigour, this measure was tested with a further 841 employees from MBDA, and all statistical analyses were repeated. This led to a 16 item, 5 factor measure. This constituted the second phase of development and is presented below.

7.7 Phase 2: Participants and method

In total, 841 employees from MBDA completed FEIS. For transparency, the 841 participants referred to here are the same 841 participants referred to in Study 3 and the second phase of CICS development (Study 2). Of the 841 participants, the vast majority were male ($n=636$, 83%) and aged 50 or above (35.4%). Those aged 41-50 (20.7%), 31-40 (23.4%), and under 30 (20.4%) relatively equally represented. This was based on a sample of 627, as 214 did not provide their age. Data was collected from the countries forming the integrated organisation; France ($n=352$), the UK ($n=323$) and Italy ($n=166$), not Germany.

Participants completed FEIS as part of Study 3, and the data were also used in this study to constitute the second phase of FEIS development. Participants predominantly completed FEIS online after receiving an email inviting them to participate in a wider study involving two questionnaires and multiple measures (Study 3). This email was sent by the Innovation Manager in each country, and provided basic information about the study and the links to the online questionnaires. Each Innovation Manager adapted their email as they thought was appropriate for their country. Mainly, this involved the French Innovation Manager including additional information assuring participants that the data would be confidential and an individual's data could only be accessed by researchers at University of Manchester, and not by the organisation’s management.

In the UK, this data collection approach was supplemented by the researcher spending fifteen days in main thoroughfares of the three UK sites, approaching individuals at random to introduce the research to them and request that they participate. In these cases, participants could
either complete the questionnaires immediately on a pre-arranged computer, or could take away a paper copy of the questionnaire containing FEIS.

7.8 Phase 2: Data analysis

7.8.1 Data checking

Ensuring suitability of the data involved addressing missing data and assessing normality assumptions which must be met for the psychometric analyses to be performed. For information about normality assumptions refer to Tabachnick and Fidell (2013).

7.8.2 Missing data

The pattern of missing data was assessed for the data set with the exception of the demographic data (e.g. age, gender). The issue of missing data, i.e. a partially incomplete data matrix (Lance & Vandenberg, 2009), is a common problem in research and should be addressed as the first point of any analysis (Schlomer, Bauman & Card, 2010). A Missing Value Analysis was conducted to assess the pattern of missingness in the data. 17.1% of the data were considered missing.

Little’s Missing Completely At Random test was not significant (.06), indicating data was Missing Completely At Random (MCAR). To address the issue of data MCAR the imputation method Expectation Maximisation (EM) was used as it is the most widely recommended for data MCAR (Martin et al., 2007) and has been used in innovation research (e.g. Singh & Smith, 2004). Following EM, data from 841 participants were acceptable for analysis.

7.8.3 Normality assumption

The sequence for establishing multivariate normality as outlined by Tabachnick and Fidell (2013) was followed:

1. Outliers: parcel zscores were calculated and values above 3.29 identified to establish the presence of outliers. .01% exceeded this level; some data exceeding 3.29 are to be expected in large data sets (Field, 2005), thus it was concluded that there were no significant outlier distortions in this data.
2. Skew and kurtosis: assessed at the variable level. Skew and kurtosis zscores were calculated (skew divided by standard error for skew), with values of zero indicating no skew or kurtosis. Often a cut off of 1.96 is adhered to (e.g. Kerr, Hall & Kozub, 2002), with values above that indicating that the variable in question is skewed or kurtotic. However, in larger samples a cut off of 2.58 can be used (Turner, 2014). No variables evidenced skew or kurtosis.

3. Linearity: the assumption of a straight-line relationship between two variables was assessed using bivariate scatterplots. These evidenced reasonable linearity in all cases.

4. Homoscedasticity: the assumption that the variability of data points is the same in two continuous variables (Tabachnick & Fidell, 2013) was tested using bivariate scatterplots. These evidenced acceptable homoscedasticity in all cases.

7.8.4 Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) was conducted on data from the 841 questionnaires to examine the factor structure of FEIS and identify the meaningful factors underlying the measure. One of the main uses of Exploratory Factor Analysis is measure development, for which EFA is preferred over Confirmatory Factor Analysis (Hayton et al., 2004; Kim et al., 1999; Worthington & Whittaker, 2006). Moreover, EFA was used for a second time due to the twelve additional items introduced into FEIS at the end of the first development phase and therefore after the initial EFA was conducted.

EFA was conducted using Maximum Likelihood Extraction and Direct Oblimin rotation. Maximum Likelihood Extraction was used, as it assumes some measurement error and optimally accounts for inter-variable correlation (Fabrigar et al., 1999), which is a common feature of subjective self-perception data. Factors were rotated to improve their psychological meaningfulness (Ford et al., 1986). An Oblique rotation method was chosen as it allows factors to correlate, which is appropriate when measuring psychological constructs (Field, 2005). Eigenvalues below 1 were suppressed in accordance with the Kaiser criterion (Kaiser, 1958).

Interpretation of the scree plot (Cattell, 1966) suggested a 5 factor solution (Figure 12). To identify the most appropriate solution, two factor solutions were examined adopting four criteria (Cooper, 2002; Worthington & Whittaker, 2006).

1. Each factor should have at least three loadings above $r=.3$
2. Each item should only load onto one factor above $r=.3$ (no crossloading)
3. Item communality should not be below $r = .2$

4. Each factor should be interpretable and theoretically coherent

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The two factor solutions examined were: (1) a solution with no specified number of factors to extract, with five interpretable factors, and (2) a forced five factor solution, with four interpretable factors.

Solution (1) produced five theoretically coherent and interpretable factors, using 17 of the original 28 items. Each factor had a defensible Cronbach’s alpha (ranging from .70 to 84) (Cronbach, 1951). Solution (2) produced four interpretable factors, using 12 of the original 28 items. Three of the four factors had Cronbach’s alphas of .70 or above, with one of the factors producing a Cronbach’s alpha of .38, indicating an unreliable factor.

Factor solution (1), with five interpretable factors, was used in the current research. The reasons for this are twofold. First, all of the interpretable factors are reliable, whereas this was not the case for factor solution (2). Second, using five factors as opposed to three factors provides greater coverage of the area of Front End Innovation, whilst still using relatively few (17) items and limiting participant fatigue.
Reliability analysis highlighted two additional items that could be deleted to improve their factor’s Cronbach’s alpha. One of these items, Q26_20, was deleted, increasing the reliability from .76 to .77. The other item, Q26_18, was not deleted, as it would have resulted in a factor comprising two items, and this would violate the criteria whereby each factor must have three or more loadings/items (Byrne, 2012). Sixteen items remained.

As this work was exploratory, it was guided by the empirical data collected and integrated with the themes from the literature review. Exploratory Factor Analysis is a procedure that requires the researcher to ‘use inductive reasoning...subtly adjusting and readjusting their approach to produce the most meaningful results’ (Worthington & Whittaker, 2006, p.808).

7.8.5 Additional item deletion and new items

Item deletion was based on how well the item loaded onto the factor (i.e. its contribution to that factor) and whether removing an item would improve the overall reliability of the scale. All of the remaining items were deemed to fit theoretically with other items in the factor they were measuring, and no items were removed to improve reliability.
Table 11. Final Factor Solution for the New Front End Innovation Scale

<table>
<thead>
<tr>
<th>Factor</th>
<th>Factor Label</th>
<th>Item</th>
<th>Factor Loading</th>
<th>Alpha (α)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Idea Generation (4 items)</td>
<td>My team does not have many new ideas (r)</td>
<td>-0.75</td>
<td>0.81</td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team always has lots of ideas</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team does not develop many new ideas (r)</td>
<td>-0.65</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We always find time to make new ideas</td>
<td>0.31</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Idea Selection (3 items)</td>
<td>We have always chosen winning ideas</td>
<td>0.73</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team is excellent at evaluating ideas</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team has a history of choosing good ideas</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Evaluation (3 items)</td>
<td>We spend lots of time choosing the best idea</td>
<td>0.74</td>
<td>0.70</td>
</tr>
<tr>
<td></td>
<td></td>
<td>We always look for lots of information to assess an opportunity</td>
<td>0.68</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team carefully explores the conceptual aspects of an idea</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Problem Solving Techniques (3 items)</td>
<td>We use problem solving techniques to help us decide which ideas to work on</td>
<td>0.88</td>
<td>0.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>We use problem solving techniques to assess opportunities</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We always use problem solving techniques to help us build a business case for further development work</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Open Innovation (3 items)</td>
<td>My team looks for ideas from outside our organisation to meet opportunities</td>
<td>0.77</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>My team always looks outside our company for new ideas</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We always work with people outside our organisation to improve innovation</td>
<td>0.48</td>
<td></td>
</tr>
</tbody>
</table>

(r) = reverse scored item

7.8.6 Factor labeling

Factor 1 was labeled Idea Generation as it concerns the ability of the team to generate new ideas. An example item is: “My team does not develop many new ideas”, a reverse scored item.

Factor 2 was labeled Idea Selection, as it concerns whether a team has previously and currently chosen ideas that would be valuable if developed. An example item is: “We have always chosen winning ideas”.

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Factor 3 was labeled Evaluation, and pertains to the careful consideration of ideas and opportunities before deciding whether to proceed. An example item is: “We spend lots of time choosing the best idea”.

Factor 4 was labeled Problem Solving Techniques as it concerns the use of problem solving techniques to facilitate the assessment of new ideas and opportunities. The factor label reflects that all items were negatively loaded. An example item is: “We use problem solving techniques to help us decide which ideas to work on”.

Factor 5 was labeled Open Innovation, as it concerns the extent to which the team is willing to open their innovation process to encourage outside influence and look outside their organisation for ideas and opportunities. An example item is: “My team looks for ideas from outside our organisation to meet opportunities”.

7.8.7 Scale reliability
Cronbach’s alpha (Cronbach, 1951) was calculated to estimate factor reliability. Reliability refers to the internal consistency of a measure, and of the scores obtained (Anastasi & Urbina, 1997). The cutoff for an acceptable Cronbach’s alpha value is typically .70 (Tavakol & Dennick, 2011). All factors exhibited Cronbach’s alpha of .70 or above.

7.9 Interim summary
The preceding section presented the Exploratory Factor Analysis conducted as part of the second phase in the development of FEIS, with the final factor solution presented in Table 11. With the exploratory portion of the current research complete, the factor structure was confirmed using Confirmatory Factor Analysis. This is presented below.

7.10 Confirmatory Factor Analysis
Exploratory Factor Analysis provided the factor structure of FEIS, which was then confirmed using Confirmatory Factor Analysis (CFA). All CFAs were conducted using Mplus version 7.

7.10.1 Introduction to Confirmatory Factor Analysis
Confirmatory Factor Analysis is a type of Structural Equation Modeling (SEM). SEM is a statistical analysis technique that is used for modeling the relationships between variables. These
variables may be observed or unobserved (latent). SEM is used primarily in the social sciences, and continues to be developed as an analysis technique which differentiates it from methods such as factor analysis and multiple regression (Hoyle, 2012).

SEM is interpreted using fit indices. In order to present SEM results in meaningfully, it is necessary to explain fit indices and the method of estimation used prior to presentation of SEM results, as is considered good practice (Hoyle & Panter, 1995).

### 7.10.2 Method of estimation

The method of estimation is an important consideration, as there are a number of potential approaches and each may influence the results and therefore the interpretation of model fit in a different way (Hoyle, 2012). The current research used the Maximum Likelihood (ML) method of estimation. ML has historically been the preferential method of estimation (Muthen, 2002), as it does not require a very large sample size, is applicable to different types of data (e.g. ratio, interval, continuous), and is considered to provide accurate results (Beauducel & Herzberg, 2006; Bowen & Guo, 2012). The use and reporting of ML has been recommended previously (e.g. Hoyle & Panter, 1995).

### 7.10.3 Fit indices

Fit indices are used to assess model fit. Model fit is the extent to which the model represents the data and reflects the underlying theory (Hooper, Coughlan & Mullen, 2009). Fit indices can be absolute or incremental. The current research uses two absolute fit indices. First, chi-square. This is almost always reported, in conjunction with the degrees of freedom (df), although it should be cautiously interpreted due to its sensitivity to sample sizes, and it has been argued that it is not as useful as other absolute fit indices, such as RMSEA. RMSEA is the second absolute fit index used in the current research, with values below .06 believed to indicate a model with good fit. Although RMSEA is also sensitive to sample size, over estimating model fit in small samples, it is less sensitive to this issue than chi-square (Fan, Thompson & Wang, 1999).

The current research also used two incremental fit indices to assess CFA model fit. First, the Tucker and Lewis Index (TLI). TLI is particularly appropriate when used in conjunction with ML estimation and a larger sample size (Hu & Bentler, 1995). Values of 0 indicate no fit whilst values of 1 indicate perfect fit. Values above .90 are believed to indicate good model fit (Schumacker & Lomax, 2010), although the more conservative value of .95 is also used (Hu &
Bentler, 1995). Similarly, the Comparative Fit Index (CFI) ranges from 0 (no fit) to 1 (perfect fit), with the same cut-offs applied. CFI is the second incremental fit index used in the current research.

### 7.10.4 Strategies for improving model fit

Typically a first model is specified and the fit indices described above will indicate if the fit of the model could be improved. Model fit can usually be improved, and various strategies may be employed to improve model fit.

First, low loading items should be removed. In this case, a loading below $r=0.20$ would be considered low. Following this, modification indices are examined, and items with high modification indices are identified (Hooper et al., 2009). At this point, it is pertinent for researchers to consider that the role of SEM is to develop a model that has good statistical fit and is theoretically coherent; being led solely by low loadings and modification indices may lead to a model which is statistically robust, but not theoretically coherent, and therefore not useful (Joreskog & Sorbom, 1996; Reisinger & Mavondo, 2006). Likewise, a model may be theoretically coherent despite not meeting strict cut-offs for fit statistics, leading to the rejection of a (theoretically) acceptable model; a Type 1 error (Marsh, Hau & Wen, 2004).

Second, parceling can be used to improve model fit, and it is regularly used for this purpose (e.g. Landis, Beal & Tesluk, 2000; Martens, 2005; Nasser & Wisenbaker, 2003; Rogers & Schmitt, 2004). However, some argue that parceling is controversial (e.g. Little, Cunningham & Shahar, 2002; Sterba, 2011), as it may mask the sources of model misfit, one of which may be theoretical incoherence. Parcelling should be used when the researcher is confident that there are not substantive issues with the proposed model that are causing the poor fit (Bandalos & Finney, 2009; Sterba, 2011). One of the main criticisms of parceling is that when parceling is used, item-to-parcel allocations should be carefully considered as usually there are many item-to-parcel allocation combinations and each may lead to a different level of model fit (Sterba, 2011). However, the number of item-to-parcel allocation combinations is limited in the current research when scales have only three items. With these considerations in mind, parceling is commonly used.

In addition to improving model fit, alternative (competing) models should be tested during SEM, and CFA in particular, as is consistent in peer-reviewed publications containing CFA (e.g. Serretti & Olgiati, 2004; Stockdale, Gridley, Balogh & Holtgraves, 2002).
7.10.5 Confirmatory Factor Analysis modeling

With an introduction to SEM given, the results of the CFAs conducted in the current research are detailed.

First, a CFA was conducted on the final factor solution presented earlier. This model showed adequate fit regarding RMSEA, but not TLI ($\chi^2 = 550.68 \ (n = 841; \ df = 94; \ p=.00) \ CFI = .92, \ TLI = .89, \ RMSEA = .07$). Sources of model misfit were sought, which involved exploring the modification indices and identifying factors with low loadings. Item q26_18 was removed from Open Innovation due to it having the lowest loading of all the items in FEIS (.46) and having a high modification index (above 5), as items with low loadings and high modification indices can cause poor model fit (Bagozzi & Yi, 1988). However this did not substantially improve the fit of the model ($\chi^2 = 550.68 \ (n = 841; \ df = 94; \ p=.00) \ CFI = .92, \ TLI = .90, \ RMSEA = .07$). However, the small improvement in TLI means this model provides reasonable fit if the less conservative cutoffs with CFI and TLI are used. Moreover, removing one item from Open Innovation would result in a two item scale, which was previously identified as problematic (Byrne, 2012). The slight improvement of the fit statistics did not warrant incorporating a two item scale.

A third model was then specified following closer examination of the modification indices. The largest modification index was 41.63, between ‘err8’ and Idea Generation. Residual ‘err8’ was associated with q26_8, and thus this item was removed. This improved the fit of the model ($\chi^2 = 429.57 \ (n = 841; \ df =80; \ p=.00) \ CFI = .93, \ TLI = .91, \ RMSEA = .07$).

To further improve the third model, a final model was developed using parcelled items and continuing to remove item q26_8. Items were parcelled using rank ordering, i.e. the items with the lowest and highest correlations were parcelled together. Due to each factor having three items, one item per factor was not parcelled. Specifically, items q26_12 and q26_5 formed an Evaluation parcel, items q26_8 and q26_18 formed an Open Innovation parcel, items q26_3 and q26_13 formed an Idea Generation parcel, items q26_28 and q26_29 formed an Idea Selection parcel, and items q26_6 and q26_11 formed a Problem Solving Techniques parcel. Adopting parcelling substantially improved the fit of the model, yielding a model with very good fit ($\chi^2 = 57.61 \ (n = 841; \ df =25; \ p=.00) \ CFI = .99, \ TLI = .98, \ RMSEA = .04$). This model used the items presented in Table 12; a 15 item scale.
Table 12. Final Factor Solution for the New Front End Innovation Scale following Confirmatory Factor Analysis

<table>
<thead>
<tr>
<th>Factor Label</th>
<th>Item</th>
<th>Factor Loading</th>
<th>Alpha (α)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Idea Generation</td>
<td>My team does not have many new ideas (r)</td>
<td>-0.75</td>
<td>0.81</td>
</tr>
<tr>
<td>(3 items)</td>
<td>My team always has lots of ideas</td>
<td>0.72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My team does not develop many new ideas (r)</td>
<td>-0.65</td>
<td></td>
</tr>
<tr>
<td>2 Idea Selection</td>
<td>We have always chosen winning ideas</td>
<td>0.73</td>
<td>0.84</td>
</tr>
<tr>
<td>(3 items)</td>
<td>My team is excellent at evaluating ideas</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My team has a history of choosing good ideas</td>
<td>0.61</td>
<td></td>
</tr>
<tr>
<td>3 Evaluation</td>
<td>We spend lots of time choosing the best idea</td>
<td>0.74</td>
<td>0.70</td>
</tr>
<tr>
<td>(3 items)</td>
<td>We always look for lots of information to assess an opportunity</td>
<td>0.68</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My team carefully explores the conceptual aspects of an idea</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>4 Problem Solving</td>
<td>We use problem solving techniques to help us decide which ideas to</td>
<td>0.88</td>
<td>0.77</td>
</tr>
<tr>
<td>Techniques</td>
<td>work on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3 items)</td>
<td>We use problem solving techniques to assess opportunities</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td></td>
<td>We always use problem solving techniques to help us build a</td>
<td>0.69</td>
<td></td>
</tr>
<tr>
<td></td>
<td>business case for further development work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Open Innovation</td>
<td>My team looks for ideas from outside our organisation to</td>
<td>0.77</td>
<td>0.72</td>
</tr>
<tr>
<td>(3 items)</td>
<td>meet opportunities</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>My team always looks outside our company for new ideas</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>We always work with people outside our organisation to</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td></td>
<td>improve innovation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(r) = reverse scored item

As the current research sought to develop a measure comprising multiple scales, it was pertinent to conduct Confirmatory Factor Analysis on each FEIS scale too. These analyses are presented in Table 13.
Table 13. Confirmatory Factor Analysis Model Fit Statistics for Each FEIS Scale

<table>
<thead>
<tr>
<th>Scale</th>
<th>Model fit</th>
<th>Goodness of fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idea Generation</td>
<td>$\chi^2 = 571.74 \ (n = 841; \ df = 3; \ p = .00)$ CFI = 1.00, TLI = 1.00, RMSEA = .00</td>
<td>Excellent</td>
</tr>
<tr>
<td>Idea Selection</td>
<td>$\chi^2 = 202.25 \ (n = 841; \ df = 3; \ p = .00)$ CFI = 1.00, TLI = 1.00, RMSEA = .00</td>
<td>Excellent</td>
</tr>
<tr>
<td>Evaluation</td>
<td>$\chi^2 = 100.68 \ (n = 841; \ df = 3; \ p = .00)$ CFI = 1.00, TLI = 1.03, RMSEA = .00</td>
<td>Excellent</td>
</tr>
<tr>
<td>Problem Solving Techniques</td>
<td>$\chi^2 = 1075.59 \ (n = 841; \ df = 3; \ p = .00)$ CFI = 1.00, TLI = 1.00, RMSEA = .03</td>
<td>Good</td>
</tr>
<tr>
<td>Open Innovation</td>
<td>$\chi^2 = 31.61 \ (n = 841; \ df = 3; \ p = .00)$ CFI = .96, TLI = .89, RMSEA = .04</td>
<td>Adequate</td>
</tr>
</tbody>
</table>

The analysis of each FEIS scale identified one scale that may benefit from future development efforts: Open Innovation.

7.10.6 Equality constraints

It should be noted that to conduct CFAs on FEIS scales comprising three items, which was four of the five scales (Idea Generation was the exception), it was necessary to apply equality constraints. Equality constraints are when the residuals for two of the three items in a scale are constrained equal (Byrne, 2012), and they are used when a model is saturated (or ‘just-identified’). Saturation occurs when the number of known inputs to a model is equal to the number of estimated parameters. In the current research, this occurred with FEIS scales comprising three items. When a model is saturated, no information can be extracted from the covariance matrix and fit statistics cannot be generated, as a saturated model is guaranteed to fit any data perfectly (Arbuckle, 2011). The central role of fit statistics in the interpretation of CFA means that a saturated model is not useful, and therefore equality constraints were applied. This approach has also been adopted previously in research from the psychology (Suh & Yi, 2006) and innovation (Beets et al., 2008; Chan, 2000) disciplines, and although difficult in some statistical software, such as AMOS, Mplus supports the application of equality constraints in order to achieve an unsaturated model.
7.10.7 Higher order factor structure

Finally, the presence of a higher order factor structure was also explored. It is advisable to explore the presence of a higher order factor structure as it can provide a model that is more parsimonious and interpretable (Byrne, 2012; Chen, Sousa & West, 2005), and testing competing models is good practice (e.g. Serretti & Olgiati, 2004; Stockdale et al., 2002). In order to identify a higher order factor structure, an EFA was conducted using the five FEIS factors, specifying no fixed number of factors to extract. A one factor solution was generated within four iterations, suggesting no higher order factor structure. This factor solution is presented in Table 14.

Table 14. Higher Order Factor Structure of FEIS

<table>
<thead>
<tr>
<th>Factor</th>
<th>Higher order factor label</th>
<th>Factor</th>
<th>Factor Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Front End Innovation</td>
<td>Evaluation</td>
<td>0.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Problem Solving</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Techniques</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Idea Selection</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Idea Generation</td>
<td>0.23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Open Innovation</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Note the factor loadings are unrotated, unlike in all other factor analyses presented in the current research which used Direct Oblimin rotation, and therefore they are not directly comparable to other factor loadings presented in the current research. Factor loadings could not be rotated as only one factor was extracted.

7.11 Interim summary

The preceding section presented the second phase in the development of FEIS. Using data from MBDA employees, a 15 item, 5 factor scale was produced. A first Confirmatory Factor Analysis partially confirmed the factors of FEIS, and various steps were subsequently taken to identify sources of model misfit. The presence of a higher order structure was not supported.

The development of FEIS will be now be briefly discussed in relation to the existing literature, implications for academia and practitioners, and limitations and suggestions for future development of FEIS.
7.12 Discussion

The two development phases of the Front End Innovation Scale presented in this chapter led to a theoretically coherent measure of Front End Innovation that may, following additional development, be a viable alternative to existing approaches to measuring FEI, many of which are less psychometrically robust.

An initial set of 38 items measuring the seven key dimensions of FEI were developed and tested using a sample of innovation and product managers and working adults (phase 1). This produced a 28 item measure which was tested further within a single organisation (phase 2). This resulted in a 15 item, 5 factor measure.

A visual conceptualisation of the factors comprising FEIS is presented in Figure 13. This model represents the synthesis of several well-known models of FEI and recent literature in the domain. Like Koen et al. (2001), Figure 13 shows five factors comprising FEI. Akin to Cooper’s (1988) model, Idea Generation, Idea Selection and Evaluation feature prominently. The new model progresses our understanding of FEI with the addition of the previously unaccounted for dimensions of Open Innovation and Problem Solving Techniques.

On the basis of previous literature (e.g. Cooper, 1988), it is also possible to hypothesise the interrelations between the dimensions of FEI (c.f. Figure 13). There are three core FEI activities that can be hypothesised to form a process. Idea Generation leads to multiple options, which are then refined during Idea Selection (as conceptualised in notions such as the idea funnel). Finally, the selected ideas undergo Evaluation. Open Innovation and Problem Solving Techniques are situated as universal themes that influence the three core FEI activities. However, current research continues to acknowledge a lack of understanding as to what activities constitute FEI and in which order they should occur (Markham, 2013).
The Front End Innovation Scale offers a number of improvements to the measurement of FEI. First, it is fully focused on FEI. Many extant measures focus on the full innovation process and draw conclusions regarding FEI based on this. However, this assumption of a direct relationship is problematic due to the many activities that occur between the first and last stages of the innovation process (Makkonen & van der Have, 2013). Moreover, FEI is substantively different to the latter stages of the innovation process (Markham, 2013), and as such a measure specific to FEI is appropriate.

Second, because of the focus on the underlying subjective perceptions that drive FEI, the new measure is generalisable across organisations and industries, whereas specific outcome measures cannot be generalised. For example, an outcome measure in one organisation (e.g. number of patents, which is in itself a highly problematic and – at best – partial measure of innovation) may not be relevant to another organisation. However, the perception as to whether Idea Generation is effective may be generalised across industries and within an organisation. This is possible because the Front End Innovation Scale focuses on the underlying subjective perceptions of FEI that are common in any setting.

Third, FEIS advances FEI measurement because psychometric principles were used to develop and to statistically evaluate the items. This led to a more robust measure than alternative approaches to measuring FEI, which do not appear to have been developed in this way.
FEIS has a number of implications for researchers. First, providing a measure developed using psychometric principles provides researchers with a measure of FEI that can be confidently used in research due to the rigour with which it was developed.

Second, the emergence of Problem Solving Techniques and Open Innovation as distinct factors suggests that greater consideration should be given to these issues during FEI. For example, although many companies profess to engage in open innovation (Chesbrough, 2003; Chesbrough, 2006; Gassmann et al., 2010), it is not practiced by all organisations (Trott & Hartmann, 2009), with practices varying across industries and size of firms (Rogers, 2004), and it is not clear to what extent organisations engage in open innovation during FEI specifically. Equally, the employment of Problem Solving Techniques varies across companies and industries, and the relevance of problem solving techniques to FEI specifically may not be realised yet.

Third, FEIS may be used to relate FEI activities to activities or outcomes later on in the innovation process, for example formalised product development. Currently, these relationships are largely unexplored (Makkonen & van der Have, 2013). Clear exposition of the extent to which FEI influences latter innovation stages would have both theoretical and practical implications.

Fourth, FEIS could be used as one part of a composite measure of overall innovation performance. Composite measures of innovation may be appropriate as they reflect the multi-stage nature of innovation (Makkonen & van der Have, 2013).

The new Front End Innovation Scale has a number of practical implications. First, the new Front End Innovation Scale offers a measure of FEI that can be confidently used due to the psychometric rigour with which it was developed. A robust psychometric measure of perceptions of FEI will allow decisions to be made based upon reliable and valid data. Having the ability to accurately measure FEI may increase the likelihood of it being measured and therefore a greater chance of acting on the results (Cruz-Cazares, Bayona-Saez & Garcia-Marco, 2013). Further, being able to better manage FEI may also lead to better management of the innovation process as a whole.

Second, despite the rigour of FEIS it is brief and easy to administer when compared to other psychometric measures. This will allow organisations to efficiently monitor and manage FEI activities, as employees will be more willing to complete a short measure.

Third, the scale provides some clarity to the “fuzzy” nature of FEI, as it provides five distinct factors that comprise FEI (Idea Generation, Idea Selection, Evaluation, Problem Solving...
Techniques and Open Innovation), and therefore five distinct areas that organisations seeking to improve their FEI capability can focus on.

### 7.13 Limitations and future research

The two development phases presented in this study have a number of limitations and present a number of potential avenues for future research.

First, the generalisability of the research presented herein may be questioned, and more data from different organisations, industries and countries will be required to assess generalisability. In particular, the first development phase involved predominantly UK-based participants, and a substantial portion of participants in the second development phase were also UK-based. As a result, the findings may be less applicable outside the UK. To address this, future research could replicate the second development phase in different languages and organisations. Researchers may wish to employ invariance analysis to explore the differences across languages, countries and cultures.

Second, the Front End Innovation Scale has not been compared with other measures of FEI, such as that developed by Koen et al. (2001). This would further test whether FEIS is accurately measuring FEI. This would go some way to demonstrating construct validity. A possible approach is to triangulate the existing quantitative data with qualitative data. Triangulation allows a deeper exploration of assumptions underlying a construct (Denscombe, 2010), and triangulation with qualitative data may illuminate new perspectives on a topic (Scott, Mannion, Davies & Marshall, 2001). Moreover, qualitative analysis techniques such as thematic analysis seek to identify patterns in the data, much the same as factor analysis (O’Toole, Talbot & Fidock, 2008). Using a novel method, such as a narrative approach, for triangulation would also go some way to addressing calls for innovation research to utilise more innovative forms of data (e.g. Anderson et al., 2004).

Third, additional work on the items may be beneficial, with the aim of improving the reliability of the scales. In particular, of the Open Innovation and Evaluation, as these have the lowest reliabilities. Although they meet or exceed the recommend cut off, they may still be improved. Moreover, improvement in the Open Innovation scale may improve the adequate fit demonstrated through Confirmatory Factor Analysis, and improvement in both scales may lead to the identification of a parsimonious, higher order factor structure, as the current research could not identify such a structure.
Fourth, bias may be introduced into FEIS and the resulting data due to its self-report nature.

Fifth, the current study does not provide evidence of the criterion validity of FEIS. Future research should explore whether higher “scores” on FEIS correlate with a more effective FEI stage.

7.14 Conclusion

The Front End of the Innovation process has been the subject of considerable research interest but FEI has been characterised by inadequate measurement. Research Aim 1 sought to develop a reliable and valid measure of Front End Innovation. The Front End Innovation Scale introduced in the current research represents a more robust measure than the existing measures. Moreover, it provides clarity to the understanding and measurement of FEI and opportunities for more reliable measurement and generalisable FEI research. In doing so, FEIS may go some way to enabling Front End Innovation to lose its’ “fuzzy” moniker.
8 STUDY 2: DEVELOPMENT OF THE CREATIVE AND INNOVATIVE CLIMATE SCALE (RESEARCH AIM 2)

8.1 Chapter overview

Study 2 was conducted to address Research Aim 2, which sought to develop a valid and reliable measure of Creative and Innovative Climate. This chapter presents the development of the Creative and Innovative Climate Scale (CICS), which extends the existing measures of creative climate and innovative climate by contributing a measure developed using psychometric principles and triangulated with qualitative data.

CICS is a 33 item measure comprising 10 factors (Valuing Creativity and Innovation, Team Cohesion, Autonomy, Goal Awareness, Resources, Risk Taking, Ideation Systems, Internal Networks, Internal Collaboration, External Collaboration).

Comparable existing measures are discussed, followed by the results of the first ($n=416$) and second ($n=841$) development phases. The third development phase, comprising the triangulation of these results with qualitative narrative data ($n=30$), is then discussed. Implications for academia and practitioners, and limitations and suggestions for future development of CICS, will be then outlined.

8.2 Existing measures of Creative and Innovative Climate

There has been a long history of attempts to measure organisational culture and climate. Several efforts have also been made to measure creativity and innovation climate specifically. Before discussing the development of CICS, it is important to locate CICS within the existing literature surrounding Creative and Innovative Climate measures. As discussed in the Creative and Innovative Climate literature review chapter, there has been much debate regarding the dimensions that may constitute Creative and Innovative Climate, and currently there is no consensus (Ahmed, 1998; Rank et al., 2004; Hunter et al., 2005). This state of the science has resulted in problematic measurement of Creative and Innovative Climate, and these challenges have been exacerbated by the fact that extant measures have been developed using varying degrees of psychometric principles.

Arguably the most comprehensive review of Creative and Innovative Climate measures identified three main limitations befalling existing measures (Mathisen & Einarsen, 2004). First,
the most consistent criticism of existing measures is that they have not been developed using psychometric principles and as such often lack psychometric quality. This is the case with Ekvall’s (1996) Creative Climate Questionnaire, for example, which was purported to have adequate psychometric quality but the information upon which this claim was made was often not presented. The KEYS has presented evidence to support claims of a factor structure with good fit, although confirmatory factor analyses revealed many items loaded onto more than one factor, and the RMSEA was adequate (RMSEA = .06) not excellent. Moreover, no exploratory factor analyses were presented (Amabile et al., 1996; Mathisen & Einarsen, 2004). Second, there is a lack of clarity regarding whether measures of Creative and Innovative Climate are targeted at the individual, team or organisational level. Perhaps due to a lack of clarity in the original measures, researchers utilising these measures often misapply it. For example, the Team Climate Inventory (TCI) is located in the team level, however researchers have extensively applied it at the individual level (Mathisen, Einarsen, Jorstad & Bronnick, 2004). Moreover, Mathisen and Einarsen (2004) note that the authors of a measure sometimes utilise their measure at a level which they have previously stated it does not apply to (e.g. Ekvall, 1996). The level-of-analysis issue clearly has ramifications for the (mis) interpretation of research findings.

Third, the statistical evidence suggests flaws with the theory upon which some measures of Creative and Innovative Climate are based. For example, the Siegel Scale of Support for Innovation (Siegel & Kaemmerer, 1978) is based on five factors, however analysis of the factor structure revealed one factor that accounted for the majority of the variance. This emphasises the importance of seeking consensus, as much as is possible, regarding the dimensions that constitute Creative and Innovative Climate, and indeed whether creative climate and innovative climate are comprised of a single construct or two constructs.

In addition to the arguments made by Mathisen and Einarsen (2004), the lack of consensus regarding the dimensions comprising Creative and Innovative Climate is arguably also a contributing factor to the lack of a consensual measurement approach.

Concluding their review, only two existing measures were found to have acceptable psychometric underpinning (specifically, validity information): the KEYS (Amabile et al., 1996) and the TCI (Anderson & West, 1998). Mathisen and Einarsen (2004) arguably sought to encourage researchers to continue working on the measurement of Creative and Innovative Climate, as they recommended that the KEYS and TCI be used as a basis for future measure development activities. However, poor validity and reliability continues to prevail in measures of
Creative and Innovative Climate (Denison et al., 2014), suggesting this topic still requires attention.

The aim of this chapter is to introduce a robust psychometric measure of individual perceptions of Creative and Innovative Climate that is based on a comprehensive review of existing Creative and Innovative Climate dimensions and that has been informed by triangulated data. Put briefly, existing measures are neither robust psychometrically nor are they developed using more than one source or type of data; CICS aims to be both of these.

8.3 Psychometric principles

Psychometric principles guided the development of CICS. By using psychometric principles, CICS is differentiated from previous measures of creative climate or innovative climate, of which only two had ‘acceptable’ psychometric underpinning (Mathisen & Einarsen, 2004).

Psychometrics, concerned with the scientific measurement of psychological constructs, has a long-standing history in psychology and a wide application to the measurement of constructs of importance in the social sciences (Furr & Bacharach, 2008; Kline, 2000). Psychometric principles stipulate that measures should be reliable (consistent), valid (measure what it purports to measure), standardised and unbiased (c.f. Rust & Golombok, 2009 for detailed exposition of the principles of psychometrics).

CICS was developed in three phases. The first two phases took a quantitative approach whilst the third phase took a qualitative approach. The first phase will now be discussed.

8.4 Phase 1: Method and participants

Psychometric principles were followed in this phase (c.f. Rust & Golombok, 2009). In particular, there was a focus on following a consistent methodology for measure construction, the use of an adequate sample size for the statistical methodology employed, and the use of rigorous statistical analyses.

Suggestions as to the steps involved in constructing a psychometric measure are largely similar, although there is no absolute consensus (Furr & Bacharach, 2008). The methodology outlined by DeVellis (2012) is considered a good example of rigorous construction guidelines for psychometric measures (Worthington & Whittaker, 2006). The psychometric measure construction stages proposed by DeVellis (2012) are presented next.
1. Establish what construct is trying to be measured
2. Generate items
3. Establish measure format
4. Ask experts to review items
5. Consider appropriateness of including validation items
6. Administer instrument
7. Analyse instrument responses
8. Optimise instrument length

Establishing which constructs to measure followed a thorough literature review of pertinent creative climate and innovative climate studies and existing measures. This was largely based on Hunter et al.’s (2005) systematic review of existing Creative and Innovative Climate taxonomies. Existing measures were adapted where possible, consistent with Mathisen and Einarsen’s (2004) argument that existing measures in this area should be improved through adaptation and utilising existing work, as opposed to developing a new measure.

The dimensions of the taxonomies reviewed by Hunter et al. (2005) were examined by the researcher, and were retained against the following criteria:

1. The dimension (including synonymous dimension labels) must occur three or more times. For example, Risk Orientation (Nystrom et al., 2002), Risk-Taking (Isaksen & Kaufman, 1990) and Risk Taking (Kitchell, 1995) were considered synonymous, and therefore a dimension labelled Risk Taking was retained.
2. The dimension could not be incorporated into a (broader) pre-existing dimension. For example, Sethi and Nicholson’s (2001) dimension Senior Management Encouragement to Take Risk was incorporated into the broader dimension Top Management Support.

Overall, eleven dimensions were retained: Challenging Work; Goal Awareness; Autonomy; Top Management Support; Risk Taking; Reward; Resources; Organisational Integration: Internal; Organisational Integration: External; Team Cohesion; Process.

Suitable items for eight of the eleven dimensions were derived from KEYS and TCI items. The definition of each dimension was considered, alongside the existing items. These were
used as the basis to generate new items which aimed to be shorter and have greater clarity of expression. Evaluating items as regards their brevity, clarity of expression and potential ambiguity in their meaning is recommended during item development (Anderson & Morgan, 2008; Goldsmith, 1996).

