Cranfield University

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Exploring aspects of organizational culture that facilitate radical product innovation in a small mature company

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ABSTRACT

Much recent discussion has highlighted the challenges posed by what have variously been called "disruptive", "discontinuous", "breakthrough" and "radical" innovations. Although the labelling may vary, the underlying themes appear to be consistent. In particular it is clear that under conditions in which the dominant "rules of the game" change as a result of emergent or shifting markets, major movements at the technological frontier, dislocations in the regulatory environment etc, even organizations with well-developed innovation capabilities get into difficulties. This is less a matter of particular technological, market or political stimuli than of the limitations of the repertoire of organizational responses available to the firm. This resurfaces a long-running concern with managing innovation in two different modes, namely "exploitation" and "exploration".

This thesis reports the results of exploratory research into specific aspects of the organizational culture within the Research and Development (R&D) setting of a small mature UK based company, Cerulean. In doing so it also identifies and discusses key management interventions for developing an innovation culture that facilitates radical product innovation. Cerulean designs and manufactures quality control instrumentation and has in the past been very successful with radically new products. In recent years this propensity for "radicalness" has declined and the company now wishes to regain this capability. A grounded research methodology and a participative action research approach was utilised to surface issues that clearly illustrated both the presence and intensity of aspects of organisation culture that enabled and inhibited radical product innovation. Participative analysis of the data identified nine emerging themes and key constructs of an innovation culture that was found to influence "radicalness" in new product development ventures. The interrelationships between the themes were discussed in the context of current theoretical perspectives in the field of innovation management. This led to the development of a conceptual model that incorporates two "ideal" archetypal forms of innovation culture. A composite instrument was developed based on existing evaluation tools and used to assess the innovation culture. First use of the instrument indicated areas of opportunity in developing a radical innovation culture.

Further participative analysis of the emergent themes and the assessment and evaluations of the extant innovation culture, resulted in a series of management interventions to stimulate the development of a culture to facilitate radical product innovation. The design of the interventions was also informed by the literature and other organizations, part of a national Discontinuous Innovation Forum (DIF) undergoing similar ambitions. The proposed interventions comprise a series of linked management actions in the form of a plan to shift the innovation culture of the company closer to a desired radical innovation culture.

Keywords: organizational culture, radical innovation, interventions, change

PUBLICATION

During the course of the research, presentation of the work and academic peer review took place through several channels. In the earlier stages of the research, during 2004, the researcher presented his work to a Research Colloquium in the Cranfield School of Management and to the Cranfield Innovation Leadership Centre.

The research and emergent findings were presented through the doctoral tracks at the EurOMA 2004 conference in Fontainebleau (McLaughlin, 2004), and at the EurOMA 2005 conference in Budapest (McLaughlin, Bessant and Smart, 2005a). Also at the EurOMA 2005 conference, the researcher presented a paper in the Co-design and New Product Development track (McLaughlin, Bessant and Smart, 2005b). At the 2005 CINET conference in Brighton, the paper presented (McLaughlin, Bessant and Smart, 2005c) won "Best Paper" award.

Papers were accepted for the Cranfield School of Management Working Paper series (McLaughlin, Bessant and Smart, 2005d), and for publication in the International Journal of Technology Management (McLaughlin, Bessant and Smart, Forthcoming).

McLaughlin, P. (2004), 'Developing an organizational culture that enables radical innovation in a mature small to medium sized company: An action research intervention', *EurOMA 2004, Doctoral track*, Fontainebleau, France.

McLaughlin, P., Bessant, J. and Smart, P. (2005a), 'An organization culture to facilitate radical innovation', *EurOMA 2005, Doctoral track*, Budapest, Hungary.

McLaughlin, P., Bessant, J. and Smart, P. (2005b), 'Unpacking a Radical Innovation Culture', *EurOMA 2005*, Budapest, Hungary.

McLaughlin, P., Bessant, J. and Smart, P. (2005c), 'Developing an Organization Culture to Facilitate Radical Innovation', *6th International CINET Conference*, Brighton, England.

McLaughlin, P., Bessant, J. and Smart, P. (2005d), 'Developing an organizational culture that facilitates radical innovation in a mature small to medium sized company: emergent findings', *Cranfield School of Management Working Paper Series*, June 2005.

McLaughlin, P., Bessant, J. and Smart, P. (Forthcoming), 'Developing an organization culture to facilitate radical innovation', *International Journal of Technology Management*.

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NOTATION

The following abbreviations and acronyms are used in this research and relate to Cerulean and its employees.

Term	Definition of term
ASM	The ASM 500- a semi-automated machine that collects vapour phase and particulate matter from cigarettes to allow further laboratory analysis of the collected material.
QTM	A Quality Test Module. One of a number of individual instrument modules that are used to measure individual product