Items were preferentially derived from KEYS and TCI as they were previously identified as the only two measures of creative climate or innovative climate with sufficient validity information to recommend their use as a basis for future developments (Mathisen & Einarsen, 2004). These scales could not be used without modification for the following reasons:

1. The Americanised KEYS items were not appropriate for the European context of the current research
2. The KEYS item content could be improved. Some items could not have been easily answered by all MBDA employees, such as “the budget for my project(s) is generally adequate”, which implies a level of seniority. Additionally, some items could arguably be amended to improve clarity of expression, such as “in this organization, there is a lively and active flow of ideas” and “people in this organization are very concerned about protecting their territory”
3. The KEYS was not freely available and therefore the operational cost of using KEYS was prohibitive
4. The focus of the TCI was at the team level, whereas the current research sought to measure individual perceptions of Creative and Innovative Climate

Moreover, there have been developments in the literature since the inception of KEYS and TCI which needed to be reflected in the current research. In particular, the growing awareness of an external focus in creativity and innovation (e.g. Open Innovation). Suitable scales from other authors within the creativity and innovation management literatures were sought to form the basis of CICS scales not covered by KEYS and TCI. This approach was taken, as opposed to creating completely new scales, following Mathisen and Einarsen’s (2004) recommendation for researchers in this area to adapt existing measures instead of ignoring earlier work and creating new scales. Items to measure Organisational Integration: External and Process were derived from Tidd and Bessant’s (2009) Innovation Audit, and items to measure Organisational Integration: Internal were based on three items from Li and Calantone’s (1998)
Marketing-Research and Development Interface scale, derivations of which have subsequently been used in other research (e.g. Luca & Atuahene-Gima, 2007).

Table 15 presents the number of items proposed to measure each dimension and where these items were derived from. The definition of each dimension was considered, alongside the existing items. These were used as the basis to generate new items which aimed to be briefer and have greater clarity of expression.

Table 15. The Number of Items Proposed to Measure Each Dimension of Creative and Innovative Climate and Their Source

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Number of items</th>
<th>Scale derived from</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenging Work</td>
<td>5</td>
<td>KEYS: Challenging Work</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>5</td>
<td>TCI: Vision</td>
</tr>
<tr>
<td>Autonomy</td>
<td>4</td>
<td>KEYS: Freedom</td>
</tr>
<tr>
<td>Top Management Support</td>
<td>7</td>
<td>KEYS: Organisational Impediments and Organisational Encouragement</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>4</td>
<td>KEYS: Organisational Impediments and Organisational Encouragement</td>
</tr>
<tr>
<td>Reward</td>
<td>3</td>
<td>KEYS: Organisational Encouragement</td>
</tr>
<tr>
<td>Resources</td>
<td>6</td>
<td>KEYS: Sufficient Resources</td>
</tr>
<tr>
<td>Organisational Integration: Internal</td>
<td>5</td>
<td>Marketing-Research and Development Interface (Li &amp; Calantone, 1998)</td>
</tr>
<tr>
<td>Organisational Integration: External</td>
<td>7</td>
<td>Innovation Audit: Linkages (Tidd &amp; Bessant, 2009)</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>6</td>
<td>TCI: Participative Safety</td>
</tr>
<tr>
<td>Process</td>
<td>7</td>
<td>Innovation Audit: Process (Tidd &amp; Bessant, 2009)</td>
</tr>
</tbody>
</table>

Following the generation of items based on factor labels and existing items, two academics specialising in creativity and innovation and three innovation practitioners then reviewed the items. The dimension labels were presented to each specialist, and they were asked for feedback on the appropriateness of the items as regards the dimension label and clarity of the items. Suggestions were made regarding improving clarity of the item wording. Specifically, their feedback was as follows:
First, the items were clear and easily understandable. Second, they perceived some repetition in the items, with some items asking the same thing in different ways. Some items were reworded to improve opacity. Practitioners and academic experts were consulted to give due consideration to how the questionnaire may be interpreted in an organisational context. This is good practice but often overlooked during measure development (Muchinsky, 2004).

Once the items were finalised, a questionnaire was constructed using the online survey software Qualtrics. It comprised 68 Creative and Innovative Climate items and 13 demographic items. Prior to wide-scale dissemination, the questionnaire was piloted with five participants, who identified potential lack of clarity in the instructions. A second stage of the pilot was conducted when these issues had been addressed to assess technical operation in three popular web browsers (Chrome, Safari and Internet Explorer).

The questionnaire was distributed electronically and in paper format to working adults. The questionnaire was electronically distributed using relevant LinkedIn groups, as social media is increasingly considered a viable (DeLamater & Ward, 2013; Sappleton, 2013), and innovative (Soderman & Dolles, 2013), data collection method. Relevant LinkedIn groups were identified by entering certain keywords in the search function on the LinkedIn website. The keywords used were: psychology, HR, culture, creativity, innovation, psychometric.

In paper format, the questionnaire was distributed to staff and students of a large UK University with the additional incentive of a bar of chocolate. The offer of a low value reward to survey respondents is a commonly used as a tactic in research as a means of increasing response rates (Dillman, 2007; Edwards et al., 2002). The researcher approached staff and students in the communal areas of key university buildings in January and February 2013, briefly introducing the questionnaire and offering the incentive. Some staff members invited the researcher to distribute the questionnaire in their offices too. All participants were assured that their responses would be confidential and provided informed consent.

8.5 Phase 1: Data analysis

Following data collection, the paper questionnaires were entered into SPSS (version 20) and combined with the data collected through Qualtrics. The data could then be analysed.
8.5.1 Data checking

Data checking involved addressing missing data and assessing normality assumptions which must be met for the psychometric analyses to be performed (c.f. Tabachnick and Fidell (2013) for detailed exposition of normality assumptions).

8.5.2 Missing data

The issue of missing data, i.e. a partially incomplete data matrix (Lance & Vandenberg, 2009), is a common problem in research and should be addressed as the first point in any analysis (Tabachnick & Fidell, 2013). A Missing Value Analysis was conducted to assess the pattern of missingness in the data. .97% of the data was considered missing.

Little’s Missing Completely At Random test was not significant (.60), indicating data was Missing Completely At Random (MCAR). To address the issue of data MCAR, both deletion and the imputation method Expectation Maximisation (EM) were used. Using deletion as the sole solution to missing data is increasingly criticised, however when used in moderation it is useful when combined with more statistically advanced imputation techniques (Cennamo & Gardner, 2008; Martin et al., 2007; Xu & Thomas, 2011). Expectation Maximisation was considered an appropriate imputation method as it is the most widely recommended for data MCAR (Martin et al., 2007). In creativity research, the issue of missing data is often addressed using deletion followed by a statistically advanced technique such as EM (e.g. DiLiello & Houghton, 2008; Kwasniewkaw & Necka, 2004; Tierney & Farmer, 2004). In the current research, one case was deleted as the participant had completed only 5 questions. Following deletion and EM, a total of 416 participant responses were acceptable for analysis.

8.5.3 Normality assumptions

The sequence for establishing multivariate normality as outlined by Tabachnick and Fidell (2013) was followed:

1. Outliers: parcel zscores were calculated and values above 3.29 identified to establish the presence of outliers. .03% exceeded this level; some values exceeding of 3.29 is expected in a large data set (Field, 2005), thus it was concluded that there were no significant outlier distortions in the data.
2. Skew and kurtosis: skew and kurtosis z-scores were calculated, with values of zero indicating no skew or kurtosis: a perfect normal distribution. Often a cut off of 1.96 is adhered to (e.g. Kerr et al., 2002), with values above that indicating that the variable in question is skewed or kurtotic. However, a cut off of 2.58 can be used in larger samples (Turner, 2014). Goal and Reward were identified as skewed (Reward; 2.78) or kurtotic (Goal; 17.27, Reward; 32.72). The relevant histograms were also consulted to judge normal distribution, as is recommended for large samples (Tabachnick & Fidell, 2013). These confirmed the skew and kurtosis suggested by the above values. When skew or kurtosis is present, some authors advocate transforming data, typically using either a square root, logarithmic or inverse approach (e.g. Tabachnick & Fidell, 2013). However, no transformation was conducted in this study. This is for two reasons. First, changing the data arguably loses some of its richness, and second, transformed data can be harder to interpret (Tabachnick & Fidell, 2013).

3. Linearity: the assumption of a straight-line relationship between two variables was assessed using bivariate scatterplots. These evidenced reasonable linearity in all cases.

4. Homoscedasticity: the assumption that the variability of data points is the same in two continuous variables (Tabachnick & Fidell, 2013) was tested using bivariate scatterplots. These evidenced reasonable homoscedasticity in all cases.

8.5.4 Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) was conducted on the data from the 416 questionnaires to examine the factor structure of CICS and identify the meaningful factors underlying the measure. One of the main uses of Exploratory Factor Analysis is measure development, with EFA always preferred over Confirmatory Factor Analysis (Hayton et al., 2004; Kim et al., 1999; Worthington & Whittaker, 2006).

EFA was conducted using Maximum Likelihood extraction and Direct Oblimin rotation. Maximum Likelihood extraction was used as it assumes some error in variable measurement and optimally accounts for inter-variable correlation (Fabrigar et al., 1999), which is a common feature of subjective self-perception data. Factors were rotated to improve their psychological meaningfulness (Ford et al., 1986). An Oblique rotation method was chosen as it allows factors to correlate, which is appropriate when measuring psychological constructs (Field, 2005). Eigenvalues below 1 were suppressed in accordance with the Kaiser criterion (Kaiser, 1958).
Interpretation of the scree plot (Catell, 1966) suggested an 11 or 12 factor solution (Figure 14). To identify the most appropriate solution, both of these factor solutions were examined adopting four criteria (Cooper, 2002; Worthington & Whittaker, 2006).

1. Each factor should have at least three loadings above \( r = .3 \)
2. Each item should only load onto one factor above \( r = .3 \) (no crossloading)
3. Item communality should not be below \( r = .2 \)
4. Each factor should be interpretable and theoretically coherent

Both the 11 and 12 factor solutions contained theoretically incoherent factors and did not contain a Risk Taking factor. The absence of a Risk Taking factor was surprising due to the theoretical arguments surrounding risk and its relationship with creativity and innovation. Therefore, the scree plot was re-examined which suggested a 13, 14 or 15 factor solution may also be appropriate. Re-examination of the scree plot can be helpful when there is either no clear discontinuity or more than one possible points of discontinuity (Hayton et al., 2004). Moreover, Hayton et al. (2004) argue that the negative effects of extracting too few factors are more severe
than extracting too many factors, thus larger factor solutions were considered. EFA is a procedure that requires the researcher to “use inductive reasoning...subtly adjusting and readjusting their approach to produce the most meaningful results” (Worthington & Whittaker, 2006, p.808).

The 13, 14 and 15 factor solutions were examined using the criteria outlined above. The 15 factor solution provided the most appropriate solution: three factors were excluded on the basis that they were under-identified (they had fewer than three loadings above $r=.3$). The remaining 12 factors utilised 49 of the original 68 items and each factor was theoretically coherent (Kline, 1994). A 12 factor solution was also consistent with the more prominent discontinuity in the scree plot at 11 or 12 factors. The alternative discontinuity at 13, 14 or 15 factors may be due to the suppression of eigenvalues below 1; Hayton et al. (2004) and Horn (1965) argue that the Kaiser criterion (this suppression rule) tends to overestimate the number of factors that should be extracted.

### 8.5.5 Additional item deletion and new items

Item deletion was based on how well the item loaded onto the factor (i.e. its contribution to that factor), and theoretical coherence (Sweeney & Soutar, 2001; Worthington & Whittaker, 2006). To assess the theoretical coherence of the items constituting each factor, the researcher, an academic specialising in creativity and an innovation practitioner each reviewed the items. They were presented with the dimension labels and asked to provide feedback on the appropriateness of the items as regards the dimension label. Seven items were identified as inconsistent with the dimension label and therefore not supporting the theoretical coherence of their factor. These seven items were removed and 42 items remained.

In summary, 68 items were written and tested in a sample of 416 working adults. All 68 items were entered into the factor analysis and 42 items remained. Discarded items did not meet the criteria for item retention detailed in the beginning of this section. Ten additional items were then generated by the researcher with input from the supervisory team using the factor labels and definitions as guidance. These items were developed with the aim of improving the reliability and cohesiveness of each factor following the item development guidelines presented in section 8.4. New items are indicated in Table 16 with an asterisk. This resulted in a 52 item measure.
Table 16. Final Factor Solution for the Creative and Innovative Climate Scale

<table>
<thead>
<tr>
<th>Factor</th>
<th>Factor Label</th>
<th>Item</th>
<th>Factor Loading</th>
<th>Alpha (α)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Valuing Creativity and Innovation</td>
<td>My organisation appreciates creative and innovative work</td>
<td>0.76</td>
<td>0.90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>My manager expects people to do creative and innovative work</td>
<td>0.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Creative and innovative work is recognised</td>
<td>0.65</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Being creative and innovative leads to success</td>
<td>0.64</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My manager wants people to have new ideas</td>
<td>0.56</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Creative and innovative work is rewarded</td>
<td>0.54</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Team Cohesion</td>
<td>People in my team trust one another</td>
<td>0.97</td>
<td>0.80</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In my team we understand and accept each other</td>
<td>0.51</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>In my team we support each other*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Autonomy</td>
<td>My manager decides what work I do (r)</td>
<td>-0.71</td>
<td>0.72</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The way I work on projects is my decision</td>
<td>0.62</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My manager tells me how I should do my work (r)</td>
<td>-0.60</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My manager is highly controlling (r)</td>
<td>-0.44</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My Function has rigid procedures (r)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Goal Awareness</td>
<td>I know what my team’s objectives are</td>
<td>0.87</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The members of my team understand these objectives</td>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We all know what our goals are*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Resources</td>
<td>The resources I need for my work are available</td>
<td>0.79</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I can always access the facilities I need for my work</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I can easily get the things I need for my work</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Risk Taking</td>
<td>Taking risks is discouraged (r)</td>
<td>-0.78</td>
<td>0.63</td>
</tr>
<tr>
<td></td>
<td></td>
<td>My manager dislikes taking risks (r)</td>
<td>-0.58</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My manager is prepared to take risks</td>
<td>0.38</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Expertise</td>
<td>We have a wide network of external specialists</td>
<td>0.54</td>
<td>0.73</td>
</tr>
<tr>
<td></td>
<td></td>
<td>We use experts to help us develop our knowledge</td>
<td>0.52</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>When needed, meetings have people from different parts of the</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>organisation attending</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We work with many different experts*</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>8</strong> Ideation Systems (4 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------</td>
<td>-----</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is a good system for searching for new ideas</td>
<td>0.53</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is a process to make sure everyone knows the innovation strategy</td>
<td>0.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Different parts of the organisation work together to generate ideas</td>
<td>0.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is a good system to help me have new ideas*</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td><strong>9</strong> Internal Networks (7 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>People across my organisation know one another</td>
<td>0.51</td>
<td>0.66</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I know lots of people outside my part of the organisation</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>People from different parts of the organisation socialise regularly</td>
<td>0.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>My organisation encourages people from different parts of the organisation to meet</td>
<td>0.39</td>
<td></td>
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<tr>
<td></td>
<td>My manager encourages me to make connections with people from other Functions*</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>I put lots of effort into making connections with people from other Functions*</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>I put lots of effort into maintaining connections with people from other Functions*</td>
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<td></td>
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<tr>
<td></td>
<td><strong>10</strong> Achievement (6 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Every team member is responsible for the success of the team</td>
<td>0.45</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My team’s objectives can be achieved</td>
<td>0.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The work I do is important</td>
<td>0.43</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The work I am doing is urgently needed by the organisation</td>
<td>0.38</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I could easily work with someone in a different part of the organisation</td>
<td>0.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>We understand the needs of our internal customers</td>
<td>0.33</td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td><strong>11</strong> Internal Collaboration (4 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Different parts of the organisation work together to set strategy</td>
<td>0.62</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Different parts of the organisation work together to set goals</td>
<td>0.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There are good systems in place to help manage the process from developing ideas to implementation</td>
<td>0.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>There are good processes to ensure different parts of the organisation have early involvement in developing new products, processes or services</td>
<td>0.38</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>12</strong> External Collaboration (4 items)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>We work with other organisations to develop new products, processes or services</td>
<td>0.58</td>
<td>0.63</td>
<td></td>
</tr>
<tr>
<td></td>
<td>We work closely with customers to develop new products, processes or services</td>
<td>0.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>We have mutual trust with our suppliers*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>We collaborate with other organisations*</td>
<td></td>
<td></td>
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</tbody>
</table>

(r) = reverse scored item
8.5.6 Factor labeling

Factor 1 was labeled Valuing Creativity and Innovation, as it concerns how the organisation recognises and rewards both creativity and innovation activities. An example item is: “My organisation appreciates creative and innovative work”.

Factor 2 was labeled Team Cohesion, and pertains to the level of trust and interpersonal understanding within the workgroup. An example item is: “People in my team trust one another”.

Factor 3 was labeled Autonomy as it concerns the level of control an individual feels they have over their work, and their perception of whether senior management supports or hinders this control. An example item is: “I decide what work I do”.

Factor 4 was labeled Goal Awareness, and pertains to the understanding that members of a team understand and agree with the team’s objectives. An example item is: “I know what my team’s objectives are”.

Factor 5 was labeled Resources, and concerns the availability of the materials and facilities an individual may need to complete their work. An example item is: “The resources I need for my work are available”.

Factor 6 was labeled Risk Taking, as it concerns the organisation’s approach to risk and the level of risk taking within the organisation. An example item is: “Taking risks is discouraged”.

Factor 7 was labeled Expertise, as it relates to the organisation’s willingness to draw on experts and a variety of knowledge when needed, from within and outside the organisation. An example item is: “We have a wide network of external specialists”.

Factor 8 was labeled Ideation Systems as it concerns idea generation, and the process by which the organisation facilitates idea generation. An example item is: “There is a good system for searching for new ideas”.

Factor 9 was labeled Internal Networks, as it concerns the extent to which individuals know people from different parts of the organisation to their own, and the extent to which the organisation encourages these interactions. An example item is: “People across my organisation know one another”.

Factor 10 was labeled Achievement, as it concerns the extent to which individuals and teams take responsibility for success and consider their work important for the success of the organisation. An example item is: “Every team member is responsible for the success of the team”.

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Factor 11 was labeled Internal Collaboration as it pertains to different parts of the organisation working together throughout the innovation process, and to set organisational strategy and goals. An example item is: “Different parts of the organisation work together to set strategy”.

Factor 12 was labeled External Collaboration as it concerns the extent to which the organisation has positive relationships with other organisations, suppliers and customers, and uses these relationships to develop new products, processes or services. An example item is: “We work with other organisations to develop new products, processes or services”.

8.5.7 Scale reliability

Cronbach’s alpha (Cronbach, 1951) was calculated to estimate factor reliability. Reliability refers to the internal consistency of a measure, and of the scores obtained (Anastasi & Urbina, 1997). The cutoff for an acceptable Cronbach’s alpha value is typically .70 (Mejias, 2007; Tavakol & Dennick, 2011). Nine of the twelve factors had Cronbach’s alpha of .70 or above. Risk, External Collaboration and Internal Networks had Cronbach’s alpha of .63, .63 and .66 respectively, and measures with Cronbach’s alpha below .70 are often used in research (e.g. Charlesworth et al., 1991; Fenwick et al., 2011; Hochwalder & Brucefors, 2005; Kober & Eggleton, 2005; Sivanathan & Fekken, 2002). Moreover, by introducing new items, future research, i.e. the second development phase of CICS, will allow the reliability of these factors to be improved.

8.6 Interim summary

The preceding section presented the first phase in the development of CICS. Using data from working adults, a 52 item, 12 factor measure was produced. To add rigour, this measure was tested with a further 841 employees from MBDA, and all statistical analyses were repeated. This led to a 33 item, 10 factor measure. This constituted the second phase of development and is presented below.

8.7 Phase 2: Participants and method

The second phase of development of CICS sought to extend the work completed during the first development phase, specifically by empirically testing CICS (including the new items introduced at the end of the first development phase) on a larger sample.
8.7.1 Participants and method

In total, 841 MBDA employees completed CICS during this development phase. For transparency, the 841 participants referred to here are the same 841 participants referred to in Study 3 and the second phase of FEIS development in Study 1. Of the 841 participants, the vast majority were male ($n=636$, 83%) and aged 50 or above (35.4%). Those aged 41-50 (20.7%), 31-40 (23.4%), and under 30 (20.4%) were relatively equally represented. This was based 627 participants, as 214 did not provide their age. Data was collected from the countries forming the integrated organisation; France ($n=352$), the UK ($n=323$) and Italy ($n=166$), not Germany.

Participants predominantly completed CICS online after receiving an email inviting them to participate in a wider study involving two questionnaires and multiple measures (Study 3). This email was sent by the Innovation Manager in each country, and provided basic information about the study and the links to the online questionnaires. Each Innovation Manager adapted their email as they thought was appropriate for their country. Mainly, this involved the French Innovation Manager including additional information assuring participants that the data would be confidential and an individual’s data could only be accessed by researchers at University of Manchester, and not by the organisation’s management.

In the UK, this data collection approach was supplemented by the researcher spending fifteen days in main thoroughfares of the three UK sites approaching individuals at random to introduce the research to them and request that they participate. In these cases, participants could either complete the questionnaires immediately on a pre-arranged computer, or could take away a paper copy of the questionnaire containing CICS.

8.8 Phase 2: Data analysis

8.8.1 Data checking

Ensuring suitability of the data involved addressing missing data and assessing normality assumptions which must be met for the psychometric analyses to be performed. For information about normality assumptions refer to Tabachnick and Fidell (2013).

8.8.2 Missing data

The pattern of missing data was assessed for the data set with the exception of the demographic data (e.g. age, gender). The issue of missing data, i.e. a partially incomplete data matrix (Lance & Vandenberg, 2009), is a common problem in research and should be addressed as the first
point of any analysis (Schlomer et al., 2010). A Missing Value Analysis was conducted to assess the pattern of missingness in the data. 20.5% of the data were considered missing.

Little’s Missing Completely At Random test was not significant (.07), indicating data was Missing Completely At Random (MCAR). To address the issue of data MCAR the imputation method Expectation Maximisation (EM) was used as it is the most widely recommended for data MCAR (Martin et al., 2007) and has been used in innovation research (e.g. Singh & Smith, 2004). Following EM, data from 841 participants were acceptable for analysis.

8.8.3 Normality assumptions

The sequence for establishing multivariate normality as outlined by Tabachnick and Fidell (2013) was followed:

1. Outliers: parcel zscores were calculated and values above 3.29 identified to establish the presence of outliers. .01% exceeded this level; some data exceeding 3.29 are to be expected in large data sets (Field, 2005), thus it was concluded that there were no significant outlier distortions in this data.

2. Skew and kurtosis: assessed at the variable level. Skew and kurtosis zscores were calculated (skew divided by standard error for skew), with values of zero indicating no skew or kurtosis. Often a cut off of 1.96 is adhered to (e.g. Kerr et al., 2002), with values above that indicating that the variable in question is skewed or kurtotic. However, in larger samples a cut off of 2.58 can be used (Turner, 2014). Team Cohesion and Goal Awareness were identified as kurtotic (2.66 and 3.13 respectively). The relevant histograms were also consulted to judge normal distribution, as is recommended for large samples (Tabachnick & Fidell, 2013). These confirmed the kurtosis suggested by the above values. When skew or kurtosis is present, some authors advocate transforming data, typically using either a square root, logarithmic or inverse approach (e.g. Tabachnick & Fidell, 2013). However, no transformation was conducted in this study. This is for two reasons. First, changing the data arguably loses some of its richness, and second, transformed data can be harder to interpret (Tabachnick & Fidell, 2013).

3. Linearity: the assumption of a straight-line relationship between two variables was assessed using bivariate scatterplots. These evidenced reasonable linearity in all cases.
4. Homoscedasticity: the assumption that the variability of data points is the same in two continuous variables (Tabachnick & Fidell, 2013) was tested using bivariate scatterplots. These evidenced acceptable homoscedasticity in all cases.

8.8.4 Exploratory Factor Analysis

Exploratory Factor Analysis was conducted on the data from the 841 questionnaires to examine the factor structure of CICS and identify the meaningful factors that underlie this measure. One of the main uses of Exploratory Factor Analysis is measure development, with EFA always preferred over Confirmatory Factor Analysis (Hayton et al., 2004; Kim et al., 1999; Worthington & Whittaker, 2006). Moreover, EFA was used for a second time due to the ten additional items introduced into CICS at the end of the first development phase and therefore after the initial EFA was conducted.

EFA was conducted using Maximum Likelihood Extraction and Direct Oblimin rotation. Maximum Likelihood Extraction was used as it assumes some measurement error and optimally accounts for inter-variable correlation (Fabrigar et al., 1999), which is a common feature of subjective self-perception data. Factors were rotated to improve their psychological meaningfulness (Ford et al., 1986). An Oblique rotation method was chosen as it allows factors to correlate, which is appropriate when measuring psychological constructs (Field, 2005). Eigenvalues below 1 were suppressed in accordance with the Kaiser criterion (Kaiser, 1958).

Interpretation of the scree plot (Catell, 1966) showed discontinuity at 6 and 14 factors (Figure 15). As there was no single clear point of discontinuity, a 14 factor solution was examined first, as this was more consistent with the first phase of CICS development in which 12 factors were identified, and the negative effects of extracting too few factors are more severe than extracting too many factors (Hayton et al., 2004). The factor solution was examined adopting four criteria (Cooper, 2002; Worthington & Whittaker, 2006).

1. Each factor should have at least three loadings above $r=.3$
2. Each item should only load onto one factor above $r=.3$ (no crossloading)
3. Item communality should not be below $r=.2$
4. Each factor should be interpretable and theoretically coherent
The 14 factor solution was examined using the criteria outlined above, and produced 10 identifiable factors using 36 items. These 10 factors measured the same theoretical constructs as 10 of the factors identified in the first CICS EFA, although some of the item content had changed as the current factor structure has fewer items than the earlier factor structure. Two factors identified in the first EFA were not identified in the current factor structure: Expertise and Achievement. This may be because Expertise and Achievement are not strictly part of an organisation’s climate.

### 8.8.5 Additional item deletion and new items

Item deletion was based on how well the item loaded onto the factor (i.e. its contribution to that factor) and whether removing an item would improve the overall reliability of the scale. All of the remaining items were deemed to fit theoretically with other items in the factor they were measuring. One item was removed from Internal Networks (Q18_46), one item was removed from Team Cohesion (Q18_11) and one item was removed from Internal Collaboration (Q18_33) in order to improve the reliability of the scale they loaded onto. Thirty-three items remained.
Table 17. Final Factor Solution for the Creative and Innovative Climate Scale

<table>
<thead>
<tr>
<th>Factor</th>
<th>Factor Label</th>
<th>Item</th>
<th>Factor Loading</th>
<th>Alpha (α)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Valuing Creativity and Innovation (3 items)</td>
<td>Creative and innovative work is recognised</td>
<td>0.78</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Creative and innovative work is rewarded</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>My organisation appreciates creative and innovative work</td>
<td>0.41</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Team Cohesion (3 items)</td>
<td>In my team we understand and accept each other</td>
<td>0.85</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td></td>
<td>In my team we support each other</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>People in my team trust one another</td>
<td>0.78</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Autonomy (3 items)</td>
<td>My manager tells me how I should do my work (r)</td>
<td>-0.63</td>
<td>0.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>My manager decides what work I do (r)</td>
<td>-0.55</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The way I work on projects is my decision</td>
<td>0.45</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Goal Awareness (3 items)</td>
<td>I know what my team’s objectives are</td>
<td>0.89</td>
<td>0.88</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The members of my team understand these objectives</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>We all know what our goals are</td>
<td>0.59</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Resources (3 items)</td>
<td>I can easily get the things I need for my work</td>
<td>0.80</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I can always access the facilities I need for my work</td>
<td>0.76</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>The resources I need for my work are available</td>
<td>0.70</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Risk Taking (3 items)</td>
<td>My manager dislikes taking risks (r)</td>
<td>-0.79</td>
<td>0.77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>My manager is prepared to take risks</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Taking risks is discouraged (r)</td>
<td>-0.61</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Ideation Systems (5 items)</td>
<td>There is a good system to help me have new ideas</td>
<td>0.63</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
<td></td>
<td>There are good systems in place to help manage the process from developing ideas to implementation</td>
<td>0.58</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>There is a good system for searching for new ideas</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>There is a process to make sure everyone knows the innovation strategy</td>
<td>0.43</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>There are good processes to ensure different parts of the organisation have early involvement in developing new products, processes or services</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Internal Networks (3 items)</td>
<td>I put lots of effort into making connections with people from other functions</td>
<td>0.92</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I put lots of effort into maintaining connections with people from other functions</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I know lots of people outside my part of the organisation</td>
<td>0.51</td>
<td></td>
</tr>
</tbody>
</table>
8.8.6 Factor labeling

Factor 1 was labeled Valuing Creativity and Innovation, as it concerns how the organisation recognises and rewards both creativity and innovation activities. An example item is: “My organisation appreciates creative and innovative work”.

Factor 2 was labeled Team Cohesion, and pertains to the level of trust and interpersonal understanding within the workgroup. An example item is: “People in my team trust one another”.

Factor 3 was labeled Autonomy as it concerns the level of control an individual feels they have over their work, and their perception of whether management supports or hinders this control. An example item is: “My manager decides what work I do”.

Factor 4 was labeled Goal Awareness, and pertains to the understanding that members of a team understand and agree with the team’s objectives. An example item is: “I know what my team’s objectives are”.

Factor 5 was labeled Resources, and concerns the availability of the materials and facilities an individual may need to complete their work. An example item is: “The resources I need for my work are available”.

Factor 6 was labeled Risk Taking, as it concerns the organisation’s approach to risk and the level of risk taking within the organisation. An example item is: “Taking risks is discouraged”.

Factor 7 was labeled Ideation Systems as it concerns the process by which the organisation facilitates idea generation. An example item is: “There is a good system to help me have new ideas”. The pilot EFA also included idea generation items, however these items did not load onto this factor, nor did they form an identifiable factor on their own.
Factor 8 was labeled Internal Networks, as it concerns the extent to which individuals know, and attempt to get to know, people from different parts of the organisation to their own. An example item is: “I know lots of people outside my part of the organisation”.

Factor 9 was labeled Internal Collaboration as it pertains to different parts of the organisation working together throughout the innovation process, and to set organisational strategy and goals. An example item is: “Different parts of the organisation work together to set strategy”.

Factor 10 was labeled External Collaboration as it concerns the extent to which the organisation has positive relationships with other organisations, suppliers and customers, and uses these relationships to develop new products, processes or services. An example item is: “We work with other organisations to develop new products, processes or services”.

8.8.7 Scale reliability

Cronbach’s alpha (Cronbach, 1951) was calculated to estimate factor reliability. Reliability refers to the internal consistency of a measure, and of the scores obtained (Anastasi & Urbina, 1997). The cutoff for an acceptable Cronbach’s alpha value is typically .70 (Bernardi, 1994; Mejias, 2007; Tavakol & Dennick, 2011). Nine of the ten factors had Cronbach’s alpha of .70 or above. Autonomy was problematic because of the low Cronbach’s alpha. However, this may be due to French and Italian participants responding differently, and less consistently, to Autonomy items than UK participants. In the full data set the Cronbach’s alpha is .57, however in the UK data (n=323) the reliability increased to .64. This difference may lie in the item ‘the way I work on projects is my decision’ (q18_16), which is also the lowest loading item and thus contributes least to the Autonomy factor. In the multinational dataset, removing this item moderately improved the reliability (to .59), whereas in the UK only data, removing this item reduced the reliability from .64 to .60.

8.9 Interim summary

The preceding section presented the Exploratory Factor Analysis conducted as part of the second phase in the development of CICS. With the exploratory portion of the current research complete, the factor structure was confirmed using Confirmatory Factor Analysis. This is presented below.
8.10 Confirmatory Factor Analysis

Exploratory Factor Analysis identified the factor structure of CICS, which was then confirmed using Confirmatory Factor Analysis, which is a type of Structural Equation Modeling (SEM). All CFAs were conducted using Mplus version 7.

8.10.1 Introduction to Confirmatory Factor Analysis

Confirmatory Factor Analysis is a type of Structural Equation Modeling. SEM is a statistical analysis technique that is used for modeling the relationships between variables. These variables may be observed or unobserved (latent). SEM is used primarily in the social sciences, and continues to be developed as an analysis technique which differentiates it from methods such as factor analysis and multiple regression (Hoyle, 2012).

SEM is interpreted using fit indices. In order to present SEM results in meaningfully, it is necessary to explain fit indices and the method of estimation used prior to presentation of SEM results, as is considered good practice (Hoyle & Panter, 1995).

8.10.2 Method of estimation

The method of estimation is an important consideration, as there are a number of potential approaches and each may influence the results and therefore the interpretation of model fit in a different way (Hoyle, 2012). The current research used the Maximum Likelihood (ML) method of estimation. ML has historically been the preferential method of estimation (Muthen, 2002), as it does not require a very large sample size, is applicable to different types of data (e.g. ratio, interval, continuous), and is considered to provide accurate results (Beauducel & Herzberg, 2006; Bowen & Guo, 2012). The use and reporting of ML has been recommended previously (e.g. Hoyle & Panter, 1995).

8.10.3 Fit indices

Fit indices are used to assess model fit. Model fit is the extent to which the model represents the data and reflects the underlying theory (Hooper et al., 2009). Fit indices can be absolute or incremental. The current research uses two absolute fit indices. First, chi-square. This is almost always reported, in conjunction with the degrees of freedom (df), although it should be cautiously interpreted due to its sensitivity to sample sizes, and it has been argued that it is not as useful as other absolute fit indices, such as RMSEA. RMSEA is the second absolute fit index.
used in the current research, with values below .06 believed to indicate a model with good fit. Although RMSEA is also sensitive to sample size, over estimating model fit in small samples, it is less sensitive to this issue than chi-square (Fan et al., 1999).

The current research also used two incremental fit indices to assess CFA model fit. First, the Tucker and Lewis Index (TLI). TLI is particularly appropriate when used in conjunction with ML estimation and a larger sample size (Hu & Bentler, 1995). Values of 0 indicate no fit whilst values of 1 indicate perfect fit. Values above .90 are believed to indicate good model fit (Schumacker & Lomax, 2010), although the more conservative value of .95 is also used (Hu & Bentler, 1995). Similarly, the Comparative Fit Index (CFI) ranges from 0 (no fit) to 1 (perfect fit), with the same cut offs applied. CFI is the second incremental fit index used in the current research.

8.10.4 Strategies for improving model fit

Typically a first model is specified and the fit indices described above will indicate if the fit of the model could be improved. Model fit can usually be improved, and various strategies may be employed to improve model fit.

First, low loading items should be removed. In this case, a loading below $r=0.20$ would be considered low. Following this, modification indices are examined, and items with high modification indices are identified (Hooper et al., 2009). At this point, it is pertinent for researchers to consider that the role of SEM is to develop a model that has good statistical fit and is theoretically coherent; being led solely by low loadings and modification indices may lead to a model which is statistically robust, but not theoretically coherent, and therefore not useful (Joreskog & Sorbom, 1996; Reisinger & Mavondo, 2006). Likewise, a model may be theoretically coherent despite not meeting strict cut offs for fit statistics, leading to the rejection of a (theoretically) acceptable model; a Type 1 error (Marsh et al., 2004).

Second, parceling can be used to improve model fit, and it is regularly used for this purpose (e.g. Landis et al., 2000; Martens, 2005; Nasser & Wisenbaker, 2003; Rogers & Schmitt, 2004). However, some argue that parceling is controversial (e.g. Little et al., 2002; Sterba, 2011), as it may mask the sources of model misfit, one of which may be theoretical incoherence. Parcelling should be used when the researcher is confident that there are not substantive issues with the proposed model that are causing the poor fit (Bandalos & Finney, 2009; Sterba, 2011). One of the main criticisms of parceling is that when parceling is used, item-to-parcel allocations
should be carefully considered as usually there are many item-to-parcel allocation combinations and each may lead to a different level of model fit (Sterba, 2011). However, the number of item-to-parcel allocation combinations is limited in the current research when scales have only three items. With these considerations in mind, parceling is commonly used.

In addition to improving model fit, alternative (competing) models should be tested during SEM, and CFA in particular, as is consistent in peer-reviewed publications containing CFA (e.g. Serretti & Olgiati, 2004; Stockdale et al., 2002).

### 8.10.5 Confirmatory Factor Analysis modeling

With an introduction to SEM given, the results of the CFAs conducted in the current research are detailed.

First, a CFA was conducted on the final factor solution presented previously. This model showed adequate fit regarding RMSEA, but not TLI or CFI ($\chi^2 = 1905.38$ ($n = 841$; df = 452; $p = .00$) CFI = .90, TLI = .88, RMSEA = .06). Sources of model misfit were sought, which involved exploring the modification indices and identifying factors with low loadings. No particularly problematic modification indices or item loadings were identified. Rank-ordered parcelling was then implemented to improve model fit. However, the resultant model exhibited poorer fit than the first model ($\chi^2 = 2394.99$ ($n = 841$; df = 148; $p = .00$) CFI = .73, TLI = .61, RMSEA = .13), leading to the modification indices and item loadings being re-examined. Item q18_16 had a relatively low loading onto Autonomy (.37) and was therefore considered for deletion. However, removing this item would have resulted in a two item Autonomy scale, and scales with three items or more are preferred (Byrne, 2012). It was therefore retained, especially given the theoretical importance of Autonomy and thus the value of having an Autonomy scale in CICS.

### 8.10.6 Identifying sources of misfit and improving model fit

In a further attempt to identify a good model fit for CICS, another CFA was conducted on the final factor solution presented in Table 3 but with the Autonomy factor removed. As Autonomy was statistically problematic in an earlier EFA but retained due to its theoretical importance, it was pertinent to explore whether this factor was negatively effecting model fit. The resultant model showed slightly improved model fit regarding CFI and TLI, which were the unsatisfactory fit indices in the first CFA, however TLI remained below the recommended cutoff.
Moreover, RMSEA was slightly worsened (although still within an acceptable range) ($\chi^2 = 1712.23 \ (n = 841; \ df = 371; \ p=.00) \ CFI = .90, \ TLI = .88, \ RMSEA = .07$).

In an effort to further improve model fit, and understand the source of the somewhat poor fit, two approaches were taken. First, the presence of national differences was assessed, to account for potential translation issues or differing cultural responses to certain items. Second, a CFA was conducted on each scale individually, to isolate problematic scales.

To explore national differences, three competing models were run, repeating the original model using the data from each country separately. Model fit was slightly worsened when using only UK data ($\chi^2 = 1051.61 \ (n = 323; \ df = 452; \ p=.00) \ CFI = .88, \ TLI = .86, \ RMSEA = .06$). Model fit was substantially worsened when using only French data ($\chi^2 = 1294.30 \ (n = 352; \ df = 452; \ p=.00) \ CFI = .86, \ TLI = .83, \ RMSEA = .07$) or only Italian data ($\chi^2 = 1131.70 \ (n = 166; \ df = 452; \ p=.00) \ CFI = .80, \ TLI = .76, \ RMSEA = .10$), although the Italian model should be interpreted with caution as the sample size is arguably too small for accurate model specification.

As model fit was worsened in each case when analysing national data, national differences or translation issues did not seem to be a cause of the model misfit. Subsequently, each scale was analysed individually to identify individual problematic scales that may have caused the model misfit. These analyses are presented in Table 18.
Table 18. Confirmatory Factor Analysis Model Fit Statistics for Each CICS Scale

<table>
<thead>
<tr>
<th>Scale</th>
<th>Model fit</th>
<th>Goodness of fit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>$\chi^2 = 141.83 \ (n = 841; \ df = 3; \ p = .00)$ CFI = 1.00, TLI = .99, RMSEA = .02</td>
<td>Good</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>$\chi^2 = 531.34 \ (n = 841; \ df = 3; \ p = .00)$ CFI = 1.00, TLI = 1.00, RMSEA = .03</td>
<td>Good</td>
</tr>
<tr>
<td>Autonomy</td>
<td>$\chi^2 = 566.85 \ (n = 841; \ df = 3; \ p = .00)$ CFI = .99, TLI = .96, RMSEA = .09</td>
<td>Adequate</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>$\chi^2 = 247.48 \ (n = 841; \ df = 6; \ p = .00)$ CFI = .94, TLI = .92, RMSEA = .06</td>
<td>Adequate</td>
</tr>
<tr>
<td>Resources</td>
<td>$\chi^2 = 249.89 \ (n = 841; \ df = 3; \ p = .00)$ CFI = 1.00, TLI = 1.00, RMSEA = .01</td>
<td>Excellent</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>$\chi^2 = 1.01 \ (n = 841; \ df = 1; \ p = .00)$ CFI = 1.00, TLI = 1.00, RMSEA = .00</td>
<td>Excellent</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>$\chi^2 = 27.78 \ (n = 841; \ df = 5; \ p = .00)$ CFI = .99, TLI = .97, RMSEA = .07</td>
<td>Adequate</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>$\chi^2 = 71.07 \ (n = 841; \ df = 3; \ p = .00)$ CFI = 1.00, TLI = .96, RMSEA = .03</td>
<td>Good</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>$\chi^2 = 193.12 \ (n = 841; \ df = 3; \ p = .00)$ CFI = 1.00, TLI = 1.00, RMSEA = .00</td>
<td>Excellent</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>$\chi^2 = .14 \ (n = 841; \ df = 2; \ p = .93)$ CFI = 1.00, TLI = 1.00, RMSEA = .00</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

The analysis of each CICS scale identified three scales that may have contributed to, or caused, the adequate fit of the first CFA model. It is therefore suggested that these three scales would also benefit from future development: Autonomy, Goal Awareness and Ideation Systems.

8.10.7 Equality constraints

It should be noted that to conduct CFAs on CICS scales comprising three items, which was eight of the ten scales (Idea Generation and External Collaboration were the exceptions), it was necessary to apply equality constraints. Equality constraints are when the residuals for two of the three items in a scale are constrained equal (Byrne, 2012), and they are used when a model is
saturated (or ‘just-identified’). Saturation occurs when the number of known inputs to a model is equal to the number of estimated parameters. In the current research, this occurred with CICS scales comprising three items. When a model is saturated, no information can be extracted from the covariance matrix and fit statistics cannot be generated, as a saturated model is guaranteed to fit any data perfectly (Arbuckle, 2011). The central role of fit statistics in the interpretation of CFA means that a saturated model is not useful, and therefore equality constraints were applied. This approach has also been adopted previously in research from the psychology (Suh & Yi, 2006) and innovation (Beets et al., 2008; Chan, 2000) disciplines, and although difficult in some statistical software, such as AMOS, Mplus supports the application of equality constraints in order to achieve an unsaturated model.

8.10.8 Higher order factor structure

Finally, the presence of a higher order factor structure was also explored. Although the existing creative and/or innovative climate measures generally do not have higher order factor structures, it is considered good practice to explore the presence of a higher order factor structure as it can provide a model that is more parsimonious and interpretable (Byrne, 2012; Chen et al., 2005). In order to identify a higher order factor structure, an EFA was conducted using the ten CICS factors, specifying no fixed number of factors to extract. This resulted in a three higher order factor solution, presented in Table 19.

<table>
<thead>
<tr>
<th>Table 19. Higher Order Factor Structure of CICS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Factor</strong></td>
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<tr>
<td>1</td>
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</tr>
</tbody>
</table>
8.10.9 Factor labeling

The first higher order factor was labeled Facilitators of Creativity and Innovation as it pertains to factors relating to collaboration, Resources and other factors that may facilitate creativity and innovation.

The second higher order factor was labeled Team Factors, as it comprised the two team-focused factors; Team Cohesion and Goal Awareness.

The third higher order factor was labeled Autonomy and Risk, as it comprised Autonomy and Risk Taking.

8.10.10 Scale reliability

Cronbach’s alpha (Cronbach, 1951) was calculated to estimate reliability of each higher order factor. Reliability refers to the internal consistency of a measure, and of the scores obtained (Anastasi & Urbina, 1997). The cutoff for an acceptable Cronbach’s alpha value is typically .70 (Bernardi, 1994; Mejias, 2007; Tavakol & Dennick, 2011). Two of the higher order factors exhibited acceptable reliability, however the higher order Autonomy and Risk factor exhibited poor reliability. This may be partially explained by the inclusion of Autonomy in this factor, as Autonomy has been identified previously as a problematic scale.

8.10.11 Confirmatory Factor Analysis

The higher order factor solution identified was then confirmed using CFA. This model showed poor fit ($\chi^2 = 20359.01$ ($n = 841$; $df = 1326$; $p=.00$) CFI = .35, TLI = .32, RMSEA = .11). First, model fit can be improved using parcelling, and therefore the model was re-specified using rank ordered parceling. However, this worsened model fit ($\chi^2 = 34497.56$ ($n = 841$; $df = 780$; $p=.00$) CFI = .18, TLI = .14, RMSEA = .21).

Second, poor model fit may have been due to the negative residual variance associated with Internal Collaboration, which was the first lower order factor entered into the model. When residual variance is negative, Byrne (2012) recommends fixing the variance of the higher order factors to 1 and constraining the residuals of two second order factors as equal. This recommendation was implemented and the model was re-run. This did not improve model fit ($\chi^2 = 13759.70$ ($n = 841$; $df = 1281$; $p=.00$) CFI = .34, TLI = .32, RMSEA = .11). Instead, the negative residual became associated with Internal Networks, which was the first lower order factor freely estimated. The persistent presence of negative residual variance indicates that this
model is flawed, which may be partially due to the inclusion of the unreliable Autonomy and Risk factor. Overall, this suggests a fundamental problem with a higher order factor solution for CICS.

**8.11 Interim summary**

The preceding section presented the second phase in the development of CICS. Using data from MBDA employees, a 33 item, 10 factor scale was produced. A first Confirmatory Factor Analysis partially confirmed the factor of CICS, and various steps were subsequently taken to identify sources of model misfit. The presence of a higher order structure was not supported.

**8.12 Phase 3: Triangulating phase 2 quantitative data with qualitative narrative data to support CICS factor structure**

Qualitative narrative data were used in addition to the quantitative data gathered in the previous phase (phase 2) of CICS development. Qualitative narrative data were used to further assess the accuracy of the factor structure that was identified in phase 2, and to add rigour to the development of CICS. This triangulation of qualitative and quantitative data constituted the third phase of CICS development.

Triangulation is viewing something from multiple perspectives (Denscombe, 2010). Whilst “tri” suggests three perspectives, within the research methods literature the term “triangulation” is typically used to denote two (or more) perspectives (Cowan, 2009; Denscombe, 2010; McMurray, Pace & Scott, 2004). Triangulation is thought to give a better understanding of the phenomena under investigation, and can be achieved through either the combination of different research methods (methodological triangulation), different researchers (investigator triangulation) or different data sources (Denscombe, 2010).

When triangulating quantitative and qualitative data, the most common approach is to combine a form of interview with a cross-sectional questionnaire (Bryman, 2006). Alternatively, existing literature has combined different qualitative methods to achieve triangulation, such as interviews and participant observation (Ahrens, 1997).

There are a number of benefits of triangulation. First, it minimises the effects of the limitations of a method. Second, it increases the veracity of the data and the confidence with
A multitude of methods exist through which qualitative data can be collected, including structured, unstructured and semi-structured interviews, focus groups and approaches aimed at eliciting stories (Myers, 2009). Some methods, such as those aimed at eliciting stories, produce narrative data (Soin & Scheytt, 2006). Using such methods can be referred to as taking a narrative approach. Narrative data are stories and anecdotes that serve as a way for people to recount, interpret and make sense of events and situations they experience (Grant, 2012; Rao, 2005). There are a number of methods that can be used to elicit stories, including Anecdote Circles.

An Anecdote Circle is a group setting where participants are encouraged to tell their stories and anecdotes following a stimulus question that opens the session. Although the purpose of an Anecdote Circle is to capture narrative data, the group setting has led to comparisons to focus groups (e.g. O’Toole et al., 2008). There appears to be no consensus regarding the distinctiveness of these two approaches.

Historically, storytelling methods such as Anecdote Circles have been relatively underutilised as a method to elicit narrative data, although narrative approaches are starting to gain popularity in business research (e.g. Escalfoni, Braganholo & Borges, 2011; Frishhammar, Floren & Wincent, 2011; Reissner, 2005; Tzortzopoulos, Cooper, Chan & Kagioglou, 2006). Narrative research has been labelled as innovative (Wildy & Pepper, 2005), and thus the increased use of narrative research contributes towards answering widespread calls within the management (Bartunek, Bobko & Venkatraman, 1993; Symon, Cassell & Dickson, 2000), creativity and innovation (e.g. Anderson et al., 2004; Bartel & Graud, 2009), and organisational climate (Soin & Scheytt, 2006; Williamson, 2002) literatures for research to consider innovative research methods.

Some of the existing literature discussed herein has utilised a narrative approach specifically as a means to triangulate other quantitative data (e.g. Frishhammar et al., 2011). However, the rigour of some of these studies is questionable; for example, Frishhammar et al. (2011) triangulate their qualitative data with two quantitative questionnaire items. Moreover, these items were asked during the qualitative interviews, reducing the overall sample size as the same sample was used for both quantitative and qualitative portions of the research. This resulted in very little quantitative data ($n=30$), which questions the reliability, accuracy and
generalisability of Frishammar et al.’s (2011) triangulated findings, as studies with small samples risk the manifestation of these issues (Bartlett, Kotrlik & Higgins, 2001).

The current research seeks to triangulate qualitative narrative data with quantitative data. It is therefore pertinent to consider the appropriateness of narrative triangulation for the current research.

8.12.1 Appropriateness of narrative triangulation for this research

There are three reasons why triangulating the quantitative data from the second phase of CICS development with narrative data is appropriate for the current research. First, a narrative approach may be particularly appropriate for triangulating Creative and Innovative Climate research as it is more likely to capture underlying assumptions than other methods, such as questionnaires (Scott et al., 2001). This is because a narrative approach is based on the telling of stories and anecdotes, which is a natural way for people to communicate, and therefore a greater quantity and quality of information may be revealed (Grant, 2012). Moreover, the relative flexibility of the Anecdote Circle format, in comparison to a questionnaire, may lead participants to share more stories. Indeed, these characteristics mean a narrative approach is considered “uniquely illuminating” for climate research (Gabriel & Griffiths, 2008, p.114).

Second, a narrative approach is suitable for the current research due to similarities with factor analytic methods. Factor analysis aims to identify a factor structure; a narrative approach is usually applied to identify patterns in data and uncover the main aspects or themes of a multidimensional construct (O’Toole et al., 2008; Ryan & Bernard, 2003). Narrative and factor analytic approaches are therefore complimentary, and their results can be meaningfully compared.

Third, a narrative approach allows new perspectives on a topic to be identified (Eriksson & Kovalainen, 2008), and thus gain a broader understanding of the topic of climate for creativity and innovation than solely using quantitative questionnaire data allows. For this reason, a narrative approach has been praised as allowing researchers to increase the rigour of their research (Dodge, Ospina & Foldy, 2005). Indeed, it has been argued that research should embrace the differences between quantitative and qualitative data, instead of considering them to be mutually exclusive approaches, and utilise the benefits for empirical research (Borins, 2011).

In conclusion, using a narrative approach for this study contributes to the literature as it provides better quality, triangulated data from which conclusions can be more confidently drawn.
Moreover, this approach goes some way to addressing multiple calls for methodological variety within the literatures of management, creativity and innovation, and organisational climate.

8.12.1 Participants and procedure

Thirty employees from MBDA's main UK site participated, most of whom were male (73%, n=22). Through their stories, it was apparent that these employees reflected different departments within MBDA. More precise demographic information was not reported to protect anonymity.

All participant recruitment was handled by the innovation practitioners within the organisation. No monetary incentive was offered, with participants offered the opportunity to share their experiences and partake in shaping the future climate of the organisation. Participants were informed that refreshments would be available throughout each Anecdote Circle session.

Four Anecdote Circles, including one pilot session, were conducted. Each Anecdote Circle lasted approximately ninety minutes. Two sessions had seven participants and two sessions had eight participants. This sample size is comparable with other narrative research (e.g. Freishammar et al., 2011; Reissner, 2005). These sessions resulted in 32 stories, meaning that each participant provided approximately one story.

Immediately before each Anecdote Circle, participants were provided with an information sheet requesting their informed consent to participate, and provided with the rules of the session, which were as follows:

• For reasons of anonymity, avoid referring to other participants or those mentioned in your story by name
• Do not talk over each other; wait for the previous person to finish before beginning your story
• Do not interrupt a participant to ask them questions about their story
• You do not have to contribute to the session if you feel uncomfortable doing so
• The stories shared should not be repeated to others outside of this room

Each Anecdote Circle was opened with a stimulus question, which is typical of the Anecdote Circle approach (Soin & Scheytt, 2006). The stimulus question was “tell me about a time when you (or someone you know) did (or wanted to do) something differently”. This is a
form of the “tell me a story about...” approach advocated by Soin and Scheytt (2006), however does not include the word story as it was felt that participants may react negatively to “story”.

Participants then told their stories, one at a time. If there was a lull, the group was reminded of the stimulus question. Once eighty minutes had passed or participants were struggling to continue contributing stories, whichever came first, the group was asked if they had any additional stories to contribute before finishing the session. In every group this prompted one or two additional stories.

All sessions were recorded by two voice recorders and later transcribed. Recordings and transcriptions were confidential and anonymised.

8.12.2 Narrative data analysis strategy

To analyse the data collected through Anecdote Circles, analysis of narratives was conducted. The current research focused on the content of the narratives, as opposed to structure or interactional context (Eriksson & Kovalainen, 2008). When analysing narrative content, thematic analysis and pattern analysis are the most common approaches (Riessman, 2008). The current research used template analysis, a form of thematic analysis. Template analysis was used because of its ability to apply structure to the broad topic of organisational climate and its appropriateness for identifying patterns or themes in data (Boyatzis, 1998; Braun & Clarke, 2006).

The data was analysed in accordance with the stages proposed by Braun and Clarke (2006) which were as follows:

1. Familiarisation with the data
2. Generate initial codes. A-priori themes formed the starting template
3. Search for themes
4. Review themes
5. Define and name themes
6. Produce a report of the findings using relevant quotes/extracts

Whilst the exact analytical procedure for thematic analysis can differ somewhat, researchers may re-read the data more, or less, frequently for example, the analysis employed
here was appropriate for the task. Moreover, qualitative research values a non-prescriptive attitude (Britten, 1995), and therefore there is no single correct approach for data analysis.

To become familiar with the data, the data were transcribed, read and re-read. A starting template was then developed, as is good practice when conducting thematic analysis (Braun & Clarke, 2006), drawing on the Creative and Innovative Climate factor labels from the second phase of CICS development and thus grounded in empirical research as opposed to a subjective opinion as to what appropriate themes may be. This provided a template of ten Creative and Innovative Climate themes, presented in Table 20.

Table 20. Thematic Analysis Starting Template Using Creative and Innovative Climate Themes

<table>
<thead>
<tr>
<th>Theme</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>An organisation’s recognition and reward of creativity and innovation</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>The level of trust and interpersonal understanding within a team</td>
</tr>
<tr>
<td>Autonomy</td>
<td>The level of control an individual feels they have over their work</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>A team’s understanding of, and agreement with, their objectives</td>
</tr>
<tr>
<td>Resources</td>
<td>Availability of facilities and resources</td>
</tr>
<tr>
<td>Risk</td>
<td>An organisation’s approach to risk and level of risk aversion</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>Idea generation and the processes an organisation uses to encourage it</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>The extent to which employees know people in different parts of the organisation</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>Different parts of an organisation working together throughout the innovation process</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>An organisation’s relationships with other organisations, customers and suppliers, and using these relationships to develop new products/processes/services</td>
</tr>
</tbody>
</table>

To identify themes from the narrative data, the data were read two further times with the starting template in mind, and themes consistent with this template were sought. Examples of themes were electronically highlighted as the data were read. Nine of the ten themes were expanded into positive and negative aspects of that theme (e.g. examples of risk aversion and examples of risk taking). This also reflects psychometric good practice of having both positive
and negative (reverse scored) items to measure each factor. No positive/negative distinction was made for Internal Networks as the data contained only positive instances.

The data were read twice more to identify any recurrent themes not covered by the starting template. The positive and negative expansion of nine of the ten themes were collapsed into a single theme (e.g. examples of risk aversion and risk taking were collapsed to form one Risk theme).

8.13 Triangulation results

Thematic analysis found support for the ten themes identified in the starting template. Each theme will briefly be discussed.

8.13.1 Valuing Creativity and Innovation

Narratives were identified that referred to MBDA’s recognition and reward of creativity and innovation. These were predominantly focused on instances where the organisation was perceived not to value creativity and innovation. For example, participants spoke strongly about the organisation’s “mental block” on non-technical innovation: “it’s really hard for someone in a non-technical environment to be considered within the company as innovative. They could be recognised for the good work that they do, and their contribution to the business, but whether it’s actually considered innovative...”. Other narratives also supported the Valuing Creativity and Innovation theme. For example, accounts of new employees realising that creativity and innovation were not always valued: “it was just stark realisation that this [a particular software package] is so ingrained in the business and change just is not liked”. These examples reflect both the reward and recognition of creativity and innovation, as is consistent with the definition of the Valuing Creativity and Innovation theme as “an organisation’s recognition and reward of creativity and innovation”.

8.13.2 Team Cohesion

Narratives were identified that referred to positive interpersonal relationships and a sense of solidarity within a team. References to Team Cohesion were indicated by socialising (“an evening session where there were people from the rest of the [team] out having a meal, a laugh and a drink”) and a team seeing themselves as a community (“we were not seen as a community”). These examples reflect positive interpersonal relationships, as is consistent with
the definition of the Team Cohesion theme as “the level of trust and interpersonal understanding within a team”.

8.13.3 Autonomy

Many of the narratives indicated that employees felt autonomous. References coded as examples of Autonomy were predominantly positive, and talked about employees taking control of their own work. For example: “I decided that I’d take matters into my own hands”. Often, this occurred despite the wishes of the management: “he liked it then later on asked me to stop it...I just politely ignored him”. Narratives were also identified that referred to managers encroaching on employees’ perceived Autonomy, either by trying to influence if a task was completed (“I got told no”) or how a task was completed (“he had ideas of micro managing what we were doing...I politely nodded and kind of ignored him”). These examples reflect feelings of control over work, which is consistent with the definition of the Autonomy theme as “the level of control an individual feels they have over their work”.

8.13.4 Goal Awareness

Narratives making reference to objectives and goals were identified, suggesting a Goal Awareness theme. Examples of Goal Awareness tended to focus on their presence, acknowledging that “there’s always objectives, those objectives are set and agreed”. One narrative drew particular attention to the senior management team, praising them for their awareness of strategic goals despite other employees disagreeing with their actions: “[it] didn’t quite resonate with me at the time...when I look back now I can understand it”. These examples consistently refer to goals and objectives, and the extent to which these were understood, as is consistent with the definition of the Goal Awareness theme as “a team’s understanding of, and agreement with, their objectives”.

8.13.5 Resources

Narratives were identified that made reference to physical and financial resources as part of a wider story, with these resources often perceived to be insufficient. These could be financial resources (“we knew there were ideas out there within the community that weren’t being implemented for whatever reason, probably cost”), or facilities such as meeting rooms (“we’re constrained and actually it’s the lack of meeting rooms that we have available to us”).
Human resources were also referred to, for example in a narrative describing a team’s difficulty “where you’ve got a development programme where you need fast reaction because of limited time scales and very limited budget, and you’re then told sorry you can’t have an engineer”. These examples reflect perceptions of the physical environment, the availability of people as a resource and the cost implications associated with creativity and innovation. These narratives were considered evidence of a Resources theme, and are consistent with the definition of Resources as “availability of facilities and resources”.

8.13.6 Risk

Similar to Resources, references to risk taking and risk aversion were identified as part of a different narrative. Narratives relating to Risk generally acknowledged the organisation’s risk averseness, focusing on instances when the organisation had avoided risk and how it was necessary to “convince” managers to take risks. This supports the fact that two of the three Risk Taking CICS items refer to the manager’s attitude and willingness to taking risks. Moreover, narratives were identified that approached Risk from the perspective of behaviour after a risky activity had succeeded: despite initial reluctance “it went to fantastic, we can claim this as a real success”. These examples seem to reflect Risk, defined as “an organisation’s approach to risk and level of risk aversion”.

8.13.7 Ideation Systems

Narratives were identified that made reference to having ideas and the processes for encouraging idea generation. Participants recounted positive experiences of having ideas within the organisation, such as one employee’s involvement with a particular team, that “gave me the opportunity to feed my ideas in and see them realised...it was really very nice to be involved with something that let me move as quickly as the ideas did”. This experience led to a patent. These examples reflect idea generation and the associated processes, as is consistent with the definition of the Ideation Systems theme as “idea generation and the processes an organisation uses to encourage it”.

8.13.8 Internal Networks

Narratives were identified that implicitly referred to knowing other people within the organisation. These included examples of informal networks, including references to “the
“grapevine”, and the steps taken in some parts of the organisation to encourage Internal Networks through “a weekly informal email”. The presence of Internal Networks was also evidenced in narratives relating to negative aspects of networking, with one participant recounting the issues they faced when trying to formally map the network relevant for a particular project: “one [nationality] colleague took one look at it, and went you can’t possibly show that to anybody, to say that person can influence that person, you can’t possibly say that”. These examples reflect the relationships between employees within MBDA, as is consistent with the definition of the Internal Networks theme as “the extent to which employees know people in different parts of the organisation”.

8.13.9 Internal Collaboration

The narrative data suggested that different parts of the organisation collaborate to achieve innovation, with methods to encourage this behaviour such as “a technology forum that’s open for anyone to post on”. Participants also expressed difficulties working with others across the organisation. This may depend on which parts of the organisation are collaborating, and whether both parties view their relationship as collaborative or supplier-customer: “it’s a source of continual frustration that we can write a purchase order but it takes up to 4 weeks for the order to be placed...I’ve made a point before that if we were dealing with external suppliers who said you can wait four weeks before we even consider the order we wouldn’t do business with them, and I don’t see why we should be dealing on a different basis with our internal suppliers”. These examples reflect employees working together within the organisation, often to achieve something new. This is consistent with the definition of the Internal Collaboration theme as “different parts of an organisation working together throughout the innovation process”.

8.13.10 External Collaboration

Narratives were identified that focused on the complexity of collaborating with other organisations and governments in the defence industry. These complexities seem to be exaggerated by the international nature of many of the organisations involved and the reconciling of national security concerns. Despite this, the narrative data contained evidence of using external experts (“an external consultant comes in”), and of employees taking an outward-focused approach: “I was calibrating all the time to see if my views were consistent with that of other people [in the management and supply chain communities]”. These examples consistently refer to
relationships with other organisations and individuals, as is consistent with the definition of the External Collaboration theme as “an organisation’s relationships with other organisations, customers and suppliers, and using these relationships to develop new products/processes/services”.

8.14 Interim summary

The preceding section presented the third phase in the development of CICS, in which the quantitative data was triangulated with qualitative narrative data. This confirmed the 10 factor structure of the 33 item CICS. Narratives were identified that focused on each of the 10 Creative and Innovative Climate factors, as determined by the definition of each factor. Moreover, no evidence for additional themes was found, providing further support for the argument that Creative and Innovative Climate comprises 10 factors.

It could be argued that these 10 themes were identified due to their inclusion in the starting template. This was not the case, as during the multiple readings of the data any themes could have been identified, including finding no evidence for the themes included in the starting template. However, the identification of the 10 themes included in the starting template is relatively unsurprising due to the fact that these 10 themes were identified through empirical research (earlier phases of CICS development), as opposed to a subjective opinion as to what appropriate themes may be.

Overall, triangulating with qualitative data offers a more defensible measure. The fact that nine of the ten themes were divided into positive and negative during the thematic analysis supports the use of reverse scored items in CICS. It also suggests that narrative data offers a useful way to triangulate with factor analysis as both seek to identify patterns in the data (O’Toole et al., 2008). Moreover, the use of narrative data addresses calls for creativity, innovation and climate research to consider more innovative forms of data (e.g. Anderson et al., 2004; Bartel & Graud, 2009; Soin & Scheytt, 2006; Williamson, 2002).

The development of CICS will be now be briefly discussed in relation to the existing literature, implications for academia and practitioners, and limitations and suggestions for future development of CICS.
8.15 Discussion

The three development phases of the Creative and Innovative Climate Scale presented in this chapter led to a theoretically coherent measure of Creative and Innovative Climate that may, following additional development, be a viable alternative to existing measures of climate, many of which are less psychometrically robust.

An initial set of 68 items measuring eleven key dimensions of Creative and Innovative Climate were developed and tested in a sample of working adults (phase 1). This produced a 52 item measure which was tested further within a single organisation (phase 2). This resulted in a 33 item, 10 factor measure, which was then triangulated with qualitative narrative data (phase 3).

CICS offers a number of improvements to the measurement of Creative and Innovative Climate. First, it explicitly covers both creative climate and innovative climate. Many existing measures purport to measure either creative climate or innovative climate, but their content is similar or the same. Whilst it could be argued that the similar content means the label is not important, using imprecise or incorrect terminology adds to the confusion surrounding creativity and innovation, and in this case, how climate supports these activities. Using terminology that focuses on either creativity or innovation reinforces the divide between these disciplines, when in fact research should arguably aim to minimise this often arbitrary divide (Anderson et al., 2014).

The results of the triangulation provided insight into climate within the organisation where the narrative data were collected. The quotes supporting these themes deepen the understanding of Resources and Internal Networks in particular. Regarding Resources, the data mention both money and physical environment, highlighting the multifaceted nature of Resources. This is important as climate research often focuses on money as the sole manifestation of Resources. Regarding Internal Networks, the narrative data highlight the informal nature of the networks, and also the inconsistency with which they are encouraged in teams within the organisation.

The new Creative and Innovative Climate Scale has a number of implications for researchers. First, providing a measure developed using psychometric principles provides researchers with a measure of Creative and Innovative Climate that can be confidently used in research due to the rigour with which it was developed. Due to issues of misused terminology and lack of differentiation between creative dimensions and innovative climate dimensions, the measurement of creative climate and innovative climate has faced challenges. These challenges have been exacerbated by the fact that extant measures have been developed using varying
degrees of psychometric principles and statistics. Indeed, a review of existing similar measures found only two (KEYS and TCI) had ‘acceptable’ psychometric properties (Mathisen & Einarsen, 2004). CICS is differentiated from KEYS and TCI for two primary reasons. First, CICS is clear in its focus on individual’s perceptions of climate, thus operating at the individual level, whereas previous studies have been criticised for using TCI as a measure of individual’s perceptions despite it being a team-level measure (Mathisen, Torsheim & Einarsen, 2006). This suggests an individual level measure was required but a suitable one was not identified. Second, CICS is unique in its use of triangulation to ensure the factor structure suggested is robust, and triangulation goes some way to demonstrating construct validity.

The second implication of CICS for researchers is that it clarifies some recurrent issues in the field related to the inconsistent terminology surrounding creativity, innovation and climate. First, it focuses on climate in relation to creativity and innovation. Climate is domain referenced, therefore it is useful to researchers, and practitioners, to be specific about the type of climate under discussion. Second, as a result of research using the terms creative climate and innovative climate synonymously, no research could be identified that has explored the difference between the factors constituting a climate supportive of creativity, and the factors constituting a climate supportive of innovation. Due to this, it is arguably not possible to differentiate factors specific to creative climate and those specific to innovation climate. Therefore, this paper clarifies that for research purposes, for accuracy, they should be combined and treated as single domain until research can identify how they differ. This is reasonable because (1) the fact that creativity research and innovation research seems to operate largely independently of each other yet has identified largely the same factors, suggests that actually Creative and Innovative Climate could be the same. 2) Examining Creative and Innovative Climate as one construct is also parsimonious. 3) Unclear differentiation between creativity and innovation and inconsistent use of terminology extends beyond climate research to creativity, innovation and organisational culture related research in general. 4) There have been calls for researchers to stop perpetuating an arbitrary division between creativity and innovation, which the terminology used in the current research goes some way to achieving (Anderson et al., 2014; Auernhammer & Hall, 2013; Buschgens et al., 2013; Yusuf, 2009).

Third, CICS provides some clarity to the dimensions comprising Creative and Innovative Climate as the current research presents ten distinct factors (Ideation Systems, Valuing Creativity and Innovation, Team Cohesion, Autonomy, Goal Awareness, Resources, Risk, Internal
Networks, Internal Collaboration, External Collaboration), and the CFAs conducted as part of the second development phase support this structure. However, it should be noted that the fit of the factor structure model requires improvement, and analysis of each CICS scale identified three scales that would benefit from future development: Autonomy, Goal Awareness and Idea Generation.

The new Creative and Innovative Climate Scale has a number of practical implications. First, CICS offers a measure of Creative and Innovative Climate that can be confidently used due to the psychometric rigour with which it was developed, and decisions can be confidently made on the resulting data. Having the ability to accurately measure Creative and Innovative Climate may increase the likelihood of it being measured and therefore acting on the results (Cruz-Cazares et al., 2013).

Second, being able to better understand and potentially measure an organisation’s climate may also lead to better management of an organisation’s creativity and innovation as a whole. This is particularly important as creativity is the first stage in the innovation process, and therefore if creativity is ignored innovation cannot occur. Moreover, achieving innovation often results in increased organisational performance.

Third, CICS provides some clarity as to what constitutes Creative and Innovative Climate as it provides ten distinct factors that will be applicable to many contexts, and provides a model that organisations can use to inform policy and procedure. Moreover, it facilitates the measurement and comparison of specific Creative and Innovative Climate factors across organisations, departments and teams. CICS also specifically draws attention to the need to foster a creative climate as well as an innovative climate, as organisations may tend to focus solely on innovation.

8.15.1 Limitations and future research

The three development phases presented in this study have a number of limitations and present a number of potential avenues for future research.

First, the generalisability of the research presented herein may be questioned, and more data from different organisations, industries and countries is required to assess generalisability; future research could explore evidence for the generalisability of CICS to other cultures and languages. Narratives are often specific to an organisation and therefore may vary considerably between organisations (Soin & Scheytt, 2006). Moreover, some participants were non-native
English speakers and this may have limited how quickly they could recall and share a story in English, and the role of group dynamics were only considered insofar as “rules” were outlined at the beginning of each Anecdote Circle. However, it is arguably impossible to assess whether all the potential stories were gathered, and abiding by a set of rules may reduce the level of “spontaneous sharing” that the Anecdote Circle method is favoured for (Dunckley & Roff-Wexler, 2009, p.78). Future research could replicate the narrative study in different languages and organisations, potentially adapting the researcher’s role to include prompting stories from less forthright participants.

Second, the Anecdote Circle approach was limited by its indirectness. Anecdote Circles are regarded as an indirect way of getting to the desired information or topic. It has been argued that as a result, participants are less likely to feel pressured to share opinions that are politically correct. However, the group nature of an Anecdote Circle and the fact that participants were completing Anecdote Circles within their work environment may negate the purported benefit of Anecdote Circles as an indirect research method that is less prone to social desirability bias (McBurney & White, 2010). This arguably reflects the relative newness of the research method and the continued effort required to develop the Anecdote Circle approach.

Third, the interpretation of the results from Study 2 are limited by the use of Anecdote Circles; specifically, the claim that this research method does not seek opinion and therefore is objective (Dunckley & Roff-Wexler, 2009). Anecdote Circles rely on individuals sharing stories, which are unavoidably their subjective interpretations of an events. Thus Anecdote Circles can be criticised for seeking to appear more objective than they are. However, this limitation was taken into account and the research method was arguably appropriately used as a source of subjective data, which is consistent with the critical realist epistemology guiding the current research. Future research should continue to acknowledge this limitation of the Anecdote Circle methodology.

Fourth, currently there has been no investigation of whether CICS relates to all aspects of the innovation process, or whether particular dimensions of the ten CICS factors are more relevant at specific stages of the innovation process. Previous research has suggested that Front End Innovation may require a different climate to latter stages of the innovation process (Zien & Buckler, 1997), and recent research has suggested that Front End Innovation should be treated differently to the rest of the innovation process (Markham, 2013). Future research may develop this line of investigation. As part of research addressing this limitation, identifying the dimensions specific to creative climate and those specific to innovative climate could be achieved.
Future research should seek to further develop CICS. Specifically, to develop the Ideation Systems, Goal Awareness and Autonomy subscales as these evidenced only adequate model fit during CFA, and the reliability of Autonomy was lower than other subscales ($\alpha=.57$). Further development work could also test the validity of CICS. Construct validity studies could be conducted to provide evidence of the validity of CICS. For example, comparing CICS with KEYS (Amabile et al., 1996). Moreover, correlation of CICS “scores” with a measure of climate related-organisational performance would provide evidence of criterion validity. However, the triangulation conducted as part of the third phase of CICS development goes some way to demonstrating construct validity.

A final limitation of the current study is that bias may be introduced into CICS and the resulting data due to its self-report nature.

8.16 Conclusion

Organisational climate for creativity and innovation has been the subject of considerable research, but is characterised by a seemingly arbitrary distinction between creative climate and innovative climate. Research Aim 2 sought to develop a reliable and valid measure of Creative and Innovative Climate, and this paper provided some clarification regarding focus on domain specific organisational climate in support of creativity and innovation. This paper introduced a new robust measure of Creative and Innovative Climate, comprising ten factors, developed using psychometric principles and triangulating this complex construct using qualitative narrative data.

It was argued that the state of the literature is not in a position to distinguish between creative climate and innovative climate, and therefore existing measures of both should be examined and a new comprehensive measure of Creative and Innovative Climate developed. The current research provides opportunities for more reliable measurement of Creative and Innovative Climate.
9 STUDY 3: ADDRESSING RESEARCH AIMS 3 AND 4

9.1 Chapter overview

This chapter presents the sample, method and results of the single level and multilevel analyses performed to address Research Aim 3 and 4, comprising Hypotheses 1 to 5, with data from 841 MBDA employees.

The Research Aims and Hypotheses posed in the current research extend the existing literature focusing on creativity, creative performance, FEI and their relationship with organisational climate. Hypotheses 1 and 2, comprising Research Aim 3, focus on Individual Creative Performance, its relationship (and distinction from) Individual Creativity, and to what extent it is related to Creative and Innovative Climate. Individual Creative Performance (and similar terms) and creativity continue to be used synonymously in the creativity literature, despite arguments for conceptual distinctness, which are supported by the presence of similarities and differences in the definitions of the two constructs. Perhaps due to this terminological confusion, there has been little empirical investigation of the relationship between creativity, conceptualised as a multifaceted construct, and Individual Creative Performance. In addition, there has also been minimal investigation of the climate conducive to Individual Creative Performance; a problem exacerbated by measurement difficulties in the creativity and climate literatures and reliance on less generalisable student samples. Hypothesis 1 elucidates the relationship between confidence, motivation and personality and creative performance, and explores the extent to which creativity and creative performance are distinct constructs, whilst Hypothesis 2 examines the relationship between Individual Creative Performance and Creative and Innovative Climate.

Given the argument that Individual Creativity and Individual Creative Performance are distinct constructs (Montag et al., 2012), findings from Hypothesis 1 could not be generalised to a potential Individual Creativity-Creative and Innovative Climate relationship. Moreover, there has been relatively little research on climate and Individual Creativity and the extant literature has been piecemeal regarding which climate dimensions are measured. Thus, a systematic investigation of the relationship between a comprehensive set of climate factors and a comprehensive set of Individual Creativity dimensions has been called for (Anderson et al., 2014; Hunter et al., 2007; Mumford & Hunter, 2005). Hypothesis 3 addresses this.
Much of the current research operates at the individual level. However, the current research also takes a multilevel approach. Herein, a multilevel approach is applied to better understand the relationships between individual perceptions of Creative and Innovative Climate, Team Creativity and FEI, which means aggregation can be avoided and the level of analysis is clearer than in some previous studies (e.g. Amabile et al., 2002; Barczak et al., 2010). Hypotheses 4 and 5 extend the limited existing empirical work on Creative and Innovative Climate, Team Creativity and FEI through the measurement of a comprehensive set of climate factors, and focus on the under-explored team level (Batey, 2012). In the case of FEI, the current research appears to offer the first such analysis. In doing so, Hypotheses 4 and 5 also address calls for further research of this kind in relation to both FEI and Team Creativity (e.g. Anderson et al., 2014; Buschgens et al., 2013; Markham, 2013; Mathiesen & Einarsen, 2004).

Study 3 addresses Research Aims 3 and 4. These Research Aims and the Hypotheses comprising them are presented below.

Research Aim 3 seeks to explore Individual Creative Performance in relation to Creative and Innovative Climate and Individual Creativity. This will be addressed through two hypotheses.

Hypothesis 1 proposes that Individual Creativity will have a significant but weak relationship with Individual Creative Performance

Hypothesis 2 proposes that Creative and Innovative Climate will have a significant and moderate relationship with Individual Creative Performance

Research Aim 4 seeks to explore Creative and Innovative Climate in relation to Individual Creativity, Team Creativity and Team Front End Innovation. This will be addressed through three hypotheses.

Hypothesis 3 proposes that Creative and Innovative Climate will have a significant but weak relationship with Individual Creativity

Hypothesis 4 proposes that Creative and Innovative Climate will have a significant and moderate relationship with Team Creativity

Hypothesis 5 proposes that Creative and Innovative Climate will have a significant and moderate relationship with Team Front End Innovation
9.2 Method

9.2.1 Participants and procedure

In total, 841 employees from MBDA participated. For transparency, the 841 participants referred to here are the same 841 participants referred to in Studies 1 and 2. Of the 841 participants, the vast majority were male \( (n=636, 83\%) \) and aged 50 or above \( (35.4\%) \). Those aged 41-50 \( (20.7\%) \), 31-40 \( (23.4\%) \), and under 30 \( (20.4\%) \) were relatively equally represented. This was based on a sample of 627, as 214 did not provide their age. Data were collected from the countries forming the integrated organisation; France \( (n=352) \), the UK \( (n=323) \) and Italy \( (n=166) \), but not Germany. Focusing on European participants addresses calls for creativity research to use non-North American samples (Anderson et al., 2004).

Using a working adult sample from one organisation improves upon much of the previous research, particularly in the areas of creativity and creative performance, that uses school children or university student samples and then generalises findings to an occupational context (Gilson, 2008).

The current study used two questionnaires. One questionnaire, the \( me^2 \), measured Individual Creativity. The second questionnaire comprised scales to measure the four other constructs addressed in this study, including the FEIS and CICS described in Studies 1 and 2. Although the current study comprised two questionnaires, these were designed to be completed together.

Participants predominantly completed both questionnaires online after receiving an email inviting them to participate in the research. This email was sent by the Innovation Manager in each country, and provided basic information about the study and the links to the online questionnaires. Each Innovation Manager adapted their email as they thought was appropriate for their country and would increase participation. Mainly, this involved the French Innovation Manager including additional information assuring participants that the data would be confidential and an individual’s data could only be accessed by researchers at University of Manchester, and not by the organisation’s management.

In the UK, this data collection approach was supplemented by the researcher spending fifteen days in main thoroughfares of the three UK sites, approaching individuals at random to introduce the research to them and request that they participate. In these cases, participants could either complete both questionnaires immediately on a pre-arranged computer, or could take away
a piece of paper containing the link to the me² questionnaire and a paper copy of the other questionnaire.

9.2.2 Translation

Due to the linguistic diversity within the organisation in which the data were collected, the questionnaire measuring Team Creativity, Front End Innovation, creative performance and Creative and Innovative Climate was translated from English into French and Italian. This represents the native languages of the three countries where data was collected.

When collecting data from a linguistically diverse set of participants, the data collection method can either be translated into all participants’ native languages, or a shared language can be used if it exists (Harzing, 2005). In the current research, it was considered beneficial for face validity and ease of understanding that the questionnaire should be presented to participants in the language of the country they were working in. Moreover, it would not artificially suppress national differences (Harzing, 2005).

The questionnaire was translated from English into French and Italian following the back-translation approach (Maneesriwongul & Dixon, 2004), also referred to as ‘double translation’, by the organisation in which the current research was conducted. Back-translation is recommended as a translation method as it is more likely to identify inconsistencies than one-way, ‘simple direct’ translation (Behling & Law, 2000), and allows data equivalence to be established. That is, the extent to which the translation is equivalent and meaningful in different cultural contexts (Hult et al., 2008). Back-translation involves the questionnaire being translated from the original language into the target language, and then translated back from the target language into the original language. This allows any inconsistencies to be identified and rectified (McGorry, 2000). In the current research, no issues were identified during the back-translation process.

Following the translation process, the French and Italian versions of the questionnaire were piloted with three employees to verify the questionnaire had retained its meaning, i.e. conceptual equivalence (Berry, 1980). The me² could not be translated due to it being a commercial tool. One employee from each of the UK, France and Italy were consulted as to whether this would be problematic for participants completing the me²; it was suggested that although participants would ideally complete the questionnaire in their native language, English was the common language within the organisation and employees were required to be competent...
in English. It was confirmed that the language contained in the questionnaire was at a level that employees should find understandable.

9.2.3 Measures

Five constructs were measured in the current research: Front End Innovation, Individual Creativity, Team Creativity, Individual Creative Performance and Creative and Innovative Climate. The scales used to measure these constructs are detailed below.

9.2.3.1 Front End Innovation

Front End Innovation was measured using the Front End Innovation Scale (FEIS), which was developed as part of this thesis and is detailed in Study 1. An earlier version of FEIS was used in this study, comprising twenty-eight items measuring five factors (Idea Generation, Idea Selection, Evaluation, Open Innovation and Problem Solving Techniques).

FEIS uses a Likert scale with seven points: Strongly disagree, Moderately disagree, Slightly disagree, Neither agree nor disagree, Slightly agree, Moderately agree, Strongly agree. An example item is “We use problem solving techniques to help us decide which ideas to work on”.

9.2.3.2 Creative and Innovative Climate

Creative and Innovative Climate was measured using the Creative and Innovative Climate Scale (CICS), which was developed as part of this thesis and is detailed in Study 2. An earlier version of CICS was used in this study, comprising fifty two items measuring twelve factors (Valuing Creativity and Innovation, Risk Taking, Team Cohesion, Expertise, Autonomy, Resources, Achievement, Goal Awareness, Ideation Systems, Internal Networks, Internal Collaboration, External Collaboration).

CICS uses a Likert scale with seven points: Strongly disagree, Moderately disagree, Slightly disagree, Neither agree nor disagree, Slightly agree, Moderately agree, Strongly agree. An example item is “My organisation appreciates creative and innovative work”.

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Individual Creativity was measured using the me² (Batey, 2004). The me² comprises 115 items measuring twelve factors (Fluency, Originality, Illumination, Incubation, Producing, Sharing, Implementing, Achievement, Tolerance of Ambiguity, Intrinsic, Curiosity and Competitive). These twelve factors can be organised into four areas; Idea Generation, Personality, Motivation and Confidence.

Each of the me² scales evidenced acceptable reliability, as tested with two separate samples of n=2351 working adults and n=947 working adults (e-metrixx, 2014). The cutoff for an acceptable Cronbach’s alpha value is typically .70 (Tavakol & Dennick, 2011). All factors had Cronbach’s alpha of .71 or above, except Tolerance of Ambiguity which had Cronbach’s alpha of .68 in one of the two samples used to establish the reliability of the me² scales. Measures with Cronbach’s alpha below .70 are often used in research (e.g. Charlesworth et al., 1991; Fenwick et al., 2011; Hochwalder & Brucefors, 2005; Kober & Eggleton, 2005; Sivanathan & Fekken, 2002). The reliability of each me² scale is presented in Table 21.

Table 21. Cronbach’s Alpha of me² Scales

<table>
<thead>
<tr>
<th>Scale</th>
<th>Alpha (α) in a sample of n=2351 working adults</th>
<th>Alpha (α) in a sample of n=947 working adults</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluency</td>
<td>0.92</td>
<td>0.89</td>
</tr>
<tr>
<td>Originality</td>
<td>0.89</td>
<td>0.88</td>
</tr>
<tr>
<td>Illumination</td>
<td>0.77</td>
<td>0.75</td>
</tr>
<tr>
<td>Incubation</td>
<td>0.80</td>
<td>0.74</td>
</tr>
<tr>
<td>Producing</td>
<td>0.91</td>
<td>0.86</td>
</tr>
<tr>
<td>Sharing</td>
<td>0.87</td>
<td>0.85</td>
</tr>
<tr>
<td>Implementing</td>
<td>0.91</td>
<td>0.85</td>
</tr>
<tr>
<td>Achievement</td>
<td>0.73</td>
<td>0.79</td>
</tr>
<tr>
<td>Tolerance of Ambiguity</td>
<td>0.68</td>
<td>0.77</td>
</tr>
<tr>
<td>Intrinsic</td>
<td>0.85</td>
<td>0.87</td>
</tr>
<tr>
<td>Curiosity</td>
<td>0.71</td>
<td>0.81</td>
</tr>
<tr>
<td>Competitive</td>
<td>0.91</td>
<td>0.90</td>
</tr>
</tbody>
</table>
In addition to the reliability information presented above, construct validity studies and a Confirmatory Factor Analysis support the use of the me² in the current research and evidence its reliability and validity (e-metrixx, 2014). To evidence construct validity, scales that formed the four areas measured by the me² were correlated with scales from other measures. For example, by showing that there was a strong correlation between Amabile, Hill, Hennessey and Tighe’s (1994) Intrinsic Motivation scale and the me² Intrinsic scale, construct validity is demonstrated and the me² can be said to measure what it purports to measure (Smith, 2005). Table 22 presents correlations between me² scales and Work Preference Inventory and International Personality Item Pool scales.

The validity of the Idea Generation area of the me² was further demonstrated through the large percent of variance explained by the me² when compared to other creativity measures. In a sample of 3,574 adults, it has been shown that the me² can predict 86% of the variance in creativity (Batey & Irving, 2010). This is substantially greater than other personality based measures, which typically explain approximately 3-14% of variance in creativity (Batey et al., 2010; Furnham, Crump, Batey & Chamorro-Premuzic, 2009).

Finally, a Confirmatory Factor Analysis showed the 12 factor me² model had good fit (χ² = 14676.30 (n = 2351; df = 2418; p=.00) CFI = .94, NNFI = .94, RMSEA = .05) (e-metrixx, 2014).
### Table 22. me² Construct Validity Evidence

<table>
<thead>
<tr>
<th>me² scale</th>
<th>Correlated with</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idea Generation</td>
<td></td>
</tr>
<tr>
<td>Fluency</td>
<td>Curiosity (.43), Extraversion (.36), Intrinsic (.56), Social Confidence (.40)</td>
</tr>
<tr>
<td>Originality</td>
<td>Openness to Experience (.37), Unconventionality (.52), Intrinsic (.39)</td>
</tr>
<tr>
<td>Incubation</td>
<td>no correlations</td>
</tr>
<tr>
<td>Illumination</td>
<td>no correlations</td>
</tr>
<tr>
<td>Personality</td>
<td></td>
</tr>
<tr>
<td>Curiosity</td>
<td>Openness to Experience (.53); Curiosity (.57); Intrinsic (.58)</td>
</tr>
<tr>
<td>Ambiguity</td>
<td>no correlations</td>
</tr>
<tr>
<td>Confidence</td>
<td></td>
</tr>
<tr>
<td>Producing</td>
<td>Openness to Experience (.43); Social Confidence (.43)</td>
</tr>
<tr>
<td>Sharing</td>
<td>Intrinsic (.49); Social Confidence (.51)</td>
</tr>
<tr>
<td>Implementing</td>
<td>Intrinsic (.57); Social Confidence (.36)</td>
</tr>
<tr>
<td>Motivation</td>
<td></td>
</tr>
<tr>
<td>Intrinsic</td>
<td>Curiosity (.40); Intrinsic (.76)</td>
</tr>
<tr>
<td>Competitive</td>
<td>Extrinsic (.49)</td>
</tr>
<tr>
<td>Achievement</td>
<td>Intrinsic (.51); Extrinsic (.41)</td>
</tr>
</tbody>
</table>

Note: all correlations significant at p<.01. The Openness to Experience, Unconventionality, Curiosity, Social Confidence and Extraversion scales were from Goldberg’s (1999) International Personality Item Pool. The Intrinsic Motivation and Extrinsic Motivation scales were from Amabile et al.’s (1994) Work Preference Inventory.

The me² uses a Likert scale with seven points: Strongly disagree, Disagree, Slightly disagree, Neither agree nor disagree, Slightly agree, Agree, Strongly agree. An example item is “I am always full of ideas”.

#### 9.2.3.4 Team Creativity

Team Creativity was measured using an adaptation of Zhou and George’s (2001) creativity measure. The measure was adapted so that nine of the thirteen items were used. Specifically, three steps were followed. First, three items were removed because they formed a stand-alone measure of individual innovation which Zhou and George (2001) had subsumed into their creativity measure. These three items have been used by researchers to measure individual innovation (e.g. Gumusluoglu & Ilsev, 2009; Janssen, 2000), which indicates that they are not appropriate to assess Team Creativity. Adapting Zhou and George’s (2001) measure in this way avoids a limitation of previous research which has used the scale in its original form and thus
used items referring to innovation or product development when seeking to measure Team Creativity (e.g. Chen, 2006; Krutzberg, 2005).

The second step in the adaption of Zhou and George’s (2001) measure was to remove one item that referred to risk (“Is not afraid to take risks”). This item was removed because it was not directly measuring Team Creativity. Moreover, CICS contained a three item Risk Taking scale, which was preferable to a single item measure of risk.

The third step in the adaption of Zhou and George’s (2001) measure was to preface each of the nine remaining items with “My team”. This adaption made the measure suitable for assessing Team Creativity as opposed to Individual Creativity. Explicitly referring to the level of analysis in an item adds clarity and is considered good practice (Rogelberg, 2005). Moreover, individual level measures are frequently amended to measure the team level, including Zhou and George’s (2001) creativity measure (e.g. Joo et al., 2012; Sung & Choi, 2012; Tu, 2009).

The Team Creativity measure uses a seven point Likert scale: Strongly disagree, Moderately disagree, Slightly disagree, Neither agree nor disagree, Slightly agree, Moderately agree, Strongly agree. An example item is “My team suggests new ways to achieve goals or objectives”.

### 9.2.3.5 Individual Creative Performance

Individual Creative Performance was measured using a three item scale developed by Oldham and Cummings (1996). A brief, additional explanation was provided below each item as prescribed by Oldham and Cummings (1996). Self-reported Individual Creative Performance was particularly appropriate as definitions of creative performance argue that it comprises activities which are both observable and unobservable (Gupta & Singh, 2014; Montag et al., 2012; Zhou & Oldham, 2001), and other-ratings of unobservable activities is arguably not feasible.

The Individual Creative Performance measure uses a Likert scale with seven points: Extremely (negative), Moderately (negative), Slightly (negative), Neutral, Slightly (positive), Moderately (positive), Extremely (positive). An example item is “How original and practical is your work?”.
9.2.3.6 Demographics

In the UK and Italy, participants were asked to provide their age, gender, directorate, department, country, site and function. Participants were also asked to provide a unique identifier. In France, a reduced number of demographic questions were asked due to concerns from the French Worker’s Union regarding the potential identification of employees by senior management. In France, all demographic questions apart from department and country were asked.

Initially, multiple age bands were going to be used (18-29 (1), 30-39 (2), 40-49 (3), 50-59 (4), 60-69 (5), 70+ (6)), however following discussion with the French Workers’ Union, broader age bands were used: <30 (1), 31-40 (2), 41-50 (3), >50 (4).

9.2.4 Justification of self-report measurement

The measures used in the current research rely on participants reporting their own preferences, ability and perceptions of their environment. The majority of previous organisational psychology research, and the majority of previous creativity and innovation research, has used self-report measurement (Hulsheger et al., 2009; Spector, 1994; Podsakoff & Organ, 1986). However, despite being a popular approach its limitations warrant further discussion.

Self-report data may lead to common method variance. Common method variance refers to variance that is attributed to the common measurement method of two variables, as opposed to a genuine relationship (Jex & Britt, 2008; Podsakoff, MacKenzie, Lee & Podsakoff, 2003). This can bias the estimation of the relationship, often artificially inflating the magnitude of the relationship (Chan, 2009).

It has been argued that self-report measurement is appropriate if the researcher is interested in characteristics of the participants, including their perceptions of their environment and their emotional states. The participant should be reasonably expected to have a knowledge of what they are asked to self-report on. For example, expecting an employee to make a judgement on the financial success of their employer may be unreasonable. Therefore, if the researcher is interested in actual environmental conditions, self-report should be used in conjunction with other-ratings (Jex & Britt, 2008; Spector, 1994).

To minimise the potential negative effects of self-report measurement, data may be supplemented with other-ratings. However, other-ratings are also subjective, as any ratings provided by people would be (Spector, 1994). Individual difference researchers have identified
that participants are usually able to accurately self-report on individual difference variables, with the exception of intelligence (Chamorro-Premuzic, Furnham & Moutafi, 2004; Furnham & Dissou, 2007), whereas organisational hierarchy may substantially effect other-ratings (Conway & Huffcutt, 2003). Indeed, people are substantially better at predicting their own scores on psychological variables than predicting their friends’ scores (Furnham & Dissou, 2007).

Additionally, self-report measurement generally assumes people will provide truthful responses. This assumption applies to the current research, as the topics investigated are nonsensitive and therefore less prone to social desirability bias than topics such as workplace discrimination or ‘dark’ behaviours (Flom, Supino & Ross, 2012).

There are clearly limitations of self-report measurement. However, some believe that the limitations may be overstated, with issues such as biased correlation estimates remaining a possibility, not a definite occurrence (Chan, 2009). Moreover, Silvia et al. (2011) concluded their review of four new self-report creativity measures by stating “self-report creativity assessment is probably much better than creativity researchers think it is” (p.1). This is supported by empirical research which sought to justify the use of self-report Team Creativity ratings. Comparison of team member and team leader ratings of Team Creativity for 20 teams showed team leaders gave slightly higher ratings of Team Creativity than team members, and this difference was not significant (Leenders et al., 2003).

Self-report measurement is appropriate for the current research as it is predominantly interested in perceptions. The measures of Creative and Innovative Climate, Individual Creativity, Team Creativity and Front End Innovation aim to measure individual perceptions of the variables they measure, and do not purport to be objective or performance measures. Individual Creative Performance was also measured using self-report. Initially this measurement was to be supplemented with supervisor-rated creative performance, using the same three item Individual Creative Performance scale. However, this was not achieved. Towards the end of the allocated data collection period it was felt by the sponsoring organisation that collection of supervisor ratings would not be possible. This was primarily due to the likelihood of employees being uncomfortable with “performance” ratings being provided by their supervisor, and potential uncertainty as to exactly how this information would be used by the organisation. It was considered likely that attempted collection of this data may result in union involvement. Various potential options for collecting this data were discussed, however none were viable, particularly within the remaining timeframe. Thus, the practical limitations of obtaining other-rated data were
realised (Jex & Britt, 2008). It was decided to continue with only self-rated Individual Creative Performance data and follow Brutus, Aguinis and Wassmer’s (2013) recommendation to clearly state the implications for interpretation. Moreover, self-reported measures correlate with supervisory ratings of creativity (Axtell et al., 2000). For these reasons, and in accordance with ethical best practice, participants were reminded immediately prior to completing the questionnaires, and in the initial email calling for participants, that the results would not be seen by management, which aimed to reduce the likelihood of social desirability bias occurring.

9.3 Interim summary

The preceding section detailed the participants, method, translation and measures used in the current research. Appendix 3 (section 13.3) presents the full questionnaire (except me2 for copyright reasons). The results of the single level and multilevel analyses performed to address Hypotheses 1 to 5 will now be presented.

9.4 Data analysis

9.4.1 Strategy

Study 3 addresses Research Aims 3 and 4, comprising Hypotheses 1 to 5. The steps taken to address these are presented in Table 23, and discussed in depth below.

Table 23. Steps Taken to Address Hypotheses 1 to 5

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Prepare data set:</td>
</tr>
<tr>
<td>2</td>
<td>Develop team codes</td>
</tr>
</tbody>
</table>
| 3    | Data checking:  
|      | • missing data  
|      | • normality assumptions |
| 4    | Calculate weighted factor scores |
| 5    | Factor analyses |
| 6    | Descriptive statistics and consider potential control variables |
| 7    | Multiple regression analyses for Hypotheses 1, 2 and 3 |
| 8    | Multilevel Modeling for Hypotheses 4 and 5 |
9.4.2 Preparing the data set

Before the data can be analysed, the data set must be prepared. This entailed reverse scoring all the reverse scored items across the various measures used in Study 3, and combining the me² data with that from the Qualtrics questionnaire.

9.4.3 Developing team codes

To conduct team level analyses, team codes were developed. Of the total sample, 650 participants provided the name of the team they worked in, and 191 participants did not provide this information. Using this information, codes for 115 teams were initially developed, and then verified by an employee of the organisation in which the research took place. The number of employees per team was then calculated to assess whether any teams could be combined, and that the size of each team was satisfactory. There is no consensual definitive ‘acceptable’ team size in the context of multilevel research, or in creativity research (Bissola et al., 2014). It is partially related to the total number of team members. For example, a team size of 2 may be satisfactory if the team only has 2 or 3 members. In the organisation studied only one team was identified that had 2 members. Moreover, total team size was not known for most teams in the current research.

Existing multilevel research does not specify the percentage of each team that participated in the research. Indeed, some existing multilevel research does not specify the size of the teams analysed (e.g. Sun, Chow, Chiu & Pan, 2013). Other existing multilevel research uses teams as small as 2 (Nohe, Michaelis, Menges, Zhang & Sonntag, 2013), 3 (Mathisen et al., 2006), or 4 members (Lai, Lam & Lam, 2013). In the current research, teams of three or more were used, with the exception of one team which had two members and both participated in the current research.

The frequency with which each of the 115 team codes appeared was reviewed, and teams of 1 and 2 people were reviewed to see if they could be combined with another team. Twenty-seven teams fit the criteria for review (10 teams had one member, 17 had two members). These teams were then examined to see if they could be placed as part of any of the other teams. Thirteen of the 27 teams could be combined with other teams. For example, the ‘Production’ team in France was combined with the ‘Manufacturing’ team in France.

Fourteen of the teams (23 individual participants) were removed and therefore were not included in team level analyses. For example, one of the two-person teams represented Facilities. However, Facilities operate uniquely within the organisation and could not be combined with
another team. Also, teams with similar functions but in different countries, such as HR in France, HR in Italy and HR in the UK, were kept separate, following advice from the organisation that national teams operate largely independently from their counterparts in other countries. Also, this ensures that national differences were not obscured. Overall, 92 teams comprising 627 individuals remained for team level analyses. Teams ranged from 2 people to 26 people, with an average team size of 7 people.

With the team codes developed, the data were checked in preparation for analysis.

9.4.4 Data checking
Ensuring suitability of the data involved addressing missing data and assessing normality assumptions which must be met for the psychometric analyses to be performed. For information about normality assumptions refer to Tabachnick and Fidell (2013).

9.4.5 Missing data
The pattern of missing data was assessed for the data set with the exception of the demographic data (e.g. age, gender). The issue of missing data, i.e. a partially incomplete data matrix (Lance & Vandenberg, 2009), is a common problem in research and should be addressed as the first point in any analysis (Schlomer et al., 2010). A Missing Value Analysis was conducted on the data to assess the pattern of missingness in the data. 25.3% of the data were considered missing.

Little’s Missing Completely At Random test was not significant (.10), indicating data was Missing Completely At Random (MCAR). To address the issue of data MCAR the imputation method Expectation Maximisation (EM) was used as it is the most widely recommended for data MCAR (Martin et al., 2007), and it has been used in innovation research (e.g. Singh & Smith, 2004). Following EM, a total of 841 participants responses were acceptable for analysis.

9.4.6 Normality assumptions
The sequence for establishing multivariate normality as outlined by Tabachnick and Fidell (2013) was followed:
1. Outliers: parcel zscores were calculated and values above 3.29 identified to establish the presence of outliers. .02% exceeded this level; some values exceeding 3.29 are to be expected in a large data set (Field, 2005), thus it was concluded that there were no significant outlier distortions in this data.

2. Skew and kurtosis: assessed at the variable level. Skew and kurtosis zscores were calculated, with values of zero indicating no skew or kurtosis: a perfect normal distribution. Often a cut off of 1.96 is adhered to (e.g. Kerr et al., 2002), with values above that indicating that the variable in question is skewed or kurtotic. However, a cut off of 2.58 can be used in larger samples (Turner, 2014). The FEI, Individual Creativity, Team Creativity and Individual Creative Performance variables were normally distributed, with none showing skew or kurtosis. Regarding the Creative and Innovative Climate variables, Team Cohesion and Goal Awareness were identified as kurtotic (2.66 and 3.13 respectively). For all skewed or kurtotic variables the relevant histograms were also consulted to judge normal distribution, as is recommended for large samples (Tabachnick & Fidell, 2013). These confirmed the skew or kurtosis suggested by the above values. When skew or kurtosis is present, some authors advocate transforming data, typically using either a square root, logarithmic or inverse approach (e.g. Tabachnick & Fidell, 2013). However, no transformation was conducted in this study. This is for two reasons. First, changing the data arguably loses some of its richness, and second, transformed data can be harder to interpret (Tabachnick & Fidell, 2013).

3. Linearity: the assumption of a straight-line relationship between two variables was assessed using bivariate scatterplots. These evidenced reasonable linearity in all cases.

4. Homoscedasticity: the assumption that the variability of data points is the same in two continuous variables (Tabachnick & Fidell, 2013) was tested using bivariate scatterplots. These evidenced acceptable homoscedasticity in all cases.

9.4.7 Weighted factor scores

Factor scores for FEIS and CICS were calculated based on the factor analyses conducted in Studies 1 and 2. Factor scores estimate what the `score’ would be if the latent variable (factor) could be measured directly for each participant (Tabachnick & Fidell, 2013). Factor scores can be calculated as an average of a participant’s scores on each item that comprise a factor. Alternatively, factor scores can be weighted. Calculating an average factor score may be appropriate if there are substantial differences in the number of items per factor,
and this type of factor score is generally acceptable for most exploratory research (DiStefano, Zhu & Mindrila, 2009; Tabachnick & Fidell, 2013). However, average factor scores give equal weight to all items measuring a factor, and thus do not take into consideration the contribution of each item to the factor. That is, that some items load more highly onto a factor than other items. Moreover, average factor scores may not be appropriate when items cross-load onto multiple factors (DiStefano et al., 2009), although this was not the case in the current research.

The current research used weighted factor scores. This approach to calculating factor scores allows items with higher loadings have more effect on the factor score than items with lower loadings. It is also stable across different samples (DiStefano et al., 2009; Grice & Harris, 1998).

9.4.8 Exploratory Factor Analysis: Team Creativity

Exploratory Factor Analysis (EFA) was conducted on the data from the 841 questionnaires to examine the factor structure of the Team Creativity measure. EFA was conducted using Maximum Likelihood Extraction and Direct Oblimin rotation. Maximum Likelihood Extraction was used as it assumes some measurement error and optimally accounts for inter-variable correlation (Fabrigar et al., 1999), which is a common feature of subjective self-perception data. Factors were rotated to improve their psychological meaningfulness (Ford et al., 1986). An Oblique rotation method was chosen as it allows factors to correlate, which is appropriate when measuring psychological constructs (Field, 2005). Eigenvalues below 1 were suppressed in accordance with the Kaiser criterion (Kaiser, 1958).

Interpretation of the scree plot (Catell, 1966) showed discontinuity at 1 factor (Figure 16), and this factor solution was examined. The factor solution was examined adopting four criteria (Cooper, 2002; Worthington & Whittaker, 2006).

1. Each factor should have at least three loadings above $r=.3$
2. Each item should only load onto one factor above $r=.3$ (no crossloading)
3. Item communality should not be below $r=.2$
4. Each factor should be interpretable and theoretically coherent
The 1 factor solution was examined using the criteria above, which confirmed the 1 factor solution. All items were retained. This factor was labeled ‘Team Creativity’ and was highly reliable (α=.95).

Table 24. Exploratory Factor Analysis of Team Creativity Measure

<table>
<thead>
<tr>
<th>Factor Label</th>
<th>Item</th>
<th>Factor Loading</th>
<th>Alpha (α)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Creativity (9 items)</td>
<td>My team is a good source of creative ideas</td>
<td>0.91</td>
<td>0.95</td>
</tr>
<tr>
<td></td>
<td>My team often has new and innovative ideas</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My teams comes up with creative solutions to problems</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My team exhibits creativity on the job when given the opportunity to do so</td>
<td>0.84</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My team generates many ideas</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My team often has a fresh approach to problems</td>
<td>0.81</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My team suggests new ways of performing work tasks</td>
<td>0.79</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My team suggests new ways to achieve goals or objectives</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td></td>
<td>My team suggests new ways to increase quality</td>
<td>0.68</td>
<td></td>
</tr>
</tbody>
</table>
9.4.9 Exploratory Factor Analysis: Individual Creative Performance

An EFA was conducted on the data from the 841 questionnaires to examine the factor structure of the Individual Creative Performance measure. EFA was conducted using Maximum Likelihood Extraction and Direct Oblimin rotation. Maximum Likelihood Extraction was used as it assumes some measurement error and optimally accounts for inter-variable correlation (Fabrigar et al., 1999), which is a common feature of subjective self-perception data. Factors were rotated to improve their psychological meaningfulness (Ford et al., 1986). An Oblique rotation method was chosen as it allows factors to correlate, which is appropriate when measuring psychological constructs (Field, 2005). Eigenvalues below 1 were suppressed in accordance with the Kaiser criterion (Kaiser, 1958).

Interpretation of the scree plot (Cattell, 1966) showed discontinuity at 1 factor (Figure 17), and this factor solution was examined. The factor solution was examined adopting four criteria (Cooper, 2002; Worthington & Whittaker, 2006).

1. Each factor should have at least three loadings above $r=.3$
2. Each item should only load onto one factor above $r=.3$ (no crossloading)
3. Item communality should not be below $r=.2$
4. Each factor should be interpretable and theoretically coherent
The 1 factor solution was examined using the criteria above, which confirmed the 1 factor solution. All items were retained. This factor was labeled ‘Individual Creative Performance’ and was reliable ($\alpha=.87$).

Table 25. Exploratory Factor Analysis of the Individual Creative Performance Measure

<table>
<thead>
<tr>
<th>Factor</th>
<th>Factor Label</th>
<th>Item</th>
<th>Factor Loading</th>
<th>Alpha ($\alpha$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Individual Creative Performance (3 items)</td>
<td>How original and practical is your work?</td>
<td>0.92</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How creative is your work?</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>How adaptive and practical is your work?</td>
<td>0.79</td>
<td></td>
</tr>
</tbody>
</table>

9.4.10 Confirmatory Factor Analysis: Individual Creativity

A Confirmatory Factor Analysis was conducted on the data from the 841 questionnaires to examine the factor structure of the Individual Creativity measure, extending a CFA presented in the me$^2$ technical specification showing that the 12 factor me$^2$ model had good fit ($\chi^2 = 14676.30$ ($n = 2351$; $df = 2418$; $p=.00$) CFI = .94, NNFI = .94, RMSEA = .05) (e-metrixx, 2014). The current research sought to confirm whether this factor structure holds true in the current research given...
the different sample. That is, whether analyses using the me² should use the 12 factors or whether a four or one factor higher order factor structure would be more appropriate for subsequent analyses. See section 8.10.1 for an introduction to CFA and explanation of the fit indices used.

It is important to be sure that analyses use the most appropriate factor solution; four and one factor structures were tested as competing models to the 12 factor solution as the literature also refers to four and one factor structures although the former has no empirical evidence and therefore may be explanatory only (Batey, 2004; e-metrixx, 2014). In the current research, neither the four or one factor structure evidenced good fit, with the four factor solution exhibiting marginally poorer fit, particularly regarding the RMSEA \( \chi^2 = 1410.44 \) (\( n = 841; \text{df} = 49; p=.00 \)) CFI = .79, TLI = .72, RMSEA = .18, than the one factor solution \( \chi^2 = 6519.24 \) (\( n = 841; \text{df} = 59; p=.00 \)) CFI = .76, TLI = .73, RMSEA = .17).

The 12 factor structure of the me² was confirmed, consistent with the me² technical specification (e-metrixx, 2014). This suggests that analyses in the current thesis should be conducted using the 12 factor solution. These findings also have implications for the argument that the me² factors could be divided into four dimensions, as Batey (2004) suggests. Specifically, any four area approach should be taken as theoretical and/or explanatory only, offering a means to explain Individual Creativity with greater theoretical parsimony.

9.4.11 Descriptive statistics

Table 26 presents the correlation coefficients for each factor included in the following analyses.


| Factor                              | M   | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|-------------------------------------|-----|----|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Problem Solving Techniques          | 3.04| 1.051|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Idea Selection                      | 2.82 | .67 | .33 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Open Innovation                     | 2.55 | .81 | .30 | .25 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Evaluation                          | 2.61 | .69 | .49 | .37 | .35 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Creative Performance                | 4.33 | .90 | .23 | .37 | .26 | .25 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Internal Collaboration              | 2.94 | .78 | .30 | .29 | .16 | .25 | .16 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Team Cohesion                       | 4.44 | .90 | .28 | .46 | .18 | .28 | .24 | .34 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Internal Networks                   | 3.92 | .83 | .12 | .11 | .22 | .15 | .21 | .20 | .06 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Goal Awareness                      | 4.32 | .83 | -.27 | .38 | .13 | .27 | .25 | .45 | .57 | .15 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Resources                           | 3.46 | .98 | .25 | .25 | .07 | .19 | .03 | .51 | .30 | .14 | .37 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Risk Taking                         | 2.90 | .89 | .11 | .22 | .10 | .18 | .18 | .15 | .23 | .08 | .22 | .16 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Ideation Systems                    | 1.94 | .56 | .46 | .34 | .29 | .32 | .19 | .61 | .30 | .22 | .37 | .50 | .19 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Valuing Creativity and Innovation   | 2.95 | .83 | .28 | .29 | .21 | .26 | .21 | .49 | .33 | .14 | .40 | .41 | .32 | .61 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| External Collaboration              | 2.47 | .58 | .31 | .35 | .44 | .32 | .25 | .52 | .32 | .35 | .37 | .32 | .21 | .53 | .43 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Autonomy                            | 2.16 | .60 | -.01 | .10 | .12 | .09 | .20 | -.06 | .06 | .12 | .02 | .05 | .18 | -.02 | .09 | .12 | 1 |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Table 26. Correlation Matrix
<table>
<thead>
<tr>
<th></th>
<th>Team Creativity</th>
<th>Idea Generation</th>
<th>General Factor Creativity</th>
<th>Fluency</th>
<th>Originality</th>
<th>Incubation</th>
<th>Illumination</th>
<th>Curiosity</th>
<th>Ambiguity</th>
<th>Intrinsic Motivation</th>
<th>Competitive</th>
<th>Achievement Motivation</th>
<th>Confidence Producing Ideas</th>
<th>Confidence Sharing Ideas</th>
<th>Confidence Implementing Ideas</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Team Creativity</td>
<td>4.04 .89 .38 .55 .33 .37 .45 .30 .52 .15 .42 .19 .25 .37 .33 .37 .08 1</td>
<td>3.29 .90 .32 .46 .32 .36 .43 .17 .34 .11 .25 .13 .28 .21 .25 .28 .10 .64 1</td>
<td>4.60 1.44.14 .19 .10 .11 .28 .01 .10 .09 .04 .01 .05 .03 .01 .01 .08 .32 .26 1</td>
<td>4.55 1.49.10 .13 .06 .03 .24 -.06 .02 .04 -.03 -.05 .00 -.07 -.09 -.03 .02 .23 .22 .80 1</td>
<td>4.84 1.40.07 .11 .09 .03 .19 -.06 .01 -.03 -.06 -.05 .02 -.12 -.09 -.06 .02 .18 .18 .65 .68 1</td>
<td>4.88 1.31.04 .03 .04 .00 .01 .03 .03 .05 -.01 .05 -.01 .03 -.02 .02 .00 .02 -.01 .17 .02 .14 1</td>
<td>4.08 1.31.03 .04 .02 -.02 .01 -.04 -.01 -.05 -.06 -.06 .00 -.11 -.09 -.06 .03 -.40 .00 .39 .28 .44 .39 1</td>
<td>5.02 1.80.08 .17 .10 .09 .19 .04 .14 .08 .07 .20 .04 .04 .05 .04 .01 .30 .20 .66 .41 .35 .10 .18 1</td>
<td>5.19 1.50.06 .07 .06 .04 .18 -.04 .04 .03 .00 -.04 .02 -.07 -.04 .00 .14 .17 .20 .60 .39 .36 .02 .21 .27 1</td>
<td>5.18 1.79.10 .18 .09 .13 .21 .02 .12 .06 .01 .05 .05 .00 .05 .01 .09 .28 .21 .73 .43 .32 .02 .21 .56 .47 1</td>
<td>5.96 1.58.08 .09 .07 .12 .03 .08 .05 .14 .09 .09 .11 .09 .12 .04 -.02 .08 .05 .37 .22 .10 -.01 .09 .21 .10 .38 1</td>
<td>4.71 1.44.11 .11 .11 .13 .10 .02 .02 .14 .06 .00 .07 .05 .04 .03 .07 .13 .10 .50 .00 .16 -.04 .10 .31 .19 .51 .52 1</td>
<td>5.40 1.63.07 .09 .02 .03 .25 -.05 .08 -.01 .04 -.07 .03 -.12 -.07 -.04 .09 .21 .21 .75 .70 .55 -.06 .20 .34 .52 .44 .11 .19 1</td>
<td>5.17 1.50.10 .16 .07 .07 .24 .01 .09 .12 .04 .02 .06 .02 .04 .07 .10 .29 .22 .73 .58 .46 .02 .21 .38 .49 .43 .13 .23 .63 1</td>
<td>4.84 1.53.14 .26 .07 .15 .28 .09 .17 .11 .15 .07 .08 .09 .05 .08 .07 .38 .26 .71 .57 .38 -.02 .15 .44 .42 .52 .28 .36 .57 .58 1</td>
</tr>
</tbody>
</table>

Note: All values at \( r = .068 \) or above are significant at \( p < .05 \). Significant values in bold.
9.5 Interim summary

The preceding section presented the preparation of the data set, development of the team codes, data checking and calculating weighted factor scores, and EFAs for the Team Creativity and Individual Creative Performance measures. The results of the single level multiple regression analyses for Hypotheses 1, 2 and 3 will now be presented.

9.6 Multiple regression analyses

Multiple Regression analyses whether an outcome variable can be predicted by several predictor variables. Focusing on prediction as opposed to the presence of a simple relationship can provide a greater understanding of the data. Multiple Regression techniques were applied to Hypotheses 1, 2 and 3.

9.6.1 Hypothesis 1

Hypothesis 1 sought to understand which Individual Creativity factors had the strongest relationships with Individual Creative Performance. Both of these variables operate at the individual level, and the relationship investigated in Hypothesis 1 is highlighted in the schematic representation in Figure 18.

Figure 18. Schematic Representation of the Hypotheses Addressed in the Current Research with Hypothesis 1 Highlighted
Multiple Regression was appropriate for Hypothesis 1 as there were twelve predictor variables. Forced Entry was used as there was insufficient theoretical background upon which to select the order in which to enter predictors into the model (if there had been, hierarchical entry could have been used). Within Forced Entry, factors were listed in order of their correlation with Individual Creative Performance, which is the order in which they are presented in Table 27.

Table 27. Multiple Regression of Individual Creative Performance and 12 \( \text{me}^2 \) Individual Creativity Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>( \text{St.} \beta )</th>
<th>( t )</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Implementing</td>
<td>0.15</td>
<td>3.09</td>
</tr>
<tr>
<td></td>
<td>Producing</td>
<td>0.05</td>
<td>0.83</td>
</tr>
<tr>
<td></td>
<td>Sharing</td>
<td>0.06</td>
<td>1.28</td>
</tr>
<tr>
<td></td>
<td>Fluency</td>
<td>0.03</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td>Intrinsic</td>
<td>0.08</td>
<td>1.71</td>
</tr>
<tr>
<td></td>
<td>Originality</td>
<td>0.07</td>
<td>1.43</td>
</tr>
<tr>
<td></td>
<td>Curiosity</td>
<td>0.03</td>
<td>0.65</td>
</tr>
<tr>
<td></td>
<td>Ambiguity</td>
<td>0.01</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>Achievement</td>
<td>-0.01</td>
<td>-0.21</td>
</tr>
<tr>
<td></td>
<td>Competitive</td>
<td>-0.06</td>
<td>-1.44</td>
</tr>
<tr>
<td></td>
<td>Illumination</td>
<td>-0.11</td>
<td>-2.75</td>
</tr>
<tr>
<td></td>
<td>Incubation</td>
<td>0.04</td>
<td>1.00</td>
</tr>
</tbody>
</table>

\( F(12, 828) = 8.39** \quad r^2 = 0.11, \quad \text{adj.} \quad r^2 = 0.10 \)

** significant to <.01

Of the 12 Individual Creativity factors entered into the regression model, Implementing (\( \beta = 0.15, \quad t=3.09, \quad p<.05 \)) and Illumination (\( \beta = -0.11, \quad t= -2.75, \quad p<.05 \)) were found to significantly relate to Individual Creative Performance. Illumination was found to negatively relate to Individual Creative Performance (i.e. greater Illumination less creative performance) and Implementing positively related to Individual Creative Performance (i.e. greater Implementing more creative performance). Overall, the model is able to explain 11% of the variance in Individual Creative Performance.

To assess the influence of age, gender and respondent's country in the current research, the above regression model was re-run as a stepwise model with these demographic variables entered into the model first. This analysis also partially addresses the question of whether completing the Individual Creativity measure in English influenced the responses of non-native English speakers.
Table 28. Multiple Regression of Individual Creative Performance and 12 me² Individual Creativity Factors Controlling for Gender, Age and Country

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country</td>
<td>0.06</td>
<td>1.48</td>
<td>0.14</td>
</tr>
<tr>
<td>Age</td>
<td>0.03</td>
<td>1.01</td>
<td>0.31</td>
</tr>
<tr>
<td>Gender</td>
<td>0.02</td>
<td>0.52</td>
<td>0.60</td>
</tr>
<tr>
<td>Implementing</td>
<td>0.15</td>
<td>4.13</td>
<td>0.00</td>
</tr>
<tr>
<td>Producing</td>
<td>0.05</td>
<td>3.32</td>
<td>0.00</td>
</tr>
<tr>
<td>Intrinsic</td>
<td>0.08</td>
<td>2.34</td>
<td>0.02</td>
</tr>
</tbody>
</table>

F(6, 615) = 16.33** r²=.14, adj. r²=.13

** significant to <.01

In this case, three iterations of the regression model were computed, and the third and final model explained the greatest proportion of the variance in Individual Creative Performance at 14%. Stepwise regression removes non-contributory variables; in this case, the final model contained the three demographic variables and three of the twelve Individual Creativity factors. None of the control variables were significant predictors of Individual Creative Performance, whilst all the remaining Individual Creativity factors were significant predictors of Individual Creative Performance. Implementing (β=.20, t=4.13, p<.05), Producing (β=.15, t=3.32, p<.05) and Intrinsic (β=.11, t=2.34, p<.05) were positively and significantly related to Individual Creative Performance. This suggests that age, gender and country have limited influence upon the current research, and that Implementing may be the most consistent Individual Creativity predictor of Individual Creative Performance. As regards questionnaire completion, the fact that the demographic variables did not explain a large proportion of additional variance and were all non-significant predictors of Individual Creative Performance suggests that non-native English speakers were not at a substantial disadvantage when completing the Individual Creativity measure in English (refer to section 9.22 for discussion of questionnaire translation).

9.6.2 Hypothesis 1: Discussion

Individual Creativity, measured by the 12 me² factors, explained 11% of the variance in Individual Creative Performance, as measured by three items (Oldham & Cummings, 1996), although only Implementing and Illumination were significantly related to Individual Creative Performance. The fact that Implementing, the extent to which a person is confident turning a creative ideas into reality (Batey, 2004), was positively related to Individual Creative Performance suggests that people who are more confident turning their ideas into reality are also

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likely to perceive themselves as performing more creativity (i.e. produce work that is original, adaptive and creative).

Existing literature on Creative Self-Efficacy may go some way to explaining this finding, as the items measuring Implementing all refer to confidence. Previous studies suggest that individuals who possess greater Creative Self-Efficacy also perform ‘better’ or more creatively (Sweetman et al., 2011; Tierney & Farmer, 2002). Moreover, the weakness of the relationship between the Implementing and Individual Creative Performance ($\beta=.15$) supports the argument that confidence implementing ideas is conceptually distinct from creative performance. Being confident in an area does not equate to performance in that area, although the process by which this occurs is currently unclear. Organisational climate may be important in this process, and the results from Hypothesis 2 (presented next) suggest this may be the case. Alternatively, level of skill may be important in the process of confidence leading to performance. A review of selection methods identified cognitive ability as the strongest predictor of job performance ($r=.65$) (Robertson & Smith, 2001), and previous research has emphasised the importance of intelligence for self-rated creativity (e.g. Batey et al., 2010; Hughes et al., 2012) and creativity measured by Divergent Thinking assessments (e.g. Furnham et al., 2009; Furnham & Nederstrom, 2010). Skilled employees may be more confident in their creative abilities, and both their skill and confidence may lead them to perform better.

Illumination was negatively related to Individual Creative Performance, suggesting that people who report that they frequently experience flashes of inspiration or insight are less likely to perform creatively in the context studied. Early research proposed Illumination as the third of four steps in the creativity process (Wallas, 1926), and a subsequent extension of Wallas’ (1926) work combined Illumination and Incubation into a single ‘idea finding’ stage (Basadur et al., 2000). However, the current research suggests that if creative performance is the desired outcome, then Illumination and Incubation are two unique stages, as one is significantly related to creative performance whilst the other is not. That Incubation does not always lead to Illumination supports this argument; if they were synonymous constructs they would always occur together and would also form a single factor during analysis.

The participants involved in the current research may go some way to explaining why Illumination may hinder creative performance, as opposed to aid it, as suggested by stage theories (e.g. Basadur et al., 2000; Wallas, 1926). The current sample comprised predominantly technical employees from an engineering organisation who may feel uncomfortable experiencing sudden
flashes of insight, preferring logical thinking processes to illuminative inspiration. The extent to
which artists and scientists differ on various personality traits, with scientists tending to be higher
on Conscientiousness and artists higher on Neuroticism (indicating they have a greater tendency
to experience emotions), supports this explanation (Burch, Pavelis, Hemsley & Corr, 2006; Feist,
2008; Nelson & Rawlings, 2010). Moreover, many of the projects undertaken in the sampled
organisation are long term (many years) thus require substantial planning. Having a detailed
planning stage at the beginning of a project may reduce the need for Illumination later on.

Alternatively, the way in which Individual Creative Performance was measured may have
determined the identification of a negative relationship with Illumination. Illumination may be a
good predictor of Divergent Thinking, for example. A person can quickly note down flashes of
insight or inspiration, however the sustained effort required for Individual Creative Performance
(as measured in the current research) does not seem to be supported by sudden flashes of insight
or inspiration.

There are a number of limitations specific to Hypothesis 1. First, using a single self-rated
measure of Individual Creative Performance may have resulted in a less accurate representation
of a participant’s Individual Creative Performance, due to social desirability bias for example. It
was speculated that greater confidence Implementing ideas may lead to Individual Creative
Performance. However, the current research focuses only on an individual’s perception of their
performance, and the current research offers no way to verify the accuracy of this perception. As
noted previously, the current research sought to obtain supervisor ratings of Individual Creative
Performance to use in conjunction with self-ratings. Although multiple attempts were made to
collect this data, it was not possible within the timeframe available and due to the potential for the
research to induce disquiet in Unionised employees. However, future research could strengthen
the measurement of Individual Creative Performance by obtaining ratings from multiple sources.

As the findings from Hypothesis 1 suggest that an individual’s creative style and their
creative performance are different phenomena, a second avenue for future research may explore
this difference further. For example, an investigation of the differences between Individual
Creative Performance and Individual Creativity could be used to develop distinct definitions of
these two constructs and also to understand to what extent they overlap. Such an investigation
could use Multidimensional Scaling (MDS), which is an exploratory technique that represents the
similarity, and dissimilarity, of variables in a spatial map (Borg & Groenen, 2005; Pinkley,
Gelfand & Duan, 2005). Although typically used in marketing, MDS has been advocated for use
in psychology because it does not require normally distributed data (Jaworska & Chupetlovska-Anastoasova, 2009), and has been used in psychological research in the development of Schwartz’s (1994) values framework.

The preceding section has presented and discussed the results pertaining to Hypothesis 1. The following section focuses on Hypothesis 2, specifically Creative and Innovative Climate factors and Individual Creative Performance.

9.6.3 Hypothesis 2

Hypothesis 2 sought to understand which Creative and Innovative Climate factors were most related to Individual Creative Performance. Both of these variables operate at the individual level, and the relationship investigated in Hypothesis 2 is highlighted in the schematic representation in Figure 19.

![Figure 19. Schematic Representation of the Hypotheses Addressed in the Current Research with Hypothesis 2 Highlighted](image)

Multiple Regression was appropriate for Hypothesis 2 as there were ten predictor variables (the 10 Creative and Innovative Climate factors). Forced Entry was used to examine the relationships between Creative and Innovative Climate and Individual Creative Performance, as there was little theoretical background upon which to select the order in which to enter predictors into the model (if there had been, hierarchical entry would have been used).
Table 29. Multiple Regression of Individual Creative Performance and 10 Creative and Innovative Climate Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Goal Awareness</td>
<td>0.12</td>
<td>2.98</td>
<td>0.00</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>0.07</td>
<td>1.62</td>
<td>0.11</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>0.12</td>
<td>3.10</td>
<td>0.00</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>0.14</td>
<td>4.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.05</td>
<td>1.11</td>
<td>0.27</td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.14</td>
<td>4.29</td>
<td>0.00</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>0.08</td>
<td>1.73</td>
<td>0.08</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.07</td>
<td>1.97</td>
<td>0.05 (.049)</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>0.02</td>
<td>0.36</td>
<td>0.72</td>
</tr>
<tr>
<td>Resources</td>
<td>0.17</td>
<td>4.38</td>
<td>0.00</td>
</tr>
</tbody>
</table>

\[ F(10, 830) = 16.94** r^2 = .17, \text{adj. } r^2 = .16 \]

** significant to <.01

Of the 10 Creative and Innovative Climate factors entered into the regression model, Goal Awareness (β= .12, t= 2.98, p<.05), Team Cohesion (β= .12, t= 3.10, p<.05), Internal Networks (β= .14, t= 4.00, p<.05), Autonomy (β= .14, t= 4.29, p<.05), Risk Taking (β= .07, t= 1.97, p<.05) and Resources (β= .17, t= 4.38, p<.05) were found to significantly relate to Individual Creative Performance. All significant relationships were positive, i.e. greater Goal Awareness, Team Cohesion, Internal Networks, Autonomy and Risk Taking relates to greater creative performance. Overall, the model (the 10 Creative and Innovative Climate factors) explained 17% of the variance in Individual Creative Performance.

9.6.4 Hypothesis 2: Discussion

Creative and Innovative Climate explained 17% of the variance in Individual Creative Performance, with Goal Awareness, Team Cohesion, Internal Networks, Autonomy, Resources and Risk Taking all positively and significantly related to Individual Creative Performance.

9.6.4.1 Goal Awareness and Individual Creative Performance

The first Creative and Innovative Climate factor significantly related to Individual Creative Performance was Goal Awareness. This suggests that people who work in teams that are aware of and understand their objectives also perform more creatively. This may be because awareness of goals is a prerequisite to Individual Creative Performance; to apply creativity to a
work task the individual must know what they are ultimately trying to achieve, and only then can they apply their creativity to achieve that goal.

Importantly, the Goal Awareness items used in the current research did not explicitly refer to being creative as a goal, suggesting that the presence of clear broad goals alone encourages Individual Creative Performance. This finding is contrary to arguments that creative performance behaviours should be an explicit goal in order to increase creative performance (Shalley, 2008), and to Goal Setting Theory which argues that specific, challenging goals facilitate higher levels of creative performance (Locke & Latham, 1990; Klotz et al., 2012).

Having broad goals may be sufficient to achieve creative performance, with employees automatically applying creativity in order to achieve a goal. This reinforces the importance of organisations providing employees with techniques such as Theory of Inventive Problem Solving (TRIZ), which may be particularly appealing to Conscientious, ordered engineers and scientists as it provides clear processes to follow (Birdi, Leach & Magadley, 2012; Cavallucci & Oget, 2013). Alternatively, an employee may only apply creativity in response to a broad goal, and thus perform creatively, in organisations that value creativity and innovation and therefore reward employees for behaving creatively or innovatively. However, the current study found no support for a relationship between Valuing Creativity and Innovation and Individual Creative Performance.

Although the current study suggests that broad goals facilitate Individual Creative Performance, broad goals may not be as effective at facilitating Individual Creative Performance as creativity-specific goals. To ascertain the extent to which creativity-specific goals explain additional variance to that explained by broad Goal Awareness, the current study could be replicated. Using identical measures will allow findings to be easily compared; a persistent limitation of the creativity literature is the plethora of definitional and measurement approaches makes comparing studies (and reaching parsimonious conclusions) harder (Batey & Furnham, 2006). A future replication may also measure the extent to which employees had goals that included a directive to be creative. Anecdotal evidence suggests MBDA did not have such goals, however an empirical measurement of employee and supervisor perceptions of whether goals included a directive to be creative could be used as a control variable. Insufficient consideration of the participants and whether they had broad or creativity-specific goals has been a criticism of previous research in this area (Montag et al., 2012; Unsworth, 2001).
9.6.4.2 Team Cohesion and Individual Creative Performance

The second Creative and Innovative Climate factor significantly and positively related to Individual Creative Performance was Team Cohesion. This suggests that people who work in teams perceived as supportive, trusting and accepting also perform more creatively.

One possible explanation for this finding is that when the team environment is cohesive, individuals feel more confident, including regarding creativity, and therefore are more likely to perform creatively. Existing research has explored the relationship between creative self-efficacy and creativity (e.g. Tierney & Farmer, 2002), however to date no research has explored whether Creative Self-Efficacy mediates the relationship between climate (for example, Team Cohesion) and Individual Creative Performance.

Alternatively, Team Cohesion may facilitate Knowledge of Who Knows What (Richert et al., 2012), which in turn facilitates Individual Creative Performance. Knowledge of Who Knows What has already been identified as a determinant of Individual Creative Performance (as measured by supervisor-rated Ideation), although it has not been investigated as a mediator as there has only been one study of this new construct to date.

The current research also confirms that trust and psychological safety are aspects of Team Cohesion, as previous studies have focused on trust and psychological safety only, and identified positive relationships with Individual Creative Performance (e.g. Brattstrom et al., 2012; Craig & Kelly, 1999; Kessel et al., 2012).

9.6.4.3 Internal Networks and Individual Creative Performance

The third Creative and Innovative Climate factor significantly and positively related to Individual Creative Performance was Internal Networks. This suggests that those who put effort into making and maintaining connections within the organisation also perform more creatively, and supports the little existing research that has also identified a positive relationship, albeit using samples with limited generalisability to an organisational context (e.g. Cattani & Ferriani, 2008; Klep et al., 2013).

The relationship between Internal Networks and Individual Creative Performance may be a bi-directional one (as is the case for all correlational research). Here, Internal Networks may lead to Individual Creative Performance, or performing creatively may lead to Internal Networks. A possible explanation is that those with a propensity to perform creatively seek out information from other people (their network) to aid their creative work. In these cases, Knowledge of Who
Knows What may also support Individual Creative Performance (Richter et al., 2012). The presence of a significant relationship between Team Creativity and Internal Networks further supports this conclusion.

Organisational politics may also play a role in the ability of a person to utilise their Internal Networks to facilitate their Individual Creative Performance. This suggests that both Knowledge of Who Knows What and political awareness could be investigated as mediators of the Internal Networks-Individual Creative Performance relationship in future research. There appears to have been no empirical investigation of the role of organisational politics in creativity and creative performance. This research gap is most closely informed by a seemingly small number of publications acknowledging the importance of organisational politics for innovation (e.g. Asimakou, 2009; Thomas, 2000; Wolfe, 1994), however the organisational politics and creativity literatures appear disparate.

In addition to addressing the research gap regarding the role of organisational politics identified above, future research would benefit from taking a qualitative approach to understanding why those with a larger internal network also perform creatively. Perhaps they are more aware of other work within the organisation, and use creativity to compete with others’ work. Quantitatively, a moderated Internal Networks-Extraversion-Individual Creative Performance relationship may be identified, as having larger networks may relate to levels of Extraversion, which has been positively related to creativity (Furnham, Batey, Anand & Manfield, 2008), and to greater knowledge, which may lead to greater combinations of ideas and therefore greater creativity (Blind Variation Selective Retention model; Simonton, 1999).

9.6.4.4 Autonomy and Individual Creative Performance

The fourth Creative and Innovative Climate factor significantly and positively related to Individual Creative Performance was Autonomy. This suggests that people who have control over their work also perform more creatively. Previous literature is relatively consistent in identifying Autonomy as an important prerequisite for a number of positive outcomes, such as job satisfaction and reduced turnover intention (e.g. Barrick & Mount, 1993; Dysvik & Kuvaa, 2013; Gillet, Gagne, Sauvagere & Fouquereau, 2013). Creativity research has also argued that Autonomy is important for thinking freely, openness to new ideas and a state of mind that encourages creativity, although previous research found no relationship between Autonomy and Individual Creative Performance when the latter was measured as Fluency (Grawitch et al., 2013).
The current research contradicts these findings, although comparison is limited by the different measurement approaches taken by the current research and Grawitch et al. (2003), and the latter’s use of a student sample. However, these contradictory results may be partially explained by the different measurement approaches. A person may be able to generate many ideas irrespective of whether the organisational climate supports autonomous working, but the sustained effort required for Individual Creative Performance as measured in the current research may benefit from Autonomy. The latter requires a greater need for practical, social and political sensitivity, and thus a different skill set to ideation.

A possible explanation for these findings is that having practical freedom, i.e. freedom to decide when to work on which task, also provides psychological freedom, i.e. the freedom to think deeply about an issue and think around an issue, which may lead to Individual Creative Performance. Although there has not been any empirical investigation of different forms of Autonomy and their comparative relationships with Individual Creative Performance, it has been proposed that Autonomy comprises three facets (Autonomy over work scheduling, work methods and decision making) (Cordery & Parker, 2012; Morgeson & Humphrey, 2006). Future research could investigate their relationships with Individual Creative Performance. This may identify Autonomy over work methods as the strongest predictor of Individual Creative Performance, because whilst there may be no choice over when a task must be done and someone else may have the final decision regarding a task, for example, maintaining control over how a task is done provides the opportunity for an individual to perform creatively. However, this is speculative and empirical investigation is required.

Interpreting the Autonomy-Individual Creative Performance relationship is limited by the reliability of the Autonomy scale at slightly below the .60 cutoff. The Autonomy CICS scale has been identified as requiring further development, and one of the primary aims of future CICS development will be to improve the reliability of this scale.

**9.6.4.5 Risk Taking and Individual Creative Performance**

The fifth Creative and Innovative Climate factor significantly related to Individual Creative Performance was Risk Taking. This suggests that people who perceive the climate to encourage Risk Taking, and are encouraged by their managers to take risks, perceive themselves to perform more creatively.
Although there is very little existing empirical literature examining the relationship between organisational climates that encourage Risk Taking and Individual Creative Performance, it is logical that working in a climate in which Risk Taking is encouraged leads to increased Risk Taking, which can lead to Individual Creative Performance. Supporting this argument is the fact that taking risks can achieve something new or different (Im et al., 2013), and novelty is a key aspect of Individual Creative Performance (Gupta & Singh, 2014; Montag et al., 2012; Zhou & Oldham, 2001). Future research may wish to explore the interplay between Risk Taking and Autonomy; if employees take risks because they feel management “allows” them to, i.e. Autonomy, it may be that both are required prerequisites for Individual Creative Performance. Previously a higher order factor structure for CICS is presented in which Autonomy and Risk Taking form a single factor, which supports the argument of co-dependence of the Creative and Innovative Climate factors theoretically, if not empirically.

For practitioners, the primary implication of a Risk Taking-Individual Creative Performance relationship is to emphasise the importance of Risk Taking within organisations that are typically risk averse, such as the one in which the current research was primarily conducted. It may be challenging for large, multinational organisations which are traditionally risk averse to change (Edwards & Bowen, 2010). Likewise, for the employees of high technology organisations that may have been recruited for their risk aversion (Charlton (2009) critiques organisations populated mainly with scientists for recruiting this tendency).

Given the importance of Individual Creative Performance and the challenge some organisations face to encourage Risk Taking, future research that evaluates strategies for encouraging Risk Taking may be beneficial. Educating employees on creativity and teaching creativity techniques, ideally those with evidence of their effectiveness (e.g. TRIZ; Birdi et al., 2012), may offer a good starting point.

9.6.4.6 Resources and Individual Creative Performance

The final Creative and Innovative Climate factor significantly and positively related to Individual Creative Performance was Resources. This suggests that people who find it difficult to obtain the resources and facilities required for their work are unlikely to perform creatively, and those with access to resources perceive themselves as performing more creatively.

This supports previous findings that Resources are an important antecedent to Individual Creative Performance (e.g. Alder, 1994; Kolb, 1992; Whitelock et al., 2008), particularly time as
a resource (e.g. Baer & Oldham, 2006; Hsu & Fan, 2010). This may be especially true in the current sample of a high technology engineering organisation, in which creative performance may involve developing a product prototype using expensive materials, for example. Facilities are required that offer an appropriate physical environment in which to work, and both financial and physical space resources are required to prototype an idea.

Previous research has identified the physical environment as important for creativity and innovation (e.g. Dul & Ceylan, 2011; Lee & Kang, 2013; Oksanen & Stahle, 2013). The current research supports earlier findings, identifying Resources as a facilitator of Individual Creative Performance. It also partially extends previous research that focused on creativity, not Individual Creative Performance, and its relationship with the environment.

However, the current study is limited by its use of a self-reported Individual Creative Performance measure. MBDA employees perceive themselves as performing more creatively when there are greater Resources. However, they may: 1. not actually be performing more creatively, or 2. not require greater Resources to perform creatively. To explicate the former implication, additional measures of Individual Creative Performance are required, such as supervisor- and peer-ratings (although these are still subjective and prone to bias (Spector, 1994)). Explicating the latter implication, that employees may not require the levels of Resources they perceive they require, is more complex and depends on why it occurs. A positive relationship between Resources and Individual Creative Performance may be a self-fulfilling prophecy (Dvir, Eden, Avolio & Shamir, 2002; Merton, 1948), i.e. employees believe Resources are a prerequisite for Individual Creative Performance and therefore do not perform creatively unless an appropriate level of Resources are available to them. There is increasing discussion of “frugal innovation”, predominantly in countries with fewer Resources such as India and various African countries (Soni & Krishnan, 2014; Zeschky, Winterhalter & Gassmann, 2014). As the current study was located within comparatively Resource-rich countries, participants may have been more likely to believe Resources are a necessary prerequisite for innovation and related constructs, such as Individual Creative Performance. A cross-cultural study may provide insight into the veracity of this explanation, focusing on a Resource-poor country as a comparison to the current research. Such an investigation may find little difference between countries. If this were the case, it may be due to the differences in approach when the Resources being used are an individual’s own or their organisations. The former may be greater motivation for frugality, although product quality may also play a role; for defence organisations it is particularly
important that every product works every time it is used, leading to products being “over-engineered” and thus costly (Frankenstein, 1995).

### 9.6.5 Shared variance

Cumulatively, the two analyses presented in 9.6.1 and 9.6.3 suggest that 28% of the variance in Individual Creative Performance may be explained by a person’s creative style and Creative and Innovative Climate. To empirically assess the shared variance a further regression was performed in which Creative and Innovative Climate and Individual Creativity were simultaneously regressed onto Individual Creative Performance. The 12 Individual Creativity factors were used because neither the one or four factor solution for the Individual Creativity measure were supported.

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
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<td>0.69</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>2.16</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>0.13</td>
<td>3.89</td>
<td>0.00</td>
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<tr>
<td></td>
<td>0.13</td>
<td>3.13</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>0.17</td>
<td>4.62</td>
<td>0.00</td>
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<tr>
<td></td>
<td>0.07</td>
<td>2.02</td>
<td>0.04</td>
</tr>
<tr>
<td></td>
<td>0.10</td>
<td>2.17</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
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<td></td>
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<td>2.16</td>
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<td>1.01</td>
<td>0.32</td>
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<tr>
<td></td>
<td>0.00</td>
<td>0.06</td>
<td>0.96</td>
</tr>
<tr>
<td></td>
<td>0.08</td>
<td>1.80</td>
<td>0.07</td>
</tr>
</tbody>
</table>

\[ F(22, 818) = 12.72** \quad r^2 = .26, \quad \text{adj. } r^2 = .24 \]

** significant to <.01
The prediction model was statistically significant, and explained 26% of the variance in Individual Creative Performance. Of the 10 Creative and Innovative Climate factors and 12 Individual Creativity factors entered into the regression model, Team Cohesion ($\beta = .08, t = 2.16, p < .05$), Internal Networks ($\beta = .13, t = 3.89, p < .05$), Goal Awareness ($\beta = .13, t = 3.13, p < .05$), Resources ($\beta = .17, t = 4.62, p < .05$), Risk Taking ($\beta = .07, t = 2.02, p < .05$), Ideation Systems ($\beta = .10, t = 2.17, p < .05$), Autonomy ($\beta = .12, t = 3.78, p < .05$), Originality ($\beta = .11, t = 2.33, p < .05$), Illumination ($\beta = -.08, t = -2.27, p < .05$), Intrinsic ($\beta = .10, t = 2.16, p < .05$) and Competitive ($\beta = -.08, t = -2.18, p < .05$) were found to significantly relate to Individual Creative Performance. All significant relationships were positive, except for Illumination and Competitive which were negatively related to Individual Creative Performance. Overall, the model explained 26% of the variance in Individual Creative Performance.

The model presented in Table 30 suggests that Creative and Innovative Climate is a better predictor of Individual Creative Performance than Individual Creativity, as the beta weightings were larger for Climate factors and a greater number of Climate factors were significant in the model when compared to Individual Creativity factors. The semi-partial correlations were squared to more rigorously test what proportion of the variance explained was unique to Creative and Innovative Climate as opposed to shared between both Creative and Innovative Climate and Individual Creativity. 4% of the variance explained in Individual Creative Performance was uniquely explained by Creative and Innovative Climate factors (1% by Internal Networks, 1% by Autonomy and 2% by Resources) and 1% of the variance in Individual Creative Performance was explained only by Individual Creativity (5% from both Originality and Incubation). Cumulatively, 5% of the variance explained is unique, indicating that 21% of the variance in Individual Creative Performance is shared by Creative and Innovative Climate and Individual Creativity. That is, almost one-fifth of the variance that can be explained is unique and four-fifths is shared. This may suggest that Creative and Innovative Climate and Individual Creativity are, to some extent, overlapping constructs. This may be explained by both constructs being self-report measures with a focus on creativity, albeit with one measure focusing on creativity and innovation in relation to organisational climate, and the other measure focusing on an individual’s beliefs about their own creative style. Overall, this analysis extends the Creative and Innovative Climate-Individual Creative Performance and Individual Creativity and Individual Creative Performance relationships examined separately in 9.6.1 and 9.6.3, identifying a similar level of variance explained but providing greater understanding of what proportion of this variance is shared as opposed to unique.
9.6.6 Summary

Of the independent variables analysed in 9.6.1, 9.6.3 and 9.6.5, Creative and Innovative Climate is able to explain more of the variance in Individual Creative Performance than Individual Creativity can, suggesting that the climate in which an individual works is more influential on their Individual Creative Performance than their creative style. This may be because creative style may help individuals to think creatively, but in order for them to behave creatively the environment they work in must be supportive. Performing creatively requires sustained effort, and thus although an individual may have a creative style that facilitates Individual Creative Performance, the likelihood of them applying the effort needed may depend on the climate. If the climate does not support an individual to act creatively, then any creative thinking cannot be utilised.

A number of limitations specific to Hypothesis 2 have been noted. Specifically, the use of a single self-rated measure of Individual Creative Performance, the relatively poor reliability of the Autonomy measurement scale, and limited generalisability of the findings to industries and organisations with different characteristics to MBDA. This context may influence employee perceptions, for example regarding the importance of Resources and high quality output, and thus the current results. Moreover, the quantitative nature of the current research limits speculation as to how factors are related to one another. For example, the role of creativity-specific versus broad goals in encouraging Individual Creative Performance, or the interplay between Risk Taking and Autonomy; if employees take risks because they feel management “allows” them to, it may be that both are required prerequisites for Individual Creative Performance. Interviews, for example, could explore this relationship.

In addition to suggestions of future research to investigate the role of different facets of Autonomy and cross-cultural research to explore the self-fulfilling prophecy involved in the perceived need for Resources, a consistent recommendation for future research was to explore the role of potential mediators or moderators of various Creative and Innovative Climate and Individual Creative Performance relationship. First, Creative Self-Efficacy was proposed as a potential mediator or moderator of the relationship between Individual Creative Performance and Goal Awareness, Team Cohesion and Risk Taking. Second, Knowledge of Who Knows What (Richer et al., 2012) was proposed as a potential mediator or moderator of the relationship between Individual Creative Performance and Internal Networks and Team Cohesion. Third,
organisational politics was proposed as a potential mediator or moderator of the relationship between Individual Creative Performance and Internal Networks.

Exploring the relationships between Creative and Innovative Climate and Goal Awareness highlighted the importance of educating employees on creativity and creativity techniques. Finding that employees may automatically seek to apply creativity to achieve a goal suggests that organisations should provide employees with techniques to aid this endeavour, such as TRIZ. Second, the Risk Taking-Individual Creative Performance relationship highlighted the importance of organisations overcoming their risk aversion, to which education on creativity and teaching creativity techniques may offer a good starting point.

The preceding section has presented and discussed the results pertaining to Hypothesis 2. The following section focuses on Hypothesis 3 and the relationship between Creative and Innovative Climate and Individual Creativity.

9.6.7 Hypothesis 3

Hypothesis 3 sought to understand which Creative and Innovative Climate factors were most related to Individual Creativity. Both of these variables operate at the individual level, and the relationship investigated in Hypothesis 3 is highlighted in the schematic representation in Figure 20.

Figure 20. Schematic Representation of the Hypotheses Addressed in the Current Research with Hypothesis 3 Highlighted
Multiple Regression was appropriate for Hypothesis 3 as there were ten predictor variables (the 10 Creative and Innovative Climate factors). The correlation matrix was examined and regressions were run only if a me^2 dimension had a significant relationship with at least one Creative and Innovative Climate dimension, as a significant correlation coefficient suggests a relationship exists. One me^2 dimension, Incubation, did not meet this criterion and therefore no multiple regression was conducted to analyse the relationship between Incubation and Creative and Innovative Climate. The relationships between the eleven remaining me^2 dimensions and Creative and Innovative Climate were analysed. Each me^2 dimension was analysed individually, as opposed to using the General Factor of Creativity, for thoroughness.

All analyses used Forced Entry, as there was little theoretical background upon which to select the order in which to enter predictors into the model. All analyses entered Individual Creativity factors in order of their correlation with the relevant Creative and Innovative Climate factor.

Table 31. Multiple Regression of Individual Fluency and 10 Creative and Innovative Climate Factors

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<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
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</thead>
<tbody>
<tr>
<td>#1 Valuing Creativity and Innovation</td>
<td>0.08</td>
<td>1.739</td>
<td>0.08</td>
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<td>Ideation Systems</td>
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<td>Autonomy</td>
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<td>Team Cohesion</td>
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<td>Risk Taking</td>
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</tbody>
</table>

\[ F(10, 830) = 1.27 \quad r^2 = .02, \quad adj. \ r^2 = .00 \]

None of the ten Creative and Innovative Climate factors entered into the regression model were significantly related to individual Fluency. Overall, the model, the ten Creative and Innovative Climate factors, explains 2% of the variance in individual Fluency.
Table 32. Multiple Regression of Individual Originality and 10 Creative and Innovative Climate Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Ideation Systems</td>
<td>-0.12</td>
<td>-2.35</td>
<td>0.02</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.05</td>
<td>1.12</td>
<td>0.26</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>-0.01</td>
<td>-0.28</td>
<td>0.78</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>-0.07</td>
<td>1.45</td>
<td>0.15</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>0.04</td>
<td>0.88</td>
<td>0.38</td>
</tr>
<tr>
<td>Resources</td>
<td>0.01</td>
<td>0.22</td>
<td>0.83</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>0.00</td>
<td>0.01</td>
<td>0.99</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.05</td>
<td>1.45</td>
<td>0.15</td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.01</td>
<td>0.38</td>
<td>0.71</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>0.07</td>
<td>1.69</td>
<td>0.09</td>
</tr>
</tbody>
</table>

\[ F(10, 830) = 1.99^* r^2 = .02, \ adj. r^2 = .01 \]

* significant to <.05

Of the 10 Creative and Innovative Climate factors entered into the regression model, Ideation Systems (β= -.12, t= -2.35, p<.05) was found to significantly and negatively relate to individual Originality. Ideation Systems negatively related to Originality, i.e. individuals who perceive the environment to have systems to aid idea generation reported lower levels of Originality. Overall, the model (the 10 Creative and Innovative Climate factors) is able to explain 2% of the variance in individual Originality.

Table 33. Multiple Regression of Individual Illumination and 10 Creative and Innovative Climate Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Ideation Systems</td>
<td>0.09</td>
<td>-1.83</td>
<td>0.07</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.06</td>
<td>1.27</td>
<td>0.21</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>-0.06</td>
<td>-1.35</td>
<td>0.18</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>-0.02</td>
<td>-0.36</td>
<td>0.72</td>
</tr>
<tr>
<td>Resources</td>
<td>0.01</td>
<td>0.34</td>
<td>0.73</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>-0.03</td>
<td>0.74</td>
<td>0.46</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>0.08</td>
<td>1.58</td>
<td>0.12</td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.03</td>
<td>0.85</td>
<td>0.40</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>0.06</td>
<td>1.36</td>
<td>0.17</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.03</td>
<td>0.76</td>
<td>0.45</td>
</tr>
</tbody>
</table>

\[ F(10, 830) = 1.71 r^2 = .02, \ adj. r^2 = .01 \]
None of the 10 Individual Creativity factors entered into the regression model were significantly related to individual Illumination. Overall, the model (the 10 Creative and Innovative Climate factors) is able to explain 2% of the variance in individual Illumination.

Table 34. Multiple Regression of Individual Curiosity and 10 Creative and Innovative Climate Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Team Cohesion</td>
<td>0.16</td>
<td>3.62</td>
<td>0.00</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>-0.01</td>
<td>-0.23</td>
<td>0.82</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>0.09</td>
<td>2.34</td>
<td>0.02</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.01</td>
<td>0.20</td>
<td>0.85</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>0.01</td>
<td>0.19</td>
<td>0.85</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>-0.03</td>
<td>-0.74</td>
<td>0.46</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.01</td>
<td>0.20</td>
<td>0.83</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>-0.01</td>
<td>-0.10</td>
<td>0.92</td>
</tr>
<tr>
<td>Resources</td>
<td>0.03</td>
<td>0.75</td>
<td>0.45</td>
</tr>
<tr>
<td>Autonomy</td>
<td>-0.01</td>
<td>-0.18</td>
<td>0.85</td>
</tr>
</tbody>
</table>

F(10, 830) = 2.28* r²=.03, adj. r²=.02

* significant to <.05

Of the 10 Creative and Innovative Climate factors entered into the regression model, Team Cohesion (β= .16, t= 3.62, p<.05) and Internal Networks (β= .09, t= 2.34, p<.05) were found to significantly relate to individual Curiosity. Both were positively related to Curiosity. That is, those who work in more cohesive teams and have greater internal networks also report themselves to be more curious. Overall, the model (the 10 Creative and Innovative Climate factors) is able to explain 3% of the variance in individual Originality.
Table 35. Multiple Regression of Individual Ambiguity and 10 Creative and Innovative Climate Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.13</td>
<td>3.52</td>
<td>0.00</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>-0.09</td>
<td>-1.77</td>
<td>0.08</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>0.07</td>
<td>1.52</td>
<td>0.13</td>
</tr>
<tr>
<td>Resources</td>
<td>0.01</td>
<td>0.18</td>
<td>0.86</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>0.01</td>
<td>0.14</td>
<td>0.89</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.02</td>
<td>0.45</td>
<td>0.65</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>0.03</td>
<td>0.67</td>
<td>0.50</td>
</tr>
<tr>
<td>Risk</td>
<td>0.00</td>
<td>0.01</td>
<td>0.99</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>0.00</td>
<td>-0.08</td>
<td>0.93</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>0.02</td>
<td>0.33</td>
<td>0.74</td>
</tr>
</tbody>
</table>

$F(10, 830) = 2.38 \ast r^2=.03, \text{adj} \cdot r^2=.02$

* significant to <.05

Of the 10 Creative and Innovative Climate factors entered into the regression model, Autonomy ($\beta= .13, t= 3.52, p<.05$) was found to significantly relate to individual Ambiguity. The relationship was positive, indicating that those who have greater Autonomy at work also report themselves to be more tolerant to ambiguity. Overall, the model (the 10 Creative and Innovative Climate factors) is able to explain 3% of the variance in individual tolerance of Ambiguity.

Table 36. Multiple Regression of Individual Intrinsic Motivation and 10 Creative and Innovative Climate Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>0.12</td>
<td>2.77</td>
<td>0.01</td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.08</td>
<td>2.19</td>
<td>0.03</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>0.02</td>
<td>0.34</td>
<td>0.74</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>0.07</td>
<td>1.76</td>
<td>0.08</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.04</td>
<td>0.90</td>
<td>0.37</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.00</td>
<td>0.12</td>
<td>0.10</td>
</tr>
<tr>
<td>Resources</td>
<td>0.04</td>
<td>0.94</td>
<td>0.35</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>-0.02</td>
<td>-0.34</td>
<td>0.74</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>-0.05</td>
<td>-1.15</td>
<td>0.25</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>-0.06</td>
<td>-1.19</td>
<td>0.24</td>
</tr>
</tbody>
</table>

$F(10, 830) = 2.59 \ast r^2=.03, \text{adj} \cdot r^2=.02$

* significant to <.05

Of the 10 Creative and Innovative Climate factors entered into the regression model, Team Cohesion ($\beta= .12, t= 2.77, p<.05$) and Autonomy ($\beta= .08, t= 2.19, p<.05$) were found to
significantly relate to individual Intrinsic Motivation. Both were positively related to Intrinsic Motivation. That is, those who work in more cohesive teams and have greater Autonomy are also more intrinsically motivated. Overall, the model (the 10 Creative and Innovative Climate factors) is able to explain 3% of the variance in individual Intrinsic Motivation.

Table 37. Multiple Regression of Individual Competitive Motivation and 10 Creative and Innovative Climate Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Networks</td>
<td>0.15</td>
<td>4.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.08</td>
<td>1.65</td>
<td>0.10</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.09</td>
<td>2.33</td>
<td>0.02</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>0.02</td>
<td>0.31</td>
<td>0.76</td>
</tr>
<tr>
<td>Resources</td>
<td>0.03</td>
<td>0.76</td>
<td>0.45</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>0.04</td>
<td>0.87</td>
<td>0.38</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>-0.01</td>
<td>-0.15</td>
<td>0.88</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>-0.01</td>
<td>-0.21</td>
<td>0.84</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>-0.08</td>
<td>-1.73</td>
<td>0.08</td>
</tr>
<tr>
<td>Autonomy</td>
<td>-0.05</td>
<td>-1.48</td>
<td>0.14</td>
</tr>
</tbody>
</table>

F(10, 830) = 3.82**, r^2 = .04, adj. r^2 = .03

** significant to <.01

Of the 10 Creative and Innovative Climate factors entered into the regression model, Internal Networks (β = .15, t = 4.00, p < .05) and Risk Taking (β = .09, t = 2.33, p < .05) were found to significantly relate to individual Competitive Motivation. Both were positively related to Competitive Motivation. That is, those who have greater internal networks and take feel they can take more risks are also more motivated by competition. Overall, the model (the 10 Creative and Innovative Climate factors) is able to explain 4% of the variance in individual Competitive Motivation.
Table 38. Multiple Regression of Individual Achievement Motivation and 10 Creative and Innovative Climate Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Internal Networks</td>
<td>0.14</td>
<td>3.84</td>
<td>0.00</td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.05</td>
<td>1.44</td>
<td>0.15</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.05</td>
<td>1.36</td>
<td>0.18</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>0.07</td>
<td>1.48</td>
<td>0.14</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>0.05</td>
<td>0.98</td>
<td>0.33</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.01</td>
<td>0.12</td>
<td>0.91</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>-0.06</td>
<td>-1.23</td>
<td>0.22</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>-0.01</td>
<td>-0.27</td>
<td>0.79</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>-0.03</td>
<td>-0.61</td>
<td>0.54</td>
</tr>
<tr>
<td>Resources</td>
<td>-0.04</td>
<td>-0.89</td>
<td>0.37</td>
</tr>
</tbody>
</table>

*significant to <.05

Of the 10 Creative and Innovative Climate factors entered into the regression model, Internal Networks (β=.14, t= 3.84, p<.05) was found to significantly relate to individual Achievement Motivation. The relationship was positive, indicating that those who have more greater internal networks are also more motivated by achieving excellence. Overall, the model (the 10 Creative and Innovative Climate factors) is able to explain 3% of the variance in individual tolerance of Achievement Motivation.

Table 39. Multiple Regression of Individual Confidence Producing Ideas and 10 Creative and Innovative Climate Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 Ideation Systems</td>
<td>-0.14</td>
<td>-2.77</td>
<td>0.01</td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.08</td>
<td>2.18</td>
<td>0.03</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>0.11</td>
<td>2.53</td>
<td>0.01</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.05</td>
<td>1.01</td>
<td>0.31</td>
</tr>
<tr>
<td>Resources</td>
<td>0.04</td>
<td>0.90</td>
<td>0.37</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>0.03</td>
<td>0.60</td>
<td>0.55</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>-0.01</td>
<td>-0.28</td>
<td>0.78</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>0.04</td>
<td>0.95</td>
<td>0.34</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.03</td>
<td>0.67</td>
<td>0.50</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>0.02</td>
<td>0.43</td>
<td>0.67</td>
</tr>
</tbody>
</table>

**significant to <.01

Of the 10 climate factors entered into the regression model, Ideation Systems (β= -.14, t= -2.77, p<.05), Autonomy (β= .08, t= 2.18, p<.05) and Team Cohesion (β= .11, t= 2.53, p<.05)
were found to significantly relate to individual Producing. Ideation Systems was negatively related to Producing, and Autonomy and Team Cohesion were positively related to Producing. That is, those who perceive they work in an environment with greater proliferation of organisational systems for idea generation are less confident producing ideas, whilst those with greater Autonomy and working in more cohesive teams reported themselves to have more confidence producing ideas. Overall, the model (the 10 Creative and Innovative Climate factors) is able to explain 4% of the variance in individual Confidence Producing Ideas.

Table 40. Multiple Regression of Individual Confidence Sharing Ideas and 10 Creative and Innovative Climate Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Networks</td>
<td>0.11</td>
<td>2.85</td>
<td>0.01</td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.07</td>
<td>1.91</td>
<td>0.06</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>0.10</td>
<td>2.22</td>
<td>0.03</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>0.03</td>
<td>0.72</td>
<td>0.47</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.03</td>
<td>0.76</td>
<td>0.45</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>-0.02</td>
<td>-0.42</td>
<td>0.68</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.00</td>
<td>0.04</td>
<td>0.97</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>-0.01</td>
<td>-0.28</td>
<td>0.78</td>
</tr>
<tr>
<td>Resources</td>
<td>0.00</td>
<td>-0.01</td>
<td>0.99</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>-0.05</td>
<td>-0.96</td>
<td>0.34</td>
</tr>
</tbody>
</table>

F(10, 830) = 2.61* $r^2 = .03$, adj. $r^2 = .02$

* significant to <.05

Of the 10 Creative and Innovative Climate factors entered into the regression model, Internal Networks ($\beta = .11, t = -2.85, p<.05$) and Team Cohesion ($\beta = .10, t = 2.22, p<.05$) were found to significantly relate to individual Sharing. Both were positively related to Sharing, indicating that those with greater Internal Networks and those who work in more cohesive teams are more confident sharing their ideas with others. Overall, the model (the 10 Creative and Innovative Climate factors) is able to explain 3% of the variance in individual Confidence Producing Ideas.
Table 41. Multiple Regression of Individual Confidence Implementing Ideas and 10 Creative and Innovative Climate Factors

<table>
<thead>
<tr>
<th>Model</th>
<th>St.β</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>0.13</td>
<td>2.95</td>
<td>0.00</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>0.07</td>
<td>1.4</td>
<td>0.14</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>0.09</td>
<td>2.45</td>
<td>0.01</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>0.06</td>
<td>1.25</td>
<td>0.21</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>0.01</td>
<td>0.29</td>
<td>0.77</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>-0.03</td>
<td>-0.72</td>
<td>0.47</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.04</td>
<td>1.04</td>
<td>0.30</td>
</tr>
<tr>
<td>Resources</td>
<td>0.00</td>
<td>0.06</td>
<td>0.95</td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.06</td>
<td>1.69</td>
<td>0.09</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.09</td>
<td>1.85</td>
<td>0.06</td>
</tr>
</tbody>
</table>

\[ F(10, 830) = 4.19^{**}, r^2 = .05, \text{adj. } r^2 = .04 \]

** significant to <.01

Of the 10 climate factors entered into the regression model, Team Cohesion (β = .13, t= 2.95, p<.05) and Internal Networks (β = .09, t= 2.45, p<.05) were found to significantly relate to individual Implementing. Both were positively related to Implementing, indicating that those with greater Internal Networks and those who work in more cohesive teams are more confident implementing ideas. Overall, the model (the 10 Creative and Innovative Climate factors) is able to explain 5% of the variance in individual Confidence Implementing Ideas.

9.6.8 Hypothesis 3: Discussion

Overall, the variance in Individual Creativity explained by the Creative and Innovative Climate factors is small. However, there is some consistency in which climate factors emerge as significantly relating to Individual Creativity factors, with Team Cohesion and Internal Networks being related to the largest number of creativity factors.

Creative and Innovative Climate accounted for between 1% and 5% of the variance in each Individual Creativity factor. Although the amount of variance accounted for is small, it is pertinent to consider which climate factors are consistently identified as related to Individual Creativity factors, particularly as the current research seems to be unique in its conceptualisation of creativity as a multidimensional construct that extends beyond idea generation, thus extending the narrow focus of previous literature (e.g. Baer, 2010; Sosa, 2011) and answering calls for research that explores the multiple facets of climate for creativity and innovation (Anderson et al., 2014).
9.6.8.1 Idea generation

Creative and Innovative Climate had little relationship on idea generation (Fluency, Originality, Incubation and Illumination). The single significant relationship was a negative relationship between Originality and Ideation Systems, suggesting that formalised processes surrounding creativity and innovation are not conducive to individuals having unusual ideas. This may be because formalised processes constrain original thinking, which supports previous studies investigating the paradoxical need for some formalisation but not too much (e.g. Ekvall, 1996; Im et al., 2013). The fact that no other dimensions of Creative and Innovative Climate were related to idea generation suggests that organisations wishing to increase the idea generation of their employees should evaluate the formalised processes they use and potentially utilise a less rigid idea generation process. Also, as Creative and Innovative Climate had little relationship with ideation and this suggests ideation is somewhat innate, organisations seeking this attribute may focus on this in their recruitment process.

9.6.8.2 Personality

Three Creative and Innovative Climate factors emerged as important for personality (Curiosity and Tolerance of Ambiguity). Curiosity was positively related to Team Cohesion and Internal Networks, suggesting that working in a cohesive team with high levels of trust and support provides the necessary base for exploring new ideas. Alternatively, individuals with high levels of Curiosity may interact with their team more, perhaps to obtain information or to gain Knowledge of Who Knows What (Richter et al., 2012). This increased interaction may mean they feel part of the team and thus experience greater cohesion. Moreover, if Curiosity drives an individual to interact with others, this may extend beyond the team and account for the significant relationship with Internal Networks. This interpretation is supported by studies investigating Social Curiosity, which argue that a facet of Curiosity is the extent to which an individual is interested in other people (Hartung & Renner, 2013; Renner, 2006).

Tolerance of Ambiguity was positively related to Autonomy, suggesting those who prefer to have greater control over their work are also comfortable with uncertainty. A possible interpretation of this finding is that having control makes a person comfortable with uncertainty, as they know that they have the freedom to react to changes and events as they occur. Future research may investigate different facets of Autonomy in relation to Tolerance of Ambiguity, such as Autonomy over work scheduling, work methods and decision making (Cordery & Parker,
In the case of Individual Creative Performance, it was hypothesised that Autonomy over work methods may be the strongest predictor of Individual Creative Performance. This may hold true in the case of Tolerance of Ambiguity too, which would further support the argument that having control makes a person comfortable with uncertainty, as they know that they have the freedom to react to changes and events as they occur. However, this is speculative and empirical investigation is required. Moreover, these findings are limited by the relatively poor reliability of the Autonomy scale.

Outside of the creativity literature, it has been argued that employees with greater Autonomy experience lower levels of job role ambiguity (Fazli,穆罕默德 & Ahmad, 2014; Kalbers & Cenker, 2008). This was the opposite of what was found by the current study, perhaps due to the focus on role ambiguity within the finance industry, as opposed to ambiguity in relation to creativity within the defence industry. The limited existing empirical work makes confident speculating why the Tolerance of Ambiguity-Autonomy relationship seems to behave in two opposing ways difficult, however the contrast between creativity, internal auditing of financial operations and public accounting may be key.

### 9.6.8.3 Intrinsic Motivation

Intrinsic Motivation was positively related to Team Cohesion and Autonomy, suggesting that those who work in a cohesive team and have control over their work also tend to be motivated by an inherent interest in their job, or vice versa.

The current research extends existing literature that has emphasised the importance of Intrinsic Motivation for creativity (e.g. Amabile et al., 1996) by identifying which aspects of Creative and Innovative Climate relate to Intrinsic Motivation. One interpretation of the relationship between Intrinsic Motivation and Team Cohesion is that to encourage Intrinsic Motivation, an individual should operate within a team that is highly cohesive. Working in a trusting team may allow an individual to focus on their work, without being distracted by feeling uncomfortable within their team, and therefore they become motivated by an inherent interest in the job itself. This may be akin to Maslow’s Hierarchy of Needs (Maslow, 1943), in which Team Cohesion may fulfill a basic need after which Intrinsic Motivation can occur. This process may occur more quickly if other team members have similar intrinsic motives.

The present research also identified a relationship between Intrinsic Motivation and Autonomy. People who are motivated by working on personal challenges and an inherent interest
in their job may prefer to have control over how they do their work. Alternatively, having Autonomy at work may lead an individual to become motivated by the work they are doing, because they have control over it they are more interested in it. Existing research argues that, generally, people respond positively to Autonomy (Chirkov, Ryan & Sheldon, 2011; Gillet et al., 2013), and therefore having Autonomy may result in an inherent interest in the job. Furthermore, it has been argued that employees who work autonomously and are intrinsically motivated are more likely to exhibit organisational citizenship behaviours (Pohl, Santo & Battistelli, 2012). This argument may make the Intrinsic Motivation-Autonomy relationship more interesting for practitioners, as it seems that organisations could gain additional benefits from Intrinsic Motivation and Autonomy, particularly as the resultant organisational citizenship behaviours have been related to employee performance and organisational outcomes such as improved productivity and efficiency (Nielsen, Hrivnak & Shaw, 2009; Podsakoff, Whiting, Podsakoff & Blume, 2009).

Finding that Autonomy appears to be particularly important for Intrinsic Motivation, not Competitive or Achievement motivation, also supports an earlier study that argued that having freedom over work encouraged Intrinsic Motivation, and also harmonious passion, a construct similar to Intrinsic Motivation regarding a person internalising an activity (e.g. creativity) and therefore choosing to engage with it (Liu et al., 2011).

9.6.8.4 Competitive and Achievement Motivation

The current research also extends the existing literature, which tends to focus on Intrinsic Motivation, by exploring the roles of Competitive motivation and Achievement motivation. Competitive and Achievement motivation were found to significantly and positively relate to Internal Networks. A possible explanation for this finding is that having a large Internal Network encourages an individual to focus on others, or those who focus on others are more likely to have a larger Internal Network, which is consistent with the earlier argument regarding Internal Networks and social curiosity (Hartung & Renner, 2013; Renner, 2006). If having Internal Networks suggests a person is outwardly focused, a claim supported by findings that both sociability (Goffee & Jones, 1996) and Extraversion (Ishiguro, 2013; Pollet, Roberts & Dunbar, 2011) are related to having larger networks, they may also be more likely to want to compete with others as they have greater knowledge of what other people are achieving and wish to achieve the same. Instead of focusing and being motivated by the task itself (i.e. Intrinsic Motivation), both
Competitive and Achievement motivation are externally referenced as they focus on comparison with others. The fact that no significant relationships were identified between these aspects of motivation and either Internal Collaboration or External Collaboration suggest that the focus is on having connections, perhaps social knowledge such as Knowledge of Who Knows What (Richer et al., 2012), rather than working with others. However, these relationships identified in the current research were weak and only small amounts of variance could be explained.

Competitive Motivation was significantly and positively related to Risk Taking, suggesting that those who are motivated by competing with others also feel the climate encourages them to take risks. A possible explanation for this finding is that a highly competitive individual may want to take risks to be successful in a competition, an interpretation supported by social psychology literature identifying a competitiveness-Risk Taking relationship (e.g. Fujiwara & Arai, 2008), and therefore they are more aware of whether the Creative and Innovative Climate encourages Risk Taking or not. For example, one benefit of taking a risk on a new product is that if successful that individual may be considered more competent than their colleagues, and may be rewarded for the positive outcome of their Risk Taking (Auernhammer & Hall, 2013). However, this may only occur in organisations that view Risk Taking favourably, as the current research found no relationship between Risk Taking and reward in the context of creativity and innovation (Valuing Creativity and Innovation).

**9.6.8.5 Confidence**

Regarding creative confidence (Producing, Sharing and Implementing ideas), Team Cohesion was unique as it was positively and significantly related to all three forms of confidence: Producing, Sharing and Implementing. This suggests that working in a cohesive, trusting team may be the most important antecedent for creative confidence. Confidence and self-efficacy are often cited in the literature as antecedents of creativity, particularly everyday creativity (Kaufman, 2002; Martin, 2008; Tierney & Farmer, 2002). The current research supports this literature, and extends it by identifying the importance of Team Cohesion.

A significant and positive relationship was identified between Internal Networks and both confidence Sharing and confidence Implementing, suggesting that having a wide network within an organisation may be more important for the latter stages of the creative process that require working with others, opposed to during ideation. This argument is supported by investigations of the role of networks during commercialisation (e.g. Boehm & Hogan, 2014; Yoneyama, Oh &
Kim, 2004), although drawing a clear conclusion is inhibited by contradictory evidence that operating within a network (“cluster”) of organisations may not be related to the organisation’s economic performance (Fiedler & Welpe, 2011). The claim that Internal Networks may not be beneficial for the production of ideas has implications for the design of idea generation processes, and supports arguments that group idea generation techniques such as brainstorming suffer because of their group nature and the occurrence of social loafing, groupthink and production blocking (Franz, 2012; Im et al., 2013). Moreover, training for techniques that can be utilised by individuals, such as TRIZ, have been identified as effective (Birdi et al., 2012).

Confidence Producing Ideas was also significantly related to two additional Creative and Innovative Climate factors; Ideation Systems and Autonomy. The relationship between Producing and Ideation Systems was negative, suggesting that having formalised creativity may hinder confidence generating ideas. An interpretation of this finding is organisations implementing formal creativity processes may be perceived to lack confidence in the ability of their employees to generate ideas independently. As employees generally respond positively to Autonomy (Chirkov et al., 2011; Gillet et al., 2013), which includes perceptions of control over how they do their work, it is possible that interpreting an organisation’s actions as lacking confidence in ideation ability may hinder creativity and job performance. Similarly, individuals who are given Autonomy by their managers may feel more confident, including regarding ideation, as suggested by the identification of a positive and significant Confidence Producing Ideas-Autonomy relationship in the current study.

**9.6.9 Summary: Creative and Innovative Climate and Individual Creativity**

Overall, Hypothesis 3 extended the narrow focus of previous Individual Creativity literature (e.g. Baer, 2010; Sosa, 2011), answering calls for empirical investigation of multiple facets of Creative and Innovative Climate in relation to creativity (Anderson et al., 2014). However, further investigation is necessary to enlarge the currently limited pool of studies that can be compared with and used to contextualise the findings. Moreover, future research could address apparently contradictory results pertaining to the Tolerance of Ambiguity-Autonomy relationship, in which the current study contradicted previous findings from outside the creativity literature (e.g. Fazli et al., 2014; Kalbers & Cenker, 2008).

Of the Creative and Innovative Climate factors, Team Cohesion and Internal Networks were related to the largest number of Individual Creativity factors. Working in a cohesive team
seems to be important for encouraging a multitude of Individual Creativity dimensions (Curiosity, Intrinsic Motivation, Confidence Producing Ideas, Confidence Sharing Ideas and Confidence Implementing Ideas), although these relationships may also suggest that individuals who perceive themselves as curious, for example, are more interested in their team, thus they feel closer to other team members and experience greater Team Cohesion. The correlational nature of the current research design and analytical approach prohibits the inference of causality.

Having a wide Internal Network within an organisation seems to be important for encouraging Curiosity, Competitive Motivation, Achievement Motivation, Confidence Sharing Ideas and Confidence Implementing Ideas. Formalised processes surrounding creativity and innovation seem to negatively effect an individual’s Confidence Producing Ideas and the likelihood that they will generate original ideas. Autonomy may play a role, in that use of formalised processes may inhibit Autonomy and thus be perceived negatively by employees, meaning the positive consequences of Autonomy cannot be realised (Chirkov et al., 2011; Gillet et al., 2013).

Working in a climate that encourages Risk Taking seems to have relatively little effect on Individual Creativity, except to encourage people to be motivated by competition which supports previous literature that identified a Risk Taking-competitiveness relationship (e.g. Fujiwara & Arai, 2008).

The percentage of variance explained in Individual Creativity by Creative and Innovative Climate would be considered small (Miles & Shevlin, 2001) (Figure 21), which suggests that from theoretical and practitioner perspectives the relationships between Individual Creativity and Creative and Innovative Climate may not offer the most fruitful areas of future investigation or organisational focus. However, a pattern seemed to emerge across the (small) differences in the levels of variance explained in Individual Creativity by Creative and Innovative Climate. The fact that Creative and Innovative Climate influences the factors associated with a single person operating alone i.e. the idea generation factors, to a consistently lesser degree than the level of variance Creative and Innovative Climate explains in factors with a social focus, e.g. Team Cohesion and Internal Networks, suggests that Creative and Innovative Climate has minimal influence on an individual’s innate ability/strengths and weaknesses (e.g. particularly good at fluency or bad at incubation). This trend is evidenced even more clearly in Hypothesis 4, as Creative and Innovative Climate showed a stronger relationship with Team Creativity than Individual Creativity.
Finally, it is interesting to note that the $r^2$ and adjusted $r^2$ values are similar in all the regression models presented above. This may appear unusual as often these values differ substantially, however Field (2005) argues that the $r^2$ and adjusted $r^2$ should be as close as possible as the adjusted $r^2$ indicates the how well the model generalises. Regression models which are unlikely to replicate in the relevant population typically have substantially different $r^2$ and adjusted $r^2$ values. Moreover, regression models based on large sample sizes and with relatively few predictor variables are more likely to have similar $r^2$ and adjusted $r^2$ values, arguably because the larger the sample size the more likely a model is to represent the wider population (Meyers, Gamst & Guarino, 2012). Therefore it could be expected due to the sample size, and should be considered positive, that the $r^2$ and adjusted $r^2$ values are similar in the regression models presented above.

9.7 Interim summary

The preceding section presented the results of the multiple regression analyses for Hypotheses 1, 2 and 3. The results of multilevel analyses for Hypotheses 4 and 5 will now be presented.
9.8 Multilevel modeling

In the Literature Review it was argued that a multilevel approach is appropriate for research that explores creativity and innovation within an organisational context, because organisations are multilevel, hierarchical structures. Hypotheses 1 and 2 were designed to reflect this, and therefore these hypotheses should be addressed using multilevel data analysis techniques (Kaplan & Elliott, 1997). Before describing the analysis and results of Hypotheses 1 and 2, a brief introduction to multilevel data analysis is provided (c.f. Kozwolski and Klein (2000) for detailed exposition of multilevel data analysis).

Multilevel data analysis techniques are better suited to multilevel data for two reasons. First, because multilevel data analysis techniques take into account that the data are not independent observations, but due to their hierarchical and clustered nature there will be dependency amongst the observations made (Geiser, 2013). Single level Structural Equation Modeling, for example, does not take this into account and typically assumes that observations are entirely independent of one another (Wu & Kwok, 2012). Second, multilevel data analysis techniques are better suited to multilevel data because they negate the requirement to aggregate or disaggregate data. Before multilevel data analysis techniques were as readily available as they are today, this approach was relatively commonplace (e.g. Pirola-Merlo & Mann, 2004). However, this can lead to severe bias in estimates (Preacher, Zyphur & Zhang, 2010).

Broadly, there are two broad approaches to analysing multilevel data: Hierarchical Linear Modeling (HLM), also referred to as Multilevel Modeling (MLM), and Multilevel Structural Equation Modeling (MSEM) (Tomarksen & Waller, 2005). For clarity, herein the term HLM is preferentially used over MLM as all of these approaches could also be called multilevel modeling techniques.

Initially, only ANCOVA and OLS regression were available for the analysis of multilevel data. These were later encompassed into HLM methods (Kozwolski and Klein, 2000). More recently, the development of MSEM began, and is continued today. Scholars continue to debate whether HLM is preferable to MSEM, or vice versa (e.g. Tomarksen & Waller, 2005). Research located within the psychology literature has argued that MSEM is preferential, as it combines the advantages of HLM and SEM (Mehta & Neale, 2005). However, it has also been argued that there is no single method that is universally ‘better’, or more appropriate for every situation, as all methods have disadvantages and advantages (Kozwolski & Klein, 2000). Moreover, any
differences between the two methods are decreasing, as the continued development of MSEM leads to the two approaches becoming increasingly similar (Curran, 2003).

9.9 Hypothesis 4

Hypothesis 4 sought to understand which Creative and Innovative Climate factors were positively and significantly related to Team Creativity. Creative and Innovative Climate was measured by individual perceptions, thus was situated at the individual level, whilst Team Creativity was situated at the team level. Therefore, investigating this relationship required a multilevel approach. The relationship investigated in Hypothesis 4 is highlighted in the schematic representation in Figure 22.

Multilevel modeling allows the researcher to control for effects of a higher level variable, such as which team an individual is in. This may influence the relationship between an individual’s perception of the Creative and Innovative Climate and their Team Creativity rating.

To assess the usefulness of controlling for team when addressing Hypothesis 4, the interclass correlation coefficients (ICCs) were examined. ICC values “represent the proportion of between-group variance compared with total variance” (Byrne, 2012, p.354), and indicate whether the data warrant multilevel analysis by estimating the degree of dependence between
observations (Geiser, 2013). That is, whether perception of Creative and Innovative Climate, Team Creativity and team membership are independent of each other.

ICC values range from 0 to 1, with a value of 0 indicating that observations are independent of cluster (Geiser, 2013). Typically, ICC values range from 0 to .50, and it has been argued that when ICC values are above .10 the multilevel structure of the data should be explored (Muthen, 2002). More recently, it has also been suggested that the hierarchical structure of data should also be explored when ICC values are below .10 (Byrne, 2012; Julian, 2001; Selig, Card & Little, 2008), as even small ICC values may bias results when methods are used, such as conventional regression approaches, that do not take the hierarchical structure of the data into account (Geiser, 2013). The ICC values for Creative and Innovative Climate factors and Team Creativity are presented in Table 42.

Table 42. ICC Values for Creative and Innovative Climate and Team Creativity

<table>
<thead>
<tr>
<th>Factor</th>
<th>ICC value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Networks</td>
<td>0.14</td>
</tr>
<tr>
<td>Team Creativity</td>
<td>0.12</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.09</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>0.09</td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.08</td>
</tr>
<tr>
<td>Resources</td>
<td>0.07</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>0.07</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>0.06</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>0.05</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.03</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>0.02</td>
</tr>
</tbody>
</table>

The ICC values presented in Table 42 range from .02 to .14, suggesting which team an employee is in influences their perception of both Creative and Innovative Climate and Team Creativity. Of the CICS factors, team membership appears to particularly influence Internal Networks (ICC=.14), Risk Taking (ICC=.09), External Collaboration (ICC=.09), whereas the
influence of team membership on factors such as Goal Awareness (ICC=.03) and Valuing Creativity and Innovation (ICC=.03) was negligible. These ICC values suggest a multilevel analysis approach is appropriate for Hypothesis 4.

To address Hypothesis 4, a one-way random effects Analysis of Covariance (ANCOVA) was conducted. This is recommended when predicting an outcome variable using a level 1 predictor, whilst controlling for the effects of cluster (Geiser, 2013). To address Hypothesis 4, Creative and Innovative Climate (a level 1 predictor) was regressed onto Team Creativity, a level 2 outcome variable, whilst controlling for team membership. Table 43 presents the results. As with the Multiple Regressions presented earlier in this chapter, the Creative and Innovative Climate factors were entered into the model in order of their correlation with Team Creativity, starting with the strongest correlation (Team Cohesion).

Table 43. Regression Coefficients for Team Creativity Regressed onto Each Climate Factor

<table>
<thead>
<tr>
<th>Predictor variables</th>
<th>Model 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 variables</td>
<td></td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>0.40**</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>0.11</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>.16*</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>0.38**</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.01</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>-0.07</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>0.07</td>
</tr>
<tr>
<td>Resources</td>
<td>.12*</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>.12*</td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.06</td>
</tr>
</tbody>
</table>

\[r^2\text{ total}=0.36**\]

** p<.01 *p<.05

The data provide partial support for Hypothesis 4, showing that there is a significant and moderate relationship between Team Creativity and Team Cohesion \((r=0.40, p<0.01)\), External Collaboration \((r=0.16, p<0.05)\), Ideation Systems \((r=0.38, p<0.01)\), Internal Networks \((r=0.12, p<0.05)\)
and Resources ($r=.12, p<.05$). Overall, Creative and Innovative Climate accounted for 36% of the variance in Team Creativity, when team membership was controlled for.

### 9.9.1 Hypothesis 4: Discussion

Creative and Innovative Climate accounts for 36% of the variance in Team Creativity. There were positive and significant relationships between Team Creativity and a number of Creative and Innovative Climate factors: Team Cohesion, External Collaboration, Ideation Systems, Internal Networks and Resources.

#### 9.9.1.1 ICC values

The first finding worth consideration is whether the responses individuals gave were influenced by which team they were in, which would indicate whether Creative and Innovative Climate was consistent across MBDA, or whether perceptions of the environment are partially determined by team membership. This can be inferred from ICC values. Analysis of ICC values contributes to the literature as it provides the ability to assess whether climate is perceived consistently across an organisation, something which previous single level studies have not been able to assess in this way.

Internal Networks showed the largest dependence on team membership. A possible explanation for the inconsistent climate for Internal Networks is that the organisation does not actively encourage it, letting it develop un-managed instead. Resultantly, it may have been encouraged more by some team leaders than others. Considering that Internal Networks has been found to positively relate to a number of factors in the current study, an organisation might be well placed to actively manage their climate, an argument supported by literature positing a positive relationship between consistency of climate and organisational effectiveness (Kotrba et al., 2012; Rahn, 2014).

Team Creativity showed the second largest dependence on which team an individual is in. This suggests that any Team Creativity processes have not been consistently implemented across MBDA.

#### 9.9.1.2 Team Cohesion

The first Creative and Innovative Climate factor significantly related to Team Creativity was Team Cohesion. Team Cohesion and Team Creativity had the strongest relationship of all the
climate factors. This suggests teams that are trusting and supportive of their members also achieve greater creativity, which mirrors an earlier relationship identified between Team Cohesion and Individual Creativity. In both the cases of both Individual Creativity and Team Creativity, operating within a cohesive team may increase confidence. At the individual level, confidence and self-efficacy are often cited in the literature as antecedents of creativity (Kaufman, 2002; Martin, 2008; Tierney & Farmer, 2002). In the case of Team Creativity, it may be that Team Cohesion is particularly important for Confidence Sharing Ideas. Previous research has argued that sharing ideas within a team is critical as it prompts divergent input and allows ideas to be built upon and developed further than may be achievable alone (Harvey, 2014; Paulus, 2008; West et al., 2003), and that particular attention should be paid to how integrated a team is (Baiden et al., 2006). Taken together, the current findings and previous research suggests Confidence Sharing Ideas may mediate or moderate the relationship between Team Cohesion and Team Creativity, explaining the process whereby Team Cohesion enhances Team Creativity.

Team Cohesion encompasses trust, and thus literature exploring the role of trust is also relevant here. Empirical research identified that trust within a team increases creativity within a product development environment (Brattstrom et al., 2012), which is a similar environment to that in the current research, and that perceiving an organisation as trustworthy increases Team Creativity (Jo, Lee, Lee & Hahn, 2014). As a facet of Team Cohesion, trust and its relationship with Team Creativity may also be mediated by Confidence Sharing Ideas.

9.9.1.3 External Collaboration

The second Creative and Innovative Climate factor significantly related to Team Creativity was External Collaboration. This suggests that individuals who feel they are encouraged to collaborate with other organisations and external specialists work in teams that are considered more creative. Internal Collaboration was not significantly related to Team Creativity, suggesting that it is externally focussed collaboration that is especially valuable for Team Creativity.

Previous literature argues that Team Creativity benefits from an outward focus, perhaps as looking outward may provide more stimuli and information on which a team could build and generate new ideas from (Levine & Prietula, 2013; Luoma-Aho et al., 2012). Greater divergent input is important for Team Creativity (Harvey, 2014), and this may be stimulated more by those external to an organisation as they may be more diverse. Demographic and opinion diversity is
likely to be greater between organisations than within a single organisation. This argument is supported by the Team Creativity literature which has consistently recommended greater diversity (Egan, 2005; Kearney & Gebert, 2009; Pearsall et al., 2008; Stahl et al., 2010). Furthermore, there has been support for the importance of highly diverse networks in Individual Creativity (Baer, 2010), and innovation (Bassett-Jones, 2005; Miller & Triana, 2009).

9.9.1.4 Ideation Systems

The third Creative and Innovative Climate factor significantly related to Team Creativity was Ideation Systems. This suggests that individuals who feel there are good systems for activities including finding ideas, idea generation and managing the process from idea generation to implementation of ideas also consider their teams to be more creative.

One explanation for this finding is that formalised systems play a dual role in creativity, as they are negatively related to individual level creativity constructs but positively related to team level constructs (including FEI, which will be discussed later). Existing research suggests that formalisation, particularly during creativity, leads to convergence of ideas and individuals not wanting to break the rules and norms imposed on them (Im et al., 2013). However, studies also show that complex tasks may benefit from formalisation, with teams in particular benefiting from structure and boundaries to guide their activities and collaboration (Moenaeart, Souder, De Meyer & Deschoolmeester, 1994; Somech & Drach-Zahavy, 2007).

The dual role of Ideation Systems would benefit from further investigation. In particular to understand whether, despite the potential for formalisation to impede Team Creativity, the complex nature of team activities mean this effect is negated by the benefits of having a structure in which a team can operate. Future research of this kind may clarify inconsistencies between the results of the current study and Im et al.’s (2013) study, which found that formalisation may harm creativity.

9.9.1.5 Internal Networks

The fourth Creative and Innovative Climate factor significantly related to Team Creativity was Internal Networks. This suggests that individuals who know many people outside their part of the organisation also consider their teams to be more creative.

Crucially, the onus appears to be on knowing colleagues, as opposed to collaborating with them as evidenced by the lack of a research between Team Creativity and Internal Collaboration.
This suggests that knowing many people within an organisation can aid Team Creativity but different parts of the organisation working together in a formal manner does not support creative teams.

Individual level variables may mediate or moderate the relationship between Internal Networks and Team Creativity. At the individual level, it was speculated that having a wide Internal Network within an organisation is important for encouraging Curiosity, Competitive Motivation, Achievement Motivation, Confidence Sharing Ideas and Confidence Implementing Ideas. As regards Team Creativity, it is argued that Curiosity and Competitive Motivation may mediate or moderate the relationship with Internal Networks, which could be explored in future research. Both of these factors focus on other people; if having Internal Networks suggests a person is outwardly focused, a claim supported by findings that sociability and Extraversion are related to having larger networks (Goffee & Jones, 1996; Ishiguro, 2013; Pollet et al., 2011), they may have greater knowledge of the activities of other individuals or teams. This knowledge could be in the form of Knowledge of Who Knows What (Richter et al., 2012), which may provide more diverse information and thus aid Team Creativity (Egan, 2005; Kearney & Gebert, 2009; Pearsall et al., 2008; Stahl et al., 2010). Alternatively, having greater knowledge of the activities of other individuals or teams may stimulate Team Creativity due to a desire to compete with other individuals or teams. However, competition should be encouraged with caution and steps taken to promote constructive competition, such as clear and fair rules (Tjosvold, Johnson, Johnson & Sun, 2003), acknowledging that different personalities and genders respond differently to competition, with males typically preferring competition to females (Niederle & Verterlund, 2011), and those lower on Extraversion and Agreeableness preferring competitive team working (Beersma et al., 2003).

9.9.1.6 Resources

The fifth Creative and Innovative Climate factor significantly related to Team Creativity was Resources. This suggests that people who find it difficult to obtain the resources and facilities required for their work are unlikely to consider their team to be creative, and vice versa.

This supports previous work emphasising Resources as an important antecedent to Individual Creativity or Individual Creative Performance (e.g. Sternberg & Lubart, 1996; Woodman et al., 1993), and further suggests that this relationship holds for Team Creativity too. This extrapolation is not as obvious as it may appear; Team Creativity is a substantively different
construct to Individual Creativity, thus why aggregation of Individual Creativity scores to assess Team Creativity is problematic, and therefore what is beneficial for Individual Creativity may not be beneficial for Team Creativity, an argument further supported by the dual role of Ideation Systems identified in the current study.

A Resources-Team Creativity relationship also supports an argument offered earlier in this chapter, concerning physical environment as a form of resource. A potential explanation of this finding is that physical environment is also important for Team Creativity, so when teams wish to be creative they should have the appropriate physical space to do so, and empirical research (e.g. Dul & Ceylan, 2011; Lukersmith & Burgess-Limerick, 2013; Oksanen & Stahle, 2013) and creativity theories such as the Interactionist Perspective of Creativity (Woodman et al., 1993) support this.

9.9.1.7 Summary

Overall, Creative and Innovative Climate explained a substantially larger amount of variance in, and therefore appears to have more impact on, Team Creativity than Individual Creativity. This supports previous findings (Somech & Drach-Zahavy, 2013). However, whilst previous research treated Creative and Innovative Climate as one construct, the current research was able to identify specifically which aspects of Creative and Innovative Climate were most related to Team Creativity. This may be particularly important given that Somech and Drach-Zahavy (2013) found that climate mediated the relationship between Team Creativity and Innovation Implementation. That is, for innovation to occur, both Team Creativity and a supportive climate are required, although which aspects of climate are most important were not examined.

Findings from Hypothesis 4 also identified the dual role of Ideation Systems. It appears that structure and formalised processes are helpful for Team Creativity, whereas the opposite is true for Individual Creativity. For practitioners, this suggests that organisations may benefit from formalised creativity processes that are directly applicable to teams, and should not be focused on the individual. Future research is needed to explicate the dual role of Ideation Systems given the small number of empirical investigations of this phenomena and the inconsistent results they have produced.

A number of factors peripheral to the current research were considered as part of interpreting the results of this study. For example, the potential role of diversity in the
relationships between External Collaboration, Internal Networks and Team Creativity. Additionally, individual Curiosity and Competitive Motivation were also discussed as potential mediators or moderators of the relationships between Internal Networks and Team Creativity.

The preceding section has presented and discussed the results pertaining to Hypothesis 4. The following section focuses on Hypothesis 5, specifically team Front End Innovation and Creative and Innovative Climate.

9.10 Hypothesis 5

Hypothesis 5 sought to understand which Creative and Innovative Climate factors were positively and significantly related to team Front End Innovation. Creative and Innovative Climate was measured by individual perceptions, thus was situated at the individual level, whilst team Front End Innovation was situated at the team level. Therefore, investigating this relationship required a multilevel approach. The relationship investigated in Hypothesis 5 is highlighted in the schematic representation in Figure 23.

Figure 23. Schematic Representation of the Hypotheses Addressed in the Current Research with Hypothesis 5 Highlighted

The ICC values examined during the analysis of Hypothesis 4 supported the appropriateness of exploring the hierarchical structure Creative and Innovative Climate. To further assess the usefulness of controlling for team when addressing Hypothesis 5, the interclass
correlation coefficients (ICCs) for the five Front End Innovation factors were examined. These ICC values are presented in Table 44.

Table 44. ICC Values for FEIS Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>ICC value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idea Generation</td>
<td>0.14</td>
</tr>
<tr>
<td>Evaluation</td>
<td>0.12</td>
</tr>
<tr>
<td>Open Innovation</td>
<td>0.10</td>
</tr>
<tr>
<td>Problem Solving Techniques</td>
<td>0.09</td>
</tr>
<tr>
<td>Idea Selection</td>
<td>0.08</td>
</tr>
</tbody>
</table>

The ICC values presented in Table 44 range from .08 to .14, suggesting the team an employee is in influences their perception of Front End Innovation. In particular, team membership appears to influence perception of Idea Generation, Evaluation and Open Innovation. These ICC values suggest a multilevel analysis approach is appropriate for Hypothesis 5.

To address Hypothesis 5, the feasibility of conducting a Multilevel Structural Equation Model (MSEM) was explored. An MSEM would allow all Creative and Innovative Climate factors and all FEI factors to be modeled simultaneously; when testing multiple cross-level interactions, such as in Hypothesis 5, ideally a single model that includes all interactions would be specified (Aguinis, Gottfredson & Culpepper, 2013). However, this is often not possible when the number of parameters estimated exceeds the number of clusters, and issues of model non-convergence occur leading uninterpretable output of regression coefficients and variance explained (Aguinis, et al., 2013). Indeed, this was the case in the present research, as a single model containing all cross-level interactions was specified but it did not converge. Guidance was sought on this matter from the Mplus developers, who further reinforced that in order to analyse Hypothesis 5, it was necessary to reduce the number of parameters being estimated, and therefore one model testing all cross-level interactions from Hypothesis 5 was not feasible.

The relationship between Creative and Innovative Climate and each Front End Innovation factor was modeled separately. Although this is not statistically ideal, as discussed, it is consistent with the literature conceptualising each FEI factor as a distinct stage in the FEI process (e.g.
Cooper, 1988). Moreover, conceptualising climate as the predictor variable, and FEI as the outcome variable, is consistent with extant literature exploring the effect of climate on various workplace behaviours (e.g. Brattstrom et al., 2012; Kurtzberg & Amabile, 2001), as opposed to workplace behaviour influencing climate. Furthermore, very little is presently known about the relationship between Creative and Innovative Climate and Front End Innovation, and thus it was decided to make as few assumptions as possible, as previous research has been criticized for introducing bias by making unfounded assumptions (Lucas, 2014).

Five one-way random effects Analysis of Covariance (ANCOVAs) were conducted. This is recommended when predicting an outcome variable using a level 1 predictor, whilst controlling for the effects of cluster (team) (Geiser, 2013). To address Hypothesis 5, Creative and Innovative Climate (a level 1 predictor) was regressed onto FEI, a level 2 outcome variable, whilst controlling for team membership. Table 46 presents the results. As with the multiple regressions presented earlier, the Creative and Innovative Climate factors were entered into the model in order of their correlation with FEI, starting with the strongest correlation. Table 45 presents the order of entry for each CICS factor.
<table>
<thead>
<tr>
<th>Idea Generation</th>
<th>Idea Selection</th>
<th>Evaluation</th>
<th>Problem Solving Techniques</th>
<th>Open Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1 Team Cohesion</td>
<td>Model 2 Team Cohesion</td>
<td>Model 3 External Collaboration</td>
<td>Model 4 Ideation Systems</td>
<td>Model 5 External Collaboration</td>
</tr>
<tr>
<td>Model 1 Risk Taking</td>
<td>Model 2 Goal Awareness</td>
<td>Model 3 Ideation Systems</td>
<td>Model 4 External Collaboration</td>
<td>Model 5 Ideation Systems</td>
</tr>
<tr>
<td>Model 1 External Collaboration</td>
<td>Model 2 External Collaboration</td>
<td>Model 3 Team Cohesion</td>
<td>Model 4 Internal Collaboration</td>
<td>Model 5 Internal Networks</td>
</tr>
<tr>
<td>Model 1 Goal Awareness</td>
<td>Model 2 Ideation Systems</td>
<td>Model 3 Goal Awareness</td>
<td>Model 4 Valuing Creativity and Innovation</td>
<td>Model 5 Valuing Creativity and Innovation</td>
</tr>
<tr>
<td>Model 1 Valuing Creativity and Innovation</td>
<td>Model 2 Internal Collaboration</td>
<td>Model 3 Valuing Creativity and Innovation</td>
<td>Model 4 Team Cohesion</td>
<td>Model 5 Team Cohesion</td>
</tr>
<tr>
<td>Model 1 Ideation Systems</td>
<td>Model 2 Valuing Creativity and Innovation</td>
<td>Model 3 Internal Collaboration</td>
<td>Model 4 Goal Awareness</td>
<td>Model 5 Internal Collaboration</td>
</tr>
<tr>
<td>Model 1 Internal Collaboration</td>
<td>Model 2 Resources</td>
<td>Model 3 Resources</td>
<td>Model 4 Resources</td>
<td>Model 5 Goal Awareness</td>
</tr>
<tr>
<td>Model 1 Resources</td>
<td>Model 2 Risk Taking</td>
<td>Model 3 Risk Taking</td>
<td>Model 4 Internal Networks</td>
<td>Model 5 Autonomy</td>
</tr>
<tr>
<td>Model 1 Internal Networks</td>
<td>Model 2 Internal Networks</td>
<td>Model 3 Internal Networks</td>
<td>Model 4 Risk Taking</td>
<td>Model 5 Risk Taking</td>
</tr>
<tr>
<td>Model 1 Autonomy</td>
<td>Model 2 Autonomy</td>
<td>Model 3 Autonomy</td>
<td>Model 4 Autonomy</td>
<td>Model 5 Resources</td>
</tr>
</tbody>
</table>
Table 46. Regression Coefficients for Each Front End Innovation Factor Regressed onto Each Creative and Innovative Climate Factor

<table>
<thead>
<tr>
<th>Predictor variables</th>
<th>Idea Generation</th>
<th>Idea Selection</th>
<th>Evaluation</th>
<th>Problem Solving Techniques</th>
<th>Open Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 variables</td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 3</td>
<td>Model 4</td>
<td>Model 5</td>
</tr>
<tr>
<td>Team Cohesion</td>
<td>.22**</td>
<td>.25**</td>
<td>.15*</td>
<td>-0.06</td>
<td>0.03</td>
</tr>
<tr>
<td>Goal Awareness</td>
<td>0.03</td>
<td>0.06</td>
<td>0.06</td>
<td>-.11*</td>
<td>-0.06</td>
</tr>
<tr>
<td>External Collaboration</td>
<td>.16*</td>
<td>.13*</td>
<td>.17*</td>
<td>-0.05</td>
<td>.30**</td>
</tr>
<tr>
<td>Ideation Systems</td>
<td>0.12</td>
<td>.16*</td>
<td>.15*</td>
<td>-.39**</td>
<td>.21*</td>
</tr>
<tr>
<td>Valuing Creativity and Innovation</td>
<td>0.02</td>
<td>-0.06</td>
<td>0.05</td>
<td>0.08</td>
<td>0.04</td>
</tr>
<tr>
<td>Internal Collaboration</td>
<td>-.15*</td>
<td>-0.06</td>
<td>-0.05</td>
<td>0.03</td>
<td>-0.09</td>
</tr>
<tr>
<td>Risk Taking</td>
<td>.17**</td>
<td>0.06</td>
<td>0.03</td>
<td>0.01</td>
<td>0.08</td>
</tr>
<tr>
<td>Resources</td>
<td>0.03</td>
<td>0.06</td>
<td>0.00</td>
<td>0.03</td>
<td>0.14*</td>
</tr>
<tr>
<td>Internal Networks</td>
<td>.09*</td>
<td>0.03</td>
<td>0.01</td>
<td>0.08</td>
<td>0.05</td>
</tr>
<tr>
<td>Autonomy</td>
<td>0.01</td>
<td>0.09</td>
<td>0.02</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>$r^2$ total</td>
<td>.19**</td>
<td>.21**</td>
<td>.16**</td>
<td>.23**</td>
<td>.19**</td>
</tr>
</tbody>
</table>

** $p<.01$ * $p<.05$

The data provide partial support for Hypothesis 5 as a number of significant relationships were identified, although some relationships were weak and not moderate as proposed by Hypothesis 5. Idea Generation was significantly and positively related to Team Cohesion ($r=.22$, $p<.01$), External Collaboration ($r=.16$, $p<.05$) and Risk Taking ($r=.17$, $p<.01$), and significantly and negatively related to Internal Collaboration ($r=-.15$, $p<.05$). Creative and Innovative Climate accounted for 19% of the variance in Idea Generation.

Idea Selection was positively and significantly related to Team Cohesion ($r=.25$, $p<.01$), External Collaboration ($r=.13$, $p<.05$) and Ideation Systems ($r=.16$, $p<.05$). Creative and Innovative Climate accounted for 21% of the variance in Idea Selection.

Evaluation was positively and significantly related to Team Cohesion ($r=.15$, $p<.05$), External Collaboration ($r=.17$, $p<.05$) and Ideation Systems ($r=.15$, $p<.05$). Creative and Innovative Climate accounted for 16% of the variance in Evaluation.
Problem Solving Techniques was negatively and significantly related to Goal Awareness ($r = -.11$, $p<.05$) and Ideation Systems ($r = -.39$, $p<.01$), and Creative and Innovative Climate accounted for 23% of the variance in Problem Solving Techniques.

Open Innovation was positively and significantly related to External Collaboration ($r = .30$, $p<.01$), Ideation Systems ($r = .21$, $p<.05$) and Resources ($r = .14$, $p<.05$). Creative and Innovative Climate accounted for 19% of the variance in Open Innovation.

Overall, Creative and Innovative Climate accounted for 20% of the variance in FEI (the average of the 5 $r^2$ values), when team membership was controlled for. External Collaboration, Ideation Systems and Team Cohesion related to the largest number of FEI factors.

**9.10.1 Hypothesis 5: Discussion**

Creative and Innovative Climate accounted for between 16% and 23% of the variance in team Front End Innovation.

**9.10.1.1 ICC values**

The first finding worth consideration is whether the responses individuals gave were influenced by which team they were in, which would indicate whether Creative and Innovative Climate was consistent across MBDA, or whether perceptions of the environment are partially determined by team membership. This can be inferred from ICC values. Analysis of ICC values contributes to the literature as it provides the ability to assess whether FEI is perceived consistently across an organisation, something which previous single level studies have not been able to assess in this way. Overall, three of the five FEI factors showed dependence on team membership: team Idea Generation, team Evaluation and team Open Innovation.

**9.10.1.2 Creative and Innovative Climate and Idea Generation**

Creative and Innovative Climate accounted for 19% of the variance in team Idea Generation. Team Idea Generation was positively and significantly related to Team Cohesion, External Collaboration, Risk Taking and Internal Networks, and significantly and negatively related to Internal Collaboration.
9.10.1.3 Team Cohesion and Idea Generation

The first Creative and Innovative Climate factor significantly related to team Idea Generation was Team Cohesion. This suggests that trusting and supportive teams also achieve greater generation of ideas as a team. This may be because members of cohesive teams have greater confidence producing and sharing ideas, which leads to more ideas being generated and shared, which leads to the team being perceived as more creative. This mirrors earlier relationships identified between Team Cohesion, Individual Creativity and Team Creativity. In these cases it was argued that operating within a cohesive team may increase confidence, particularly regarding the sharing of ideas. Sharing ideas is a critical aspect of team idea generation as it allows ideas to be built upon and developed further by multiple team members (Harvey, 2014; Paulus, 2008; West et al., 2003). Taken together, the current findings and previous research suggests Confidence Sharing Ideas may mediate or moderate the relationship between Team Cohesion and Idea Generation during FEI, explaining the process whereby Team Cohesion enhances Idea Generation during FEI.

9.10.1.4 External Collaboration and Idea Generation

The second Creative and Innovative Climate factor significantly related to team Idea Generation was External Collaboration. This suggests that when individuals collaborate with external experts and other organisations their teams are more creative.

This may be due to outside sources providing stimuli for new ideas to be generated, and emphasises the importance of seeking inspiration from many different sources (Levine & Prietula, 2013; Luoma-Aho et al., 2012). Additionally, external collaborators may be more diverse than those within an organisation and therefore provide greater divergent input, which is important for ideation (Harvey, 2014). Previous literature supports the assumption that diversity is important for creativity (often conceptualised as idea generation) (Kearney & Gebert, 2009; Pearsall et al., 2008; Stahl et al., 2010) and innovation (Bassett-Jones, 2005; Miller & Triana, 2009), arguably because it can increase the number of perspectives and ideas (Webber & Donahue, 2001).
9.10.1.5 Risk Taking and Idea Generation

The third Creative and Innovative Climate factor significantly related to team Idea Generation was Risk Taking. This suggests that when individuals are encouraged to take risks their teams are more creative.

If employees fear doing the ‘wrong’ thing and taking a risk they are less likely offer ideas to the team. Conversely, if employees are encouraged to take a risk, this may encourage team Idea Generation as being able to take risks is an important prerequisite for innovation (Cooper, 2011). However, FEI is substantively different to the rest of the innovation process (Markham, 2013), and therefore explanations supporting innovation as a whole may not be relevant to FEI.

There appears to be something unique to Idea Generation during FEI that differs from Team Creativity, as evidenced by the significant relationship between Idea Generation and Risk Taking and lack of a relationship between Team Creativity and Risk Taking. Theoretically, both Idea Generation and Team Creativity operate at the team level, and both were measured using reliable scales. Moreover, the item content is relatively similar. However, both Risk Taking and Idea Generation scales contain a high proportion of reverse scored items, whereas Team Creativity contains none. The negative skew of the Risk Taking factor suggests that respondents were more likely consider themselves inhibited as regards taking risks, and then when presented with items pertaining to a lack of Idea Generation within their team, they may have been more likely to agree with those items as opposed to items worded in the positive. It is considered good practice to use reverse scored items to achieve more accurate responses (DeVellis, 2012), and as such the Idea Generation-Risk Taking relationship identified in the current study may be ‘truer’ than the lack of Team Creativity-Risk Taking relationship. However, future research would need to investigate this interpretation, particularly given that there is no absolute consensus regarding the use of negatively worded items, with some arguing that they can engender less accurate responses (Barnette, 2000; Dodeen, 2014), and it has been argued that if a response bias towards negatively worded items may indicate lack of understanding of the question (Soo, 1997).

9.10.1.6 Internal Networks and Idea Generation

The fourth Creative and Innovative Climate factor significantly related to team Idea Generation was Internal Networks. This suggests that when individuals know many people in their organisation they consider their team to be more creative.
A possible explanation for this finding is that an extensive Internal Network provides an individual with more stimuli, which in turn leads them to generate more ideas within their team. This argument draws upon the diversity literature, which argues that diversity is important for innovation (Bassett-Jones, 2005; Miller & Triana, 2009) because it can increase the number of perspectives and ideas (Webber & Donahue, 2001). Similarly, the Team Creativity literature has argued for the advantage of diversity of input to a team supports ideation (Harvey, 2014; Kearney & Gebert, 2009; Stahl et al., 2010).

As with the relationship between Team Creativity and Internal Networks, the relationship between Idea Generation during FEI and Internal Networks may be mediated or moderated by individual level variables. It is argued that Curiosity and Competitive Motivation may mediate or moderate the relationship with Internal Networks. Both of these factors focus on other people; if having Internal Networks suggests a person is outwardly focused, a claim supported by findings that sociability and Extraversion are related to having larger networks (Goffee & Jones, 1996; Ishiguro, 2013; Pollet et al., 2011), they may have greater knowledge of the activities of other individuals or teams. This knowledge could be in the form of Knowledge of Who Knows What (Richter et al., 2012), which may provide more diverse information and thus aid Idea Generation. Alternatively, having greater knowledge of the activities of other individuals or teams may stimulate Idea Generation during FEI due to a desire to compete with other individuals or teams. However, as noted previously steps should be taken to promote constructive competition, such as clear and fair rules (Tjosvold et al., 2003).

### 9.10.1.7 Internal Collaboration and Idea Generation

Internal Collaboration was significantly and negatively related to team Idea Generation, suggesting that those who perceive different parts of the organisation work together to set goals, strategy and generate ideas are less likely to consider their teams as competent in ideation.

The apparent incompatibility of these two constructs may be explained by organisational politics. In large multinational organisations, such as MBDA, collaboration across multiple parts of the organisation may been perceived as bureaucracy-laden tasks, particularly in areas such as formulating strategy which may signal organisational politics (Edwards & Kurvilla, 2005). This may demotivate team members and therefore make them less likely to generate ideas, which is problematic from a practitioner perspective as organisational politics can act as a facilitator or inhibitor of innovation (Asimakou, 2009; Thomas, 2000; Wolfe, 1994), and thus requires
appropriate management. This interpretation could be explored by future research studying the role of motivation as a mediator or moderator of this relationship. Using the me² conceptualisation of creativity, organisational politics may reduce team members’ Achievement Motivation and Intrinsic Motivation. Individuals’ inherent interest in their job may decrease if they perceive an organisation to be highly political and that this is a barrier to their work. Likewise, organisational politics as a perceived barrier to innovation may reduce team members’ belief in their ability to achieve, thus reducing their performance.

9.10.1.8 Interim summary

Overall, team Idea Generation was positively and significantly related to Team Cohesion, External Collaboration, Risk Taking and Internal Networks. Team Idea Generation was significantly and negatively related to Internal Collaboration. In addition to considering these factors individually, the current findings also extend previous research by Im et al. (2013), who identified Team Cohesion, Risk Taking, Goal Awareness (Superordinate Identity), Valuing Creativity and Innovation (Market-based Reward System), and Ideation Systems (Formalised Processes) as significantly related to team ideation. However, the current research did not replicate these findings, although this may be due to measurement differences in FEI, which Im et al. (2013) measured using items pertaining only to Originality and meeting customer needs, neither of which constitute Idea Generation during FEI.

9.10.1.9 Creative and Innovative Climate and Idea Selection

Creative and Innovative Climate accounted for 21% of the variance in team Idea Selection. Idea Selection was positively and significantly related to Team Cohesion, External Collaboration and Ideation Systems.

9.10.1.10 Team Cohesion and Idea Selection

The first Creative and Innovative Climate factor significantly related to team Idea Selection was Team Cohesion. This suggests that teams that are trusting and supportive also perceive themselves as choosing the best ideas to work on, which may be because members of cohesive teams have greater confidence producing and sharing ideas, which leads to more ideas being generated and therefore having a greater chance of selecting good ideas. This interpretation
extends earlier relationships identified between Team Cohesion, Individual Creativity, Team Creativity and Idea Generation during FEI. In these cases it was argued that operating within a cohesive team may increase Confidence Sharing Ideas, which is a critical aspect of idea generation and development (Harvey, 2014; Paulus, 2008; West et al., 2003). It was suggested that Confidence Sharing Ideas may mediate or moderate the relationship between Team Cohesion and Idea Generation during FEI, explaining the process whereby Team Cohesion enhances Idea Generation during FEI. Extending this interpretation, this three-way relationship may then allow teams to select better ideas.

The items measuring Idea Selection refer to consistency over time, such as “we have always chosen winning ideas”. Therefore, the positive relationship between Team Cohesion and Idea Selection may suggest that cohesiveness could also be stable over time. In the current research anecdotal evidence supports this interpretation, as many of the projects are long term (many years), and therefore a team will have formed and spent a considerable amount of time working together. This is supported by literature arguing that long term teams tend to be more cohesive and experience less conflict (Barrick, Stewart, Neubert & Mount, 1998), however avoidance of conflict may have negative ramifications for team performance (Hulsheger et al., 2009).

9.10.1.11 External Collaboration and Idea Selection

The second Creative and Innovative Climate factor significantly related to team Idea Selection was External Collaboration. This suggests that when people collaborate with external experts and other organisations they are more likely to perceive themselves as selecting good ideas to work on as a team.

This may be due to outside sources providing additional information by which to compare potential ideas, and therefore judge which ideas are “good”. This is consistent with the interpretation of the positive External Collaboration-FEI Idea Generation relationship, in that external collaborators offer greater diversity which is beneficial for innovation (Bassett-Jones, 2005; Miller & Triana, 2009) because it can increase the number of perspectives and ideas (Levine & Prietula, 2013; Webber & Donahue, 2001), in this case because it provides a broader range of information to judge ideas than internally-focussed teams have. A larger quantity of ideas increases the likelihood of selecting the “good” ideas, as argued in relation to the Team Cohesion-Idea Selection relationship previously. However, Team Cohesion and External
Collaboration may behave differently in relation to Idea Selection. The former may increase the likelihood of group discussion and therefore selecting good ideas, assuming inhibiting group dynamics such as groupthink (Janis, 1972) and social loafing (Paulus, 2008) do not occur. However, having a greater number of ideas to select from may overwhelm those without a process by which to select ideas (Ideation Systems: discussed next), or the appropriate knowledge to inform their selections. This knowledge may come, in part, from a team’s external collaborators. Outward-facing teams may be more aware of changes in the marketplace, for example, that effect which ideas would be considered “good” (which is a highly subjective judgement). This follows literature arguing that organisations with outward-facing CEOs and senior managers are more innovative (Major & Cordey-Hayes, 2003; Zhang, Macpherson & Jones, 2006).

Conversely, the relationship between External Collaboration and Idea Selection may be explained by teams with a history of choosing good ideas being more likely to engage in External Collaboration, as those teams are more confident in their capability regarding creativity and innovation and are therefore more willing to engage with people outside their organisation. Teams that do not engage in External Collaboration may have lower confidence regarding their innovation capability. If confidence is key, team members’ confidence may mediate or moderate the External Collaboration-Idea Selection relationship. Research linking confidence, such as Creative Self-Efficacy, to performance supports this argument (Tierney et al., 1999; 2011).

9.10.1.12 Ideation Systems and Idea Selection

The third Creative and Innovative Climate factor significantly related to team Idea Selection was Ideation Systems. This suggests that team members who perceive formalised processes for creativity and innovation are also more likely to work in a team with a history of selecting good ideas.

This relationship supports the arguments made previously that formalisation benefits Team Creativity and innovation, but hinders individual activities. For example, Ideation Systems may offer teams a framework to guide Idea Selection. Once a team has generated or collected as many ideas as possible, which may be partially driven by External Collaboration and Team Cohesion, processes may be required to aid Idea Selection. In addition to the knowledge that External Collaboration provides in support of knowing which ideas to select, Ideation Systems may provide the required process/es so that having a large number of ideas to select from does
not become overwhelming, which Van den Ende et al. (2014) note is a real possibility, especially when external entities are involved, and cite the example of IBM’s “Innovation Jam” which generated over 40,000 ideas and resulted in a costly and rushed selection process.

Moreover, following a process for Idea Selection may help manage team dynamics and regulate potentially negative dynamics, including but not limited to process conflict (conflict surrounding the allocation of tasks and how tasks are to be carried out), and avoid the detrimental effect conflict can have on team performance (Jehn & Mannix, 2001; Rahim, 2011).

9.10.1.13 Interim summary

Overall, Creative and Innovative Climate accounted for 21% of the variance in team Idea Selection. Idea Selection was positively and significantly related to Team Cohesion, External Collaboration and Ideation Systems. These findings suggest that gathering as many ideas as possible is beneficial, for which External Collaboration and Team Cohesion are beneficial, after which both External Collaboration and Ideation Systems increase the likelihood of choosing good ideas by providing additional information with which to judge ideas, and by providing a process for working as a team to select ideas. However, this interpretation does not account for the role of experience in selecting good ideas. Future replication of the current study may collect additional demographic information by which to evaluate a team’s experience (educational, work experience and experience selecting ideas) and analyse whether this is able to account for additional variance in Idea Selection during FEI. These findings could be utilised by practitioners seeking to build teams for selecting ideas during FEI. In particular, for selecting team members and for suggesting processes for a team to follow.

9.10.1.14 Creative and Innovative Climate and Evaluation

Creative and Innovative Climate accounted for 16% of the variance in team Evaluation. Evaluation was positively and significantly related to Team Cohesion, Ideation Systems and External Collaboration.

9.10.1.15 Team Cohesion and Evaluation

The first Creative and Innovative Climate factor significantly related to team Evaluation was Team Cohesion. This suggests that teams that are trusting and supportive also tend to be thorough in exploring all information relating to an idea or concept.
Three interpretations of this finding seem viable. First, the nature of Evaluation as a team level variable may mean it benefits from Team Cohesion. A team that is not trusting and supportive of each other may find any team activity more difficult, including evaluating ideas and opportunities during FEI. Previous research has hailed Team Cohesion as facilitating team performance, including more accurate attribution of team performance (internal or external) (Mach, Dolan & Tzafrir, 2010; Michalisin, Karau & Tangpong, 2004). The current study extends this literature by suggesting that Evaluation during FEI may be similarly facilitated by Team Cohesion, which the existing literature does not seem to have explored. This interpretation is supported by Idea Generation and Idea Selection also being significantly related to Team Cohesion. However, Problem Solving Techniques and Open Innovation are not similarly related to Team Cohesion. These factors have previously not been conceptualised as core elements of FEI (Cooper, 1988; Figure 13), suggesting Team Cohesion may be facilitative for a multitude of team variables but not all.

Second, teams within MBDA may have longer for Evaluation than teams in other organisations due to the long term nature of most of their projects, and therefore teams within MBDA may perceive themselves as very thorough when considering an idea or opportunity. Long term teams are also more likely to have greater cohesion (Barrick et al., 1998). A third, potentially interrelated, interpretation of this finding is that in addition to operating within a less time-pressured environment, teams in the organisation studied spend lots of time evaluating ideas and opportunities due to less efficient working practices. Potential inefficiencies may be a result of working in a highly political environment, in which evaluations must also consider the political ramifications of any decisions, or of less time pressure. An emphasis on product quality within a political environment may hinder fast decision making. Practically, an organisation could emphasise faster decision making, as research shows that some time pressure may increase teams focus, although there is currently no consensus (Burke, Priest, Salas, Sims & Mayer, 2008). Moreover, less efficient working practices may be overcome using Ideation Systems, discussed next.

9.10.1.16 Ideation Systems and Evaluation

The second Creative and Innovative Climate factor significantly related to team Evaluation was Ideation Systems. This suggests that those who feel there are formalised
processes for creativity and innovation are also more likely to feel that they work in a team that thoroughly evaluates ideas and opportunities.

As noted above, Evaluation may be facilitated by Ideation Systems. This relationship provides further support for the argument that Ideation Systems are beneficial for team activities that may require more formal structure, such as evaluating ideas and opportunities, particularly when team processes could be developed to improve efficiency. Existing research on idea evaluation during FEI propagates a formal but flexible approach, although it is inconsistent in advocating either more formality (e.g. Gaubinger & Rabl, 2014; Koen et al., 2002; Montoya-Weiss & O’Driscoll, 2000) or more flexibility (e.g. Martinsuo & Poskela, 2011). The current research would suggest that greater formality is beneficial, however practitioners implementing formalised systems should be wary of focusing solely on the team and not on the individual, due to the negative relationships between Ideation Systems and individual level creativity variables, and focus on systems that are facilitative as opposed to unnecessarily prescriptive (Perez-Freije, 2014). Whilst conceptual arguments have been made in support of facilitative systems (e.g. Perez-Freije, 2014), further research is required to examine how prescriptive a formalised process for Evaluation should be. For example, identifying organisations with existing processes, which may include training on evaluating ideas and opportunities, and comparing their formality and various organisational outcomes.

9.10.1.17 External Collaboration and Evaluation

The third Creative and Innovative Climate factor significantly related to team Evaluation was External Collaboration. This suggests that when teams collaborate with external experts and other organisations they are more likely to be very thorough when evaluating ideas and opportunities. This may be for two reasons that relate to the item content of the Evaluation scale. First, Evaluation focuses on taking time to evaluate ideas and opportunities. Involving those external to the organisation may be time consuming due to the practicalities involved in working with those outside an organisation, although this depends on how integrated an organisation is, as intra-organisational communication may be more challenging than inter-organisational communication, depending on how well integrated an organisation is (Miller, 2014).

Second, involving those external to the organisation in Evaluation may provide more information by which to evaluate ideas and opportunities. Outward-facing teams may be more aware of changes in the marketplace, for example. This follows literature arguing that
organisations with outward-facing CEOs and senior managers are more innovative (Major & Cordey-Hayes, 2003; Zhang et al., 2006).

Alternatively, it may be that Evaluation precedes External Collaboration, in that teams engaging in External Collaboration may be more thorough to avoid sharing poorly evaluated ideas and concepts with their external partners. Therefore, External Collaboration may enhance team performance. The fact that External Collaboration is positively related to all other FEI factors, as well as Team Creativity, supports this. Which of these interpretations is most accurate likely depends on the personalities of team members and the unique relationships between each team and each external collaborator. Future research may explore if frequency of collaboration impacts the extent to which a team evaluates ideas and opportunities prior to engaging with external collaborators, for example.

9.10.1.18 Interim summary

Overall, Creative and Innovative Climate accounted for 16% of the variance in team Evaluation, which was the lowest proportion of variance accounted for in an FEI factor. This suggests that of all the FEI factors, Creative and Innovative Climate may have the least effect on Evaluation during FEI.

Evaluation was positively and significantly related to Team Cohesion, External Collaboration and Ideation Systems. These findings suggest that like other FEI factors, Evaluation may benefit from cohesive teams and engagement with external collaborators. These findings also support earlier arguments highlighting the supportive role of formalised processes during FEI.

The findings are somewhat limited by the reliability of the Evaluation scale at .70, although this figure is the cutoff indicating acceptable reliability (Tavakol & Dennick, 2011). One item from the Evaluation scale had a low loading (.35), which also suggests that the Evaluation scale may benefit from further development.

9.10.1.19 Creative and Innovative Climate and Problem Solving Techniques

Creative and Innovative Climate accounted for 23% of the variance in Problem Solving Techniques, which was the largest proportion of variance climate accounted for in the FEI factors. Problem Solving Techniques was positively and negatively related to Goal Awareness and Ideation Systems.
9.10.1.20 Goal Awareness and Problem Solving Techniques

The negative relationship between Goal Awareness and Problem Solving Techniques suggests that when individuals feel comfortable with their team goals, they perceive that their teams are less likely to use Problem Solving Techniques. This may be because when goals are clearly defined there is less need to use Problem Solving Techniques to seek clarity or to address an issue, as the team does not perceive there to be a problem to solve. Thus, Goal Awareness seems to have limited importance as a facilitator of creativity, based on the findings from the current study, suggesting that organisations should not prioritise developing this aspect of Creative and Innovative Climate.

The only team-focussed meta-analysis of innovation antecedents did identify Goal Awareness as positively and significantly relating to innovation (Hulsheger et al., 2009), however all correlations were weak (below $r=.05$) and the focus was on innovation as opposed to the substantively different FEI (Bertels et al., 2011; Markham, 2013). Despite these differences, the current research is not consistent with Hulsheger et al.’s (2009) findings, suggesting future research may be appropriate to clarify this inconsistency.

The practical nature of Problem Solving Techniques suggests this finding may be of particular interest to practitioners. Practically, advocating Problem Solving Techniques may be less beneficial in organisations whose employees have clearly defined goals, and vice versa.

9.10.1.21 Ideation Systems and Problem Solving Techniques

The negative relationship between Problem Solving Techniques and Ideation Systems suggests that when there are formalised systems for ideation and idea development, teams are less likely to use Problem Solving Techniques. As with the Goal Awareness-Problem Solving Techniques relationship, this may be because formalised processes reduce the need for Problem Solving Techniques as they reduce the likelihood of perceiving there to be a problem to solve. Alternatively, a team may not perceive that they employ Problem Solving Techniques because it is part of the formalised process they follow for creativity and innovation, thus the use of Problem Solving Techniques is not recognised as a discrete activity.

However, the relationship between Problem Solving Techniques and Ideation Systems is arguably somewhat unclear, as Problem Solving Techniques could be considered part of a formalised FEI process. Indeed, it has been theorised that Problem Solving Techniques should be particularly applied during FEI, with potential money and time saving benefits over using
Problem Solving Techniques throughout the innovation process (Thomke & Fujimoto, 2000). The current findings may be specific to MBDA and organisations with similar characteristics, i.e. multinational organisations that tend to be risk averse and political (Edwards & Bowen, 2010). Replication of the current study within different organisations and industries would be beneficial to understanding the role of Problem Solving Techniques in FEI.

The practical nature of Problem Solving Techniques suggests this finding may be of particular interest to practitioners. Practically, advocating Problem Solving Techniques may be beneficial in organisations that do not use formalised processes for creativity and innovation.

9.10.1.22 Interim summary

Overall, of all the FEI factors Creative and Innovative Climate accounted for the largest proportion of variance in Problem Solving Techniques, yet Problem Solving Techniques was only positively and significantly related to Goal Awareness and Ideation Systems. This may be because having clear goals and formalised processes means teams are less likely to face problems, and therefore Problem Solving Techniques are not required. The practical nature of Problem Solving Techniques may be of particular interest to practitioners.

9.10.1.23 Creative and Innovative Climate and Open Innovation

Creative and Innovative Climate accounted for 19% of the variance in Open Innovation. Open Innovation was positively and significantly related to External Collaboration, Ideation Systems and Resources.

9.10.1.24 External Collaboration and Open Innovation

The positive relationship between External Collaboration and Open Innovation suggests that those who feel they collaborate with other organisations and external experts also believe their team looks outside the organisation for ideas and opportunities.

A possible explanation for this finding is that External Collaboration acts as a prerequisite for Open Innovation, as it is the act of collaborating with other organisations and having a wide network of external specialists that enables a team to identify the ideas they are looking for outside their organisation. Although a relationship between External Collaboration and Open Innovation is unsurprising, to date it has been assumed rather than empirically tested (e.g. Vasinore & Petraite, 2011). It seems to be accepted within the Open Innovation literature that
Open Innovation occurs as a result of collaboration (Lee, Park, Yoon & Park, 2010; Vasinore & Petraite, 2011), and the current research supports this position.

Teams that look outside their organisation for ideas and opportunities may be seeking to increase the pool of ideas they have. This is consistent with the interpretation of the External Collaboration-FEI Idea Generation and External Collaboration-FEI Idea Selection relationships, in that external collaborators offer greater diversity which is beneficial for innovation (Bassett-Jones, 2005; Miller & Triana, 2009), particularly as it can increase the number of ideas and opportunities to select from (Levine & Prietula, 2013; Webber & Donahue, 2001).

It may be argued that the relationship between External Collaboration and Open Innovation exists because they are fundamentally the same construct. The current research does not support this argument, as the correlation coefficient is substantially below $r=1.00$ ($r=.30$) (presented in Table 42). This appears to be consistent with the literature, which does not seem to explicitly use the two terms synonymously. The distinctiveness of these two constructs may be due to Open Innovation and External Collaboration being of primary importance at different stages of the innovation process. Open Innovation is conceptualised as being primarily useful as part of FEI, for the identification of ideas and opportunities. Those ideas and opportunities can be then be developed by a various collaborators, including external to the organisation, suggesting a sequential nature and temporal separation of the External Collaboration-Open Innovation relationship.

Given that organisations with outward-facing CEOs and senior managers are more innovative (Major & Cordey-Hayes, 2003; Zhang et al., 2006), and that Open Innovation has been related to organisational performance (although the relationship was curvilinear, suggesting high levels of Open Innovation may inhibit firm performance) (Laursen & Salter, 2006), practitioners may seek to encourage outward-facing teams, encouraging both External Collaboration and Open Innovation.

9.10.1.25 Ideation Systems and Open Innovation

The positive relationship between Ideation Systems and Open Innovation suggests that the presence of formalised processes for creativity and innovation is related to teams looking outside their organisation for ideas. It seems unlikely that looking outside an organisation for ways to improve innovation predicates formalised systems for most employees. However, it is possible that an organisation seeking to engage in Open Innovation would develop a formalised...
system to guide this strategic decision. Hence the top management team of an organisation may consider Open Innovation to predicate having a formalised system for creativity and innovation, whilst employees who deliver as opposed to set the strategy may consider Open Innovation to be the result of a formalised system encouraging them to engage externally to the organisation. Existing research suggests that engaging in Open Innovation is a strategic decision, i.e. top down as opposed to bottom up (Gassmann et al., 2010; Lichtenthaler, 2008; Martinez, Lazzarotti, Manzini & Garcia, 2014), including in large multinational organisations with some similar characteristics to MBDA (Dodgson, Gann & Salter, 2006). Future replications of the current study may test this hypothesised interaction between seniority and direction of the Ideation Systems-Open Innovation relationship by collecting relevant demographic information.

The relationship between Ideation Systems and Open Innovation strengthens the argument made earlier regarding the duality of Ideation Systems, in that it is negatively related to individual level variables but positively related to team level variables. It seems that in addition to benefiting Team Creativity, formalised processes may aid aspects of FEI too, such as Idea Selection and Open Innovation. This relationship provides further support for the argument that Ideation Systems are beneficial for team activities that may require a more formal structure, such as engaging with external partners for innovation. Further research is required to examine how prescriptive a formalised process for Open Innovation should be. For example, identifying organisations with existing processes and comparing their formality and various organisational outcomes. A recent review of Open Innovation strategies in the food and drink industry revealed that organisations found that Open Innovation enhanced organisational innovation performance only when there was a “dedicated architecture for collaboration”, i.e. a formalised system to guide collaboration and leverage of external knowledge (Martinez et al., 2014, p.212).

### 9.10.1.26 Resources and Open Innovation

The positive relationship between Resources and Open Innovation suggests that people who find it difficult to obtain the resources and facilities required for their work are unlikely to work in a team that engages with Open Innovation, and vice versa.

One explanation for this finding is that Open Innovation is a resource-intense activity, with expenses such as travelling between collaborating organisations potentially greater than an in-house project would incur, for example. Additionally, this result may suggest that the facilities required for Open Innovation are not available. For example, an off-site space for meeting
external specialists. Anecdotal evidence from the organisation studied supports the argument that paying for neutral meeting space between two organisations is discouraged. However, effectively prohibiting Open Innovation due to lack of Resources is somewhat short sighted of an organisation when Open Innovation can enhance both innovation and organisational performance (Laursen & Salter, 2006; Martinez et al., 2014). For practitioners seeking to encourage Open Innovation it is arguably insufficient to examine whether an organisation advocates Open Innovation in their official rhetoric, as there can be a disparity between an organisation’s official rhetoric and an individual’s rhetoric, be it within the top management team or a R&D project manager, and an individual’s rhetoric may not be consistent with the official rhetoric (Castello & Lozano, 2011). Future research may wish to compare the rhetoric and reality of organisations engaging in (or purporting to engage in) Open Innovation, as has been done in other organisational contexts, such as environmental behaviours (Preuss, 2005) and Corporate Social Responsibility (Epstein, 2007).

The current study indicates that of all the aspects of FEI, Resources are only of fundamental importance to Open Innovation. This is indicated by Resources being significantly related only to Open Innovation. The existing literature has argued that having limited resources would prohibit organisations from engaging in Open Innovation (Gassmann et al., 2010), because having limited Resources constrains what an organisation has available to exchange with other organisations (Lee et al., 2010), for example. It has been speculated that SMEs have tended to engage in Open Innovation to a lesser degree than large multinational organisations for this reason (Lee et al., 2010).

9.10.1.27 Interim summary

Overall, Creative and Innovative Climate accounted for 19% of the variance in Open Innovation. Open Innovation was positively and significantly related to External Collaboration, Ideation Systems and Resources. These findings suggested that External Collaboration is important for Open Innovation, and confirmed their conceptual distinctness. The findings also reinforced the dual role of Ideation Systems as beneficial for teams but not individuals, and highlights Resources as a facilitator of Open Innovation.

The theoretical and practitioner implications of these findings are arguably limited to large multinational organisations, similar to the context in which the current study was conducted, as SMEs have fundamentally different characteristics to large multinationals including in relation
to Open Innovation (Lee et al., 2010). Further, these findings are limited by the adequate fit of the Open Innovation scale, as evidenced during CFA analysis of each FEIS scale in which all other FEIS scales evidenced good or excellent fit.

Previous literature has identified Creative and Innovative Climate as important for innovation. Specifically, that innovative organisations have creative climates, and that those in innovative organisations have high levels of Goal Awareness and low levels of formalised processes (Ekvall, 1996). However, this is not specific to FEI, and FEI is a unique stage of the innovation process that both directly and indirectly effects the eventual success of a project (Gassmann & Schweitzer, 2014; Markham, 2013; Verworn, 2009). The current research provides some clarification as to which dimensions of Creative and Innovative Climate are most important for FEI.

Overall, there are four main conclusions that can be drawn regarding Creative and Innovative Climate and FEI. First, the findings suggest that External Collaboration is important for Open Innovation, whilst clarifying that these two constructs are conceptually distinct from one another. Given that a degree of Open Innovation leads to improved organisational performance, this finding may be of particular interest for practitioners (Laursen & Salter, 2006).

Second, additional support was found for the arguments that Ideation Systems appears to have a dual role, hindering the individual but aiding teams, and that External Collaboration appears to consistently support Team Creativity and FEI activities.

Third, the same three factors are significantly related to both Idea Selection and Evaluation (Team Cohesion, External Collaboration, Ideation Systems), suggesting that there may be some theoretical overlap between a team’s capability to choose good ideas, and how thorough they are when evaluating ideas.

Fourth, the use of Problem Solving Techniques appears to be negated by a team having clear goals. Conversely, when employees are unclear about their goals they may seek to use problem solving techniques. In such organisations, employees should be trained in various problem solving techniques so that they are equipped to use these techniques when required.

Finally, as noted throughout this section the Evaluation and Open Innovation FEIS scales would both benefit from further development. The reliability of the former and fit of the latter could be improved.
9.11 Summary

This chapter has presented and discussed the results from Research Aims 3 and 4 comprising Hypotheses 1 to 5. The following chapter provides an overall discussion for the current research.
10 DISCUSSION

10.1 Chapter overview

This chapter provides an overall discussion of Studies 1, 2 and 3 of the current research, with detailed discussions related to each Study having previously been presented at the end of each individual Study. Specifically, implications for academia and practitioners are proposed in this chapter, before considering the limitations of the current research and how these limitations may be addressed through future research.

To be able to conduct Study 3 it was necessary to develop measures of Front End Innovation (FEIS) and Creative and Innovative Climate (CICS). FEIS has a number of theoretical and practical implications as a result of being a measure fully focused on FEI and the subjective perceptions that drive FEI, and having been developed following psychometric principles.

The implications of FEIS from a theoretical perspective begin with a deepened understanding of the factors comprising Front End Innovation. The statistical techniques and sample sizes used in the development of FEIS go beyond what is typical in the innovation management literature (the closest measure to FEIS having been developed with \( n=23 \)). Resultantly, Study 1 provides a more robust investigation of the factors comprising FEIS. Moreover, not being able to identify a higher order factor structure suggests that the factors comprising FEIS are theoretically and statistically distinct. Indeed, the emergence of Problem Solving Techniques and Open Innovation as distinct factors suggests that greater consideration should be given to these issues during FEI. Previously, it has been rare that Open Innovation has been considered alongside FEI, whereas the findings from Study 1 imply that Open Innovation is an important part of FEI. The theoretical implication is that FEI goes beyond idea generation, which is contrary to many historical conceptualisations of FEI as idea generation and screening (e.g. Brem & Voigt, 2009; Cooper, 1988).

In addition to the understanding of the structure of FEI that FEIS provides, it offers an FEI-specific measure that could also be utilised as one part of a composite measure of overall innovation performance, which may be appropriate for a multi-stage construct such as innovation (Makkonen & van der Have, 2013). Additionally, FEIS may be used to relate FEI activities to activities or outcomes later on in the innovation process which to date have been largely unexplored (Makkonen & van der Have, 2013). Clear exposition of the extent to which FEI
influences subsequent innovation stages would have both theoretical and practical implications. In order for researchers to empirically test the relationship between FEI activities and latter stages of the innovation process, a reliable and valid measure of FEI is requires. The development of FEIS goes some way to achieving this.

From a practitioner perspective, FEIS offers a measure of FEI that is brief and easy to administer and can be confidently used due to the psychometric rigour with which it was developed, and therefore allows decisions to be made based upon reliable and valid data. Having good quality data upon which to make decisions about an organisation’s FEI is an important prerequisite in the management of innovation. Moreover, the ability to easily measure FEI, and increased understanding of what it comprises, may increase the likelihood of it being measured and the results being acted on pertaining to the five distinct areas of FEI (Cruz-Cazares et al., 2013).

In addition to FEIS, in order to conduct Study 3 it was necessary to develop a measure of Creative and Innovative Climate. The implications of CICS from a theoretical perspective begin with a deepened understanding of the factors comprising Creative and Innovative Climate. Development of CICS involved a clear focus at the level of individual perceptions, whereas previous measures have been unclear regarding the level at which they focus. It also involved a thorough exposition of the potential dimensions comprising Creative and Innovative Climate and followed psychometric principles throughout the development of CICS. Taking these steps addresses the primary limitations identified in existing measures (Mathisen & Einarsen, 2004). Resultantly, Study 2 provides a more robust investigation of the factors comprising CICS and a suitable measure.

In addition to the understanding of the structure of Creative and Innovative Climate that CICS provides, the implication of the title – Creative and Innovative Climate Scale – is that a creative climate and an innovative climate cannot be distinguished. Whilst they may be distinguishable in the future, the current body of literature is insufficient to accurately judge a boundary between them. Moreover, it provides a degree of terminological clarity missing in previous research, in which either “creative climate” or “innovative climate” are used when the factors comprising them are often the same (Hunter et al., 2007). Further, a theoretical implication of the naming of CICS is to minimise the (arbitrary) division between creativity and innovation, as has been called for recently (Anderson et al., 2014), and which also underpins the interdisciplinary approach to the current research.
From a practitioner perspective, CICS offers a measure of Creative and Innovative Climate that can be confidently used due to the psychometric rigour with which it was developed, and therefore provides reliable and valid data upon which organisational decisions can be made. An additional implication for practitioners is that CICS provides some clarity as to the dimensions comprising Creative and Innovative Climate, and indicates to managers which aspects of the organisation they should focus on during a culture change initiative, for example. It also provides a model that organisations can use to inform policy and procedure, and as a basis for comparison across departments and teams. CICS also specifically draws attention to the need to foster a creative climate as well as an innovative climate, as organisations may tend to focus solely on innovation.

10.2 Creative performance

Hypotheses 1 and 2 sought to understand which Individual Creativity factors and which Creative and Innovative Climate factors significantly related to self-reported Individual Creative Performance. It was posited that given the relatively weak relationships in the extant literature between creative performance and personality-related aspects of creativity, Individual Creativity was unlikely to explain a large proportion of the variance in Individual Creative Performance.

In Hypothesis 1, Individual Creativity explained 11% of the variance in Individual Creative Performance, as measured by three items (Oldham & Cummings, 1996). Only Implementing and Illumination were significantly related to Individual Creative Performance. Implementing, the extent to which a person is confident turning a creative idea into reality (Batey, 2004), was positively related to Individual Creative Performance, suggesting that people who are more confident turning their ideas into reality are also likely to perform more creativity (i.e. have work that is original, adaptive and creative).

When demographic variables were controlled for (gender, age and country), Individual Creativity explained 14% of the variance in Individual Creative Performance, with Implementing, Producing and Intrinsic significantly related to Individual Creative Performance. Taken together, these two analyses suggest that Implementing may be consistently identifiable as a predictor of Individual Creative Performance. However, no other aspects of Individual Creativity could be consistently identified as predictors of Individual Creative Performance, suggesting that their contribution should be interpreted cautiously.
In Hypothesis 2, Creative and Innovative Climate explained 17% of the variance in Individual Creative Performance, with Goal Awareness, Team Cohesion, Internal Networks, Autonomy, Resources and Risk Taking all positively and significantly related to Individual Creative Performance.

The proportions of variance accounted for by Creative and Innovative Climate is substantially larger than can be accounted for by Individual Creativity, with the former accounting for a medium amount of variance (11-25% is considered medium; Miles & Shevlin, 2001). This suggests that the climate in which an individual works is more influential on their Individual Creative Performance than their personal creative style. This is consistent with Hypotheses 1 and 2, which argued that Creative and Innovative Climate would have a stronger relationship with Individual Creative Performance than Individual Creativity would. Fundamentally, this is based on the argument that an individual’s performance may be more affected by the environment in which they work as opposed to their personality. This may be because creative style helps individuals think creatively, but in order for them to behave creatively they must work in a supportive environment. Performing creatively requires sustained effort, and thus although an individual may have a creative style that facilitates Individual Creative Performance, the likelihood of them applying the effort needed may depend on the climate. If the climate does not support an individual to act creatively, then any creative thinking cannot be utilised.

The current research also provides evidence of the conceptual distinctness of Individual Creative Performance and Individual Creativity, supporting previous arguments to this effect (Montag et al., 2012). Despite their seeming similar, only a moderate correlation was identified and Individual Creativity was able to explain only a small proportion of the variance in Individual Creative Performance. Moreover, only Implementing was consistently identified as correlated with Individual Creative Performance.

10.3 Interim summary

Overall conclusions and practical implications of the current research are now presented. Conclusions have been informed by Figure 24, which provides a visual representation of the extent to which Creative and Innovative Climate is significantly related to the variables measured in the current research (precise values in correlation matrix). The relationship between Individual Creativity and Individual Creative Performance does not benefit from graphical representation as
only one aspect of Individual Creativity was consistently identified as related to Individual Creative Performance.

Figure 24. The Number of Significant Correlations between Creative and Innovative Climate and Individual and Team Level Variables

10.4 Climate conclusions

The results of the current research suggests that Creative and Innovative Climate is highly influential for creativity and FEI. It is significantly related to factors at both the individual and team levels, as summarised in Figure 25.

Figure 25. Percentage of Variance Explained By Creative and Innovative Climate
Note: GFC refers to General Factor of Creativity

Of the ten Creative and Innovative Climate factors, Internal Networks and Team Cohesion were most often identified as significantly related to other individual and team level variables. The frequency with which they were identified as significant, and their relationships to
both individual and team variables suggests that they are the two most important aspects of Creative and Innovative Climate.

Previous literature on Creative and Innovative Climate and creativity often focused on a small number of climate factors, or even a single climate factor. Often, this has included Team Cohesion in some capacity (e.g. Fairchild & Hunter, 2014; Hulsheger et al., 2009; Joo et al., 2012), indicating that Team Cohesion has been considered an important aspect of Creative and Innovative Climate for longer than the other climate factors. However, the role of Internal Networks has not received comparable levels of attention. Therefore, the identification of Internal Networks as a similarly important aspect of Creative and Innovative Climate extends the previously narrow focus of climate research by highlighting an additional Creative and Innovative Climate factor that warrants similar levels of attention to the levels that which Team Cohesion has historically received.

10.4.1 Creative and Innovative Climate-Team Cohesion

Although the existing literature has examined Team Cohesion, results regarding its relationship with creativity have been inconsistent. Some studies have found a positive relationship (e.g. Fairchild & Hunter, 2014), including studies using an adaptation of the Team Creativity measure used in the current research (e.g. Joo et al., 2012), whilst others found no relationship (e.g. Hulsheger et al. 2009). The current research therefore provides further support for a positive creativity-Team Cohesion relationship.

However, there may be negative ramifications of high levels of Team Cohesion. Barczak et al. (2010) argued that trusting team members and considering them reliable and good at their jobs is the most important aspect of Team Cohesion for creativity, and more important than having positive feelings towards them. If teams are cohesive in that members like each other very much, groupthink may be exhibited (Janis, 1972). That is, the desire to reach a consensus rather than the most appropriate solution, to avoid creating tension in the group (Bissola et al., 2014; Brockman et al., 2010). Im et al. (2013) also warn against the potential negative effects of social loafing and production blocking.

This debate is reflected in the diversity literature, which argues that team diversity benefits creativity and innovation, however a negative by-product of diversity can be increased tension and conflict within the team (Bassett-Jones, 2005).
10.4.2 Creative and Innovative Climate-Internal Networks

Internal Networks has received substantially less focus in the existing literature, and studies have been predominantly within the domain of social network research (e.g. Perry-Smith & Shalley, 2003). These studies have consistently identified the importance of diversity of connections, but inconsistently identified both strongly and weakly connected networks as best for creativity (e.g. Baer, 2010; Sosa, 2011). Also, the positive relationship identified between Internal Networks and creativity contradicts the claim that engaging with the network to ask for help bears high reciprocation costs that may ultimately hinder creativity (Mueller & Kamdar, 2011).

The current research does not support previous social network studies that identified networks as important for creativity as measured by fluency and originality (e.g. Baer, 2010; Sosa, 2011), although this is a very different measurement approach to the one taken in the current research, as the current research found no relationship between Internal Networks (or Internal Collaboration) and fluency and originality. Instead, the current research identified aspects of Individual Creativity focused on confidence and motivation, not ideation, as related to Internal Networks, thus expanding previous social network studies by identifying additional aspects of Individual Creativity that are related to Internal Networks.

10.4.3 Creative and Innovative Climate-Ideation Systems

Following Internal Networks and Team Cohesion, Ideation Systems was related to the largest number of individual and team level variables. Ideation Systems appears to have a dual role, in that it was negatively related to individual level variables (specifically Individual Creativity), but positively related to team level variables (Team Creativity and FEI). This suggests that formalised processes for creativity and innovation hinder individuals but benefit teams.

The current research extends the limited existing Ideation Systems research, and contradicts recent research suggesting a positive relationship between administrative systems and Individual Creativity (Wang et al., 2014), although differences in conceptualisations of Ideation Systems and also whether they are generic or specific to creativity and innovation may account for this. At the team level, the current research supports assertions that managers should aim to build more structure into FEI (Markham, 2013), despite the risk of formalisation decreasing
employees’ incentives to be creative and increasing convergence of ideas due to the imposition of rules and norms (Brockman & Morgan, 2003; Im et al., 2013).

Whilst some structure may be beneficial, developing ‘Freiraum’ (physical and psychological space) is important for creativity and innovation (Auernhammer & Hall, 2013), and this reflects the complex reality that in some cases (i.e. with the individual) structure is unhelpful, but in other cases (i.e. teams) structure may be beneficial, a situation which somewhat mirrors the necessity of a carefully managed balance to realise the benefits of having well-networked, cohesive teams, whilst mitigating potential negative consequences such as groupthink (Im et al., 2013).

Overall, Internal Networks, Team Cohesion and Ideation Systems have been identified as the most important for creativity and innovation. However, other Creative and Innovative Climate variables also require consideration.

10.4.4 Other Creative and Innovative Climate factors

Like Ideation Systems, External Collaboration appears to benefit only team level variables (Team Creativity and FEI). However, unlike Ideation Systems, External Collaboration shows no (negative) relationships with individual level variables. The converse is true for Autonomy.

Further, Resources and Risk Taking are also important aspects of climate. The significant relationships identified in the current research consistently indicate that both Resources and Risk Taking are always positively associated with desired traits, and thus advantageous for creativity and FEI.

Goal Awareness, Valuing Creativity and Innovation, and Internal Collaboration were largely unrelated to creativity or FEI factors, suggesting they are relatively unimportant for creativity and FEI.

10.5 Practical implications

It is essential that organisations give due consideration to Creative and Innovative Climate. The current research suggests that Creative and Innovative Climate factors are highly influential and relate to variables at both the individual and team levels. Of all the Creative and Innovative Climate factors, organisations should address Team Cohesion and Internal Networks as the highest priority, as these two climate factors were identified as most frequently being
related to other variables, at both the individual and team levels. An organisation should actively encourage well-connected employees to introduce other employees into their networks. For example, older employees with larger and more established networks could incorporate younger employees into their network. This may also support knowledge management and knowledge transfer activities in preparation for older employees retiring. As previous research has shown that tie duration (how long the connections have known each other) is not related to creativity (Sosa, 2011), the benefits (for creativity) of introducing new people into a network may be realised quickly.

The second area of Creative and Innovative Climate that organisations should address is Ideation Systems. This appears to be a unique aspect of climate as it is the only Creative and Innovative Climate variable that appears to have a dual role, hindering individuals but benefiting teams.

Risk Taking and Resources are also very important in encouraging creativity and FEI, although they are not as important as Internal Networks and Team Cohesion. Having sufficient resources and being encouraged to take risks is likely to always be beneficial.

Goal Awareness, Valuing Creativity and Innovation, and Internal Collaboration seem to be relatively unimportant for creativity and FEI (as they were not related to many creativity or innovation variables), suggesting organisations should not focus on developing these aspects of Creative and Innovative Climate as a priority.

Organisations should consider whether they wish to encourage the individual or the team. To encourage the individual, an organisation should focus on Autonomy, in addition to the climate factors identified as most important. To encourage, the team, External Collaboration should be the focus.

When an organisation is developing an improvement strategy for their Creative and Innovative Climate, they should first consider what they are trying to achieve. If the aim is to increase Individual Creative Performance and address employees individual creative style, then focusing on the climate is unlikely to be particularly effective (evidenced by the relatively low levels of variance in Individual Creative Performance and Individual Creativity accounted for by Creative and Innovative Climate). However, if the organisation aims to improve team factors, then focusing on Creative and Innovative Climate will be advantageous, as Creative and Innovative Climate has a much larger effect on teams than it does on individuals.
An organisation should consider how consistently their organisation performs. The organisation studied in the current research exhibited inconsistency between teams in Team Creativity, FEI and climate variables. When implementing an improvement strategy focused on any of these factors, the fact that the starting point will differ depending on the team should be considered, and therefore not all teams will require or react to an improvement strategy in the same way. Strategies tailored to a team, within reason, should be considered. Indeed, other organisations such as 3M are beginning to acknowledge the importance of a consistent climate, and the futility of promoting taking risks during ideation only in parts of the organisation (Rahn, 2014).

Lastly, organisations should heed the warning of Hunter et al. (2007) when trying to improve Creative and Innovative Climate and not focus solely on Resources and Autonomy, which are often considered the easiest or most obvious to address.

10.6 Limitations and future research

There are a number of limitations to the current research. Limitations specific to individual research aims or hypotheses posed in the current research were outlined in the appropriate discussion. The following section outlines the broader limitations and, where applicable, discusses how they may be addressed in future research.

First, the current research offers valuable insight into the relationship between Creative and Innovative Climate and Front End Innovation. However, these findings cannot be generalised to the remainder of the innovation process due to FEI being substantively different to the rest of the innovation process (Bertels et al., 2011; Markham, 2013). Future research may want to explore which Creative and Innovative Climate factors are most important for the latter stages of the innovation process, such as developing a marketing strategy for a new product. Alternatively the role of formalised process may become more important as the latter stages of the innovation process can be characterised as more structured than FEI.

Second, a commercial tool was used to measure Individual Creativity that was only available in English, with no possibility of translating it into French or Italian. French and Italian participants therefore completed this measure in English and all other measures in the local language. Although all employees of the organisation studied are required to have a good command of English, having one measure in English may have negatively affected the response.
rate. Future research may explore the possibility of translating the Individual Creativity measure into other languages, if data is to be collected outside of native English speaking countries.

Moreover, the me² Individual Creativity measure is relatively new and may require further validation work as the Confirmatory Factor Analysis presented in section 9.4.10 suggests the four dimensions of the me² offer an explanatory model only and were not empirically supported. However, the me² allowed creativity be to assessed from a creative style/personality perspective and therefore it was suitable to be used in the current research.

Third, data were collected in one organisation in the defence industry, which clearly limits generalisability to other organisations and industries. However, organisations and industries with similar characteristics, such as risk-averse, multinational, high technology organisations may be able to apply the findings from this research. Future research may seek to understand to what extent the current findings can be generalised to other organisations and industries. Moreover, replicating the current research in a number of organisations would allow the measurement and multilevel modeling of organisational level variables.

Fourth, the nature of MBDA meant that 83% of the participants were male. Although there are approximately six million more working males than females (Labour Force Survey, 2014), the gender ratio in the current research goes beyond what is representative of the labour market. The fact that the sample is predominantly male limits how generalisable the findings are to female MBDA employees, and more widely to female working adults. Despite the disparity in the number of men and women in employment, there are still over eight million women in full time employment in the UK alone (Labour Force Survey, 2014), which suggests it is important to consider ways in which females may respond to the climate in which they work. As noted earlier, replicating the current research in other organisations and industries would be beneficial. Considering the predominantly male sample used in the current research, organisations providing data for future research would ideally comprise mainly females, which would allow interesting comparisons across the variables studied (Creative and Innovative Climate, Individual Creativity, Individual Creative Performance, Team Creativity and FEI), or offer a gender-balanced sample. Organisations specialising in counselling or care work may offer opportunities for sampling predominantly female organisations (Adamson, 2014; Cortis & Meagher, 2012), and organisations specialising in food services, accommodation or public administration may offer opportunities for sampling both genders equally (Workplace Gender Equality Agency, 2014).
A fifth limitation of the current research is the minimal consideration given to the role of the physical environment in supporting creativity and FEI. Whilst this has been alluded to a number of times in this thesis, the current research did not explicitly explore this and there is very little empirical work on this topic. Future research would benefit from taking an interdisciplinary approach, building on the current research and incorporating literature from environmental psychology (c.f. Dul & Ceylan, 2011; Lukersmith & Burges-Limerick, 2013) and facilities management (c.f. Lee & Kang, 2013).

Sixth, the current research used a cross-sectional design and is therefore unable to draw inferences regarding the role of time in the development of Creative and Innovative Climate. Moreover, utilising a cross-sectional and thus correlational data means that directional causation cannot be inferred. There has been a call to approach climate as a dynamic, not static, construct, and design empirical research accordingly (Erez & Gati, 2004), and using randomised controlled experiments in which participants only differ on the studied variables would identify causal relationships (Constantine, 2012; Wilkinson, 1999). However, the increased complexity of combining longitudinal and multilevel research designs, and the practical concerns of conducting randomised controlled experiments in organisations, makes this a less attractive proposition (Kozwolski & Klein, 2000). However, the continual advancement of multilevel analysis techniques may make this more achievable for future research.

Seventh, the current research collected and analysed primarily quantitative data, with comparatively little use of qualitative data during the development of CICS. Resultantly, the benefits of qualitative research could not be realised. In particular, a qualitative approach could have addressed exploratory questions pertaining to why various constructs were related to one another (Bryman, 2006; Rogelberg, 2005). Future research may address this limitation. For example, interviews could be conducted to explore why Creative and Innovative Climate may have a stronger relationship with team level constructs than individual level constructs. Alternatively, interpretations of the current research findings have identified avenues for future investigations of variables peripheral to the current research, such as the role of organisational politics in FEI.

Finally, the current research may be limited by the use of self-rated measures, particularly for creativity and Individual Creative Performance. There has been considerable debate in the literature regarding who is an appropriate judge of the elements such as ‘newness’ that comprise creativity and creative performance, with all judges (self or others) offering subjective ratings.
Moreover, using only self-report measures in the current research can increase the likelihood of common method variance occurring. Steps were taken to minimise this risk, such as following recommendations to randomly order the questionnaire items to separate responding to items measuring the same construct temporally (Harvey, Harris, Kacmar, Buckless & Pescosolido, 2014). However, future research could replicate the current study using a composite of self and other-rated creativity measures and an objective measure (e.g. patent applications), and comparing the findings. This would also contribute to the research methods literature regarding the use of self-rated measures, which are common in psychology.

10.7 Summary

The preceding section has discussed the results of the current research in relation to the wider literature, including whether the findings identified in the current research support, contradict or extend the existing literature. Lastly, limitations and directions for future research were presented.
11 CONTRIBUTIONS OF THE CURRENT RESEARCH

11.1 Chapter overview

This research consisted of three studies, developed two measures and proposed and answered five hypotheses guided by three research aims, with 1404 individuals involved in one or more aspects of this research. Whilst all of these provided interesting findings, the current research has six main contributions. This section presents these contributions.

11.2 Interdisciplinarity

The current research has taken an interdisciplinary approach, primarily combining the psychology and innovation management literatures. This was necessary because although the topics of interest in these literatures have substantial overlap, they have thus far been treated as disparate literatures. Interdisciplinarity has been heralded as a way to create knowledge, and allowed a broader perspective on the relationship between creativity, Front End Innovation and Creative and Innovative Climate to be taken.

Due to the potential benefits of an interdisciplinary approach, there have been various calls for research to adopt this approach (Agarwal & Hoetker, 2007; Hitt et al., 2007), including in relation to creativity and innovation (e.g. Anderson et al., 2014), and FEI (Van den Ende et al., 2014). The current research goes some way to addressing these calls.

11.3 Multilevel

The current research has taken a multilevel approach. Multilevel research is beneficial because it allows cross-level relationships to be investigated and estimated. Previously, methods such as aggregation could be utilised, and were utilised by early ‘multilevel’ research in creativity for example (e.g Pirola-Merlo & Mann, 2004). However, these are known to be problematic and can produce inaccurate estimations.

Although recent advances in statistical analysis and computational modeling means that (most) multilevel research is feasible, and as a result multilevel research is becoming more popular, calls for multilevel research remain (Elliot & Nakata, 2013; Yadav, 2010), including in relation to creativity and innovation (Anderson et al., 2004; Buschgens et al., 2013; Kuenzi &
Schminke, 2009) as creativity and innovation are considered perfect candidates for multilevel investigation. The current research goes some way to addressing these calls.

11.4 Two new measures

Measurement of both Creative and Innovative Climate and Front End Innovation has been fraught with problems. These have been problems of conceptualisation, in that there is no consensus as to which dimensions comprise either Creative and Innovative Climate or Front End Innovation, and also a problem of statistical robustness, as the majority of previous measures of both Creative and Innovative Climate and Front End Innovation have not been developed following psychometric principles. As a result, they often lack psychometric quality, with inadequate explanation of the statistical analysis underpinning them (e.g. Ekvall, 1996) and in some cases testing on very small samples (e.g. \( n=23 \), Koen et al., 2001, \( n=53 \), Murphy & Kumar, 1997). Research Aims 1 and 2 sought to address these limitations by developing measures of Front End Innovation and Creative and Innovative Climate, respectively.

11.4.1 Creative and Innovative Climate Scale (CICS)

Specifically, the development of CICS involved 1287 individuals across three phases of development to develop a measure comprising ten scales, all of which exhibit good or excellent psychometric quality (as assessed by fit during CFA). Moreover, the development of CICS goes some way towards addressing the three limitations inherent in existing Creative and Innovative Climate measures identified by Mathisen and Einarsen (2004). That is, that they are not developed using psychometric principles, that it is unclear whether they focus at the individual, team or organisational level, and that there has been inadequate exposition of the potential dimensions comprising Creative and Innovative Climate prior to measure development. Moreover, by explicitly not distinguishing between creative climate and innovative climate the CICS addresses calls for research to stop perpetuating an arbitrary division between creativity and innovation (Anderson et al., 2014).

More fundamentally, the development of this new measure contributes to our understanding of what Creative and Innovative Climate is, through elucidation of the factors that it consists of.

During the development of CICS, the data were triangulated. This provides a more defensible measure. Moreover, it was done so using a mixed methods approach. Moreover, the
11.4.2 Front End Innovation Scale (FEIS)

The development of FEIS involved 958 individuals over two development phases to develop a measure comprising five scales, all of which exhibit good or excellent psychometric quality (as assessed by fit during CFA). The state of the science regarding Creative and Innovative Climate measures is different to the state of the science regarding FEI measures, as there are quite a few of the former, but relatively few of the latter. In particular, unique to FEI (when compared to Creative and Innovative Climate) is the historically attempt to use objective measures such as patent count (Hagedoorn & Cloodt, 2003). However, despite patents being the product of people, objective measures overlook the people-related psychological aspects of FEI and therefore it has been argued that subjective measures are required that focus on the subjective perceptions (Adams et al., 2006; Poskela & Martinsuo, 2009). The current research contributed to meeting this need. Second, the present research addresses Markham’s (2013) call for a measure that specifically deals with the discrete measurement of FEI, seeing as FEI is conceptually distinct from other stages of the innovation process and therefore requires its own measurement approach.

More fundamentally, the development of this new measure also contributes to our understanding of what Front End Innovation is, through elucidation of the factors that comprise it.

11.5 Identification of Internal Networks and Team Cohesion as fundamentally important

Research Aims 3 and 4 (Hypotheses 2-5 in particular) included analysis of Creative and Innovative Climate. These analyses enabled the current research to identify Internal Networks and Team Cohesion as fundamentally important. Of all the Creative and Innovative Climate factors investigated in the current research, Internal Networks and Team Cohesion were related to the highest number of variables, with these variables at both the individual and team level. This suggests that Internal Networks and Team Cohesion are the most important aspects of climate for
creativity and innovation. This is a primary contribution of the current research because the
previous literature on climate, creativity and innovation is characterised by piecemeal research
that often analyses only one or two climate dimensions (often Team Cohesion, rarely Internal
Networks), and uses unidimensional measures of multidimensional constructs such as Creative
and Innovative Climate and Individual Creativity. Therefore, this research has contributed a
comprehensive investigation of Creative and Innovative Climate, creativity and innovation. It
also directs focus for future research towards the less-explored team level (Kurtzberg & Amabile,
2001; Locke & Latham, 2013), supported by the finding Creative and Innovative Climate
accounted for a much greater proportion of variance at the team level than the individual level.

11.6 Identification of the dual role of Ideation Systems

Research Aims 3 and 4 (Hypotheses 2-5 in particular) included analysis of Creative and
Innovative Climate, which allowed the current research to identify the dual role of Ideation
Systems. Ideation Systems was related to the largest number of individual and team level
variables following Internal Networks and Team Cohesion. This suggests Ideation Systems is an
important aspect of climate for creativity and innovation, and contributes to the knowledge
surrounding formalised processes for creativity and innovation, of which there was little. More
interestingly, the finding that Ideation Systems appears to have a dual role, in that it is perceived
to hinder Individual Creativity and innovation but benefit teams, contributes to the literature by
highlighting an area that requires further exploration to understand why this phenomena has this
duality. Very little research has explored these dimensions and none have identified the duality.

11.7 The first comprehensive investigation of the relationship between Creative and
Innovative Climate and each aspect of Front End Innovation

Research Aim 4 (Hypothesis 5) focused on the relationship between Creative and
Innovative Climate and Front End Innovation. Although it may appear simplistic to analyse the
relationship between each aspect of climate and each aspect of FEI, it was necessary to do so
because this type of exploratory analysis does not seem to have been conducted previously,
perhaps due to the lack of adequate FEI measurement tools. By applying some psychological
underpinning to FEI, and the measurement thereof, this was achieved. This further exemplifies
the value of interdisciplinary research.
As this seems to be the first investigation of this type, this analysis advances our understanding of the multifaceted relationship between climate and FEI.

In addition to these contributions, the current research also has high practical utility and the results are already being applied within an organisational context.


Barnette, J. (2000). Effects of stem and likert response option reversals on survey internal consistency: If you feel the need, there is a better alternative to using those negatively worded stems. Educational and Psychological Measurement, 60, 361-370.


Directorate for Science, Technology and Industry: Russian Federation (2011). Review of Innovation Policy. Accessed 24.08.2011 from [http://www.oecd.org/document/58/0,3746,en_2649_34269_48088442_1_1_1_1,00.html](http://www.oecd.org/document/58/0,3746,en_2649_34269_48088442_1_1_1_1,00.html)


& Behavioral Neuroscience, 14, 378-387.


13 APPENDICES

13.1 Visual representation of FEIS factor structure
13.2 Visual representation of CICS factor structure
13.3 Screenshots of Qualtrics questionnaire used in Study 3

Note that the second questionnaire (me²) cannot be reproduced here for copyright reasons.
<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
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<tr>
<td>My team looks for ideas from outside our organisation to meet opportunities</td>
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<td>Having the idea is more important than testing if it will work</td>
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<td>We always use problem solving techniques to help us build a business case for further development work</td>
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<td>My team carefully explores the conceptual aspects of an idea</td>
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<td>My team always has lots of ideas</td>
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<td>My team believes ideas that come from within our organisation are always most valuable</td>
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<td>We use opinions to evaluate an opportunity</td>
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<td>My team very carefully selects the best ideas to work on</td>
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<tr>
<td>My team does not have many new ideas</td>
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<td>We always work with people outside our organisation to improve innovation</td>
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<td>We do not waste time casually talking about opportunities</td>
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<td>We know which ideas are best to work on</td>
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<th>Neither Agree nor Disagree</th>
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<th>Strongly Agree</th>
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<tr>
<td>My team members all have similar ideas</td>
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<td>We never talk about our ideas outside our organisation</td>
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<td>We wait before evaluating an idea</td>
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<td>My team has a history of choosing good ideas</td>
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<tbody>
<tr>
<td>My team can always see lots of options</td>
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<td>In team meetings people are upset when their ideas are evaluated</td>
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<td>We have always chosen winning ideas</td>
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<tr>
<td>My team is excellent at evaluating ideas</td>
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</table>
This section relates to the environment in which you work.

Please answer statements beginning 'my team' and 'we' in relation to the team in which you work.

Please answer statements beginning 'my manager' in relation to your direct line manager.

All other statements should be answered in relation to the organisation as a whole.

Statements referring to resources are specific to resources for creative and innovative work.

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<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slighty Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Slighty Agree</th>
<th>Moderately Agree</th>
<th>Strongly Agree</th>
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<tr>
<td>There is a good system for searching for new ideas</td>
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<td>My organisation appreciates creative and innovative work</td>
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<td>My manager decides what work I do</td>
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<td>Taking risks is discouraged</td>
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<td>I know what my team's objectives are</td>
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<td>The members of my team understand these objectives</td>
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<td>People in my team trust one another</td>
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<td>We work with other organisations to develop new products, processes or services</td>
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<th>Statement</th>
<th>Strongly Disagree</th>
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<tbody>
<tr>
<td>The resources I need for my work are available</td>
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<td>People across my organisation know one another</td>
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<td>Every team member is responsible for the success of the team</td>
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<td>Different parts of the organisation work together to set strategy</td>
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<td>We have a wide network of external specialists</td>
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<td>There is a process to make sure everyone knows the innovation strategy</td>
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<tr>
<td>My manager expects people to do creative and innovative work</td>
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<td>The way I work on projects is my decision</td>
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<tr>
<td>Question</td>
<td>Strongly Disagree</td>
<td>Moderately Disagree</td>
<td>Slightly Disagree</td>
<td>Neither Agree nor Disagree</td>
<td>Slightly Agree</td>
<td>Moderately Agree</td>
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<td>My manager dislikes taking risks</td>
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<td>We all know what our goals are</td>
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<td>In my team we understand and accept each other</td>
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<td>We have mutual trust with our suppliers</td>
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<td>I can always access the facilities I need for my work</td>
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<tr>
<td>I know lots of people outside my part of the organisation</td>
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<td>My team’s objectives can be achieved</td>
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<td>Different parts of the organisation work together to set goals</td>
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<td>We use experts to help us develop our knowledge</td>
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<tr>
<td>Different parts of the organisation work together to generate ideas</td>
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<tr>
<td>Creative and innovative work is recognised</td>
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<td>My manager tells me how I should do my work</td>
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<td>My manager is prepared to take risks</td>
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<tr>
<td>In my team we support each other</td>
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<tr>
<td>My manager encourages me to make connections with people from other Functions</td>
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<tr>
<td>We work closely with customers to develop new products, processes or services</td>
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<td>I can easily get the things I need to do my work</td>
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<tr>
<td>People from different parts of the organisation socialise regularly</td>
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<td>The work I do is important</td>
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<tr>
<td>There are good systems in place to help manage the process from developing ideas to implementation</td>
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<tr>
<td>When needed, meetings have people from different parts of the organisation attending</td>
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<tr>
<td>There is a good system to help me have new ideas</td>
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<tr>
<td>Being creative and innovative leads to success</td>
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<td>I put lots of effort into making connections with people from other Functions</td>
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<tr>
<td>Survey Question</td>
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<td>Moderately Disagree</td>
<td>Slightly Disagree</td>
<td>Neither Agree nor Disagree</td>
<td>Slightly Agree</td>
<td>Moderately Agree</td>
<td>Strongly Agree</td>
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<td>My manager is highly controlling</td>
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<tr>
<td>My organisation encourages people from different parts of the organisation to meet</td>
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<td>The work I am doing is urgently needed by the organisation</td>
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<tr>
<td>There are good processes to ensure different parts of the organisation have early involvement in developing new products, processes or services</td>
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<tr>
<td>We work with many different experts</td>
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<td>My manager wants people to have new ideas</td>
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<td>My Function has rigid procedures</td>
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<td>I could easily work with someone in a different part of the organisation</td>
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<tr>
<td>Creative and innovative work is rewarded</td>
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<tr>
<td>We understand the needs of our internal customers</td>
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<tr>
<td>We collaborate with other organisations</td>
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<tr>
<td>I put lots of effort into maintaining connections with people from other Functions</td>
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</tbody>
</table>
This section relates to creativity in your team.

Please answer all statements in relation to the team in which you work.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Moderately Disagree</th>
<th>Slightly Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Slightly Agree</th>
<th>Moderately Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>My team suggests new ways to achieve goals or objectives</td>
<td>☐</td>
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<tr>
<td>My team suggests new ways to increase quality</td>
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<tr>
<td>My team is a good source of creative ideas</td>
<td>☐</td>
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<tr>
<td>My team exhibits creativity on the job when given the opportunity to do so</td>
<td>☐</td>
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<tr>
<td>My team often has new and innovative ideas</td>
<td>☐</td>
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<tr>
<td>My team comes up with creative solutions to problems</td>
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<tr>
<td>My team suggests new ways of performing work tasks</td>
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<tr>
<td>My team generates many ideas</td>
<td>☐</td>
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<tr>
<td>My team often has a fresh approach to problems</td>
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</table>

This section relates to your individual creativity.

<table>
<thead>
<tr>
<th>How original and practical is your work? Developing ideas, methods or products that are both totally unique and especially useful to the organisation</th>
<th>Extremely (negative)</th>
<th>Moderately (negative)</th>
<th>Slightly (negative)</th>
<th>Neutral (positive)</th>
<th>Slightly (positive)</th>
<th>Moderately (positive)</th>
<th>Extremely (positive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
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</tbody>
</table>

| How adaptive and practical is your work? Using existing information or materials to develop ideas, methods or products that are useful to the organisation | ☐                    | ☐                     | ☐                   | ☐                 | ☐                   | ☐                      | ☐                    |

| How creative is your work? The extent to which you develop ideas, methods or products that are both original and useful to the organisation | ☐                    | ☐                     | ☐                   | ☐                 | ☐                   | ☐                      | ☐                    |
Gender

Male □ Female □

Age

Which directorate are you in?

Which function are you in?

Which department are you in?

Which country are you located in?

Which site are you located in?

Are you a Contractor?

Yes □ No □

Please enter your name here. Please ensure it is identical for both questionnaires.
Your data is confidential - we only require your name to match your two questionnaires. Your name will be deleted as soon as this is done.
We thank you for your time spent taking this survey.
Your response has been recorded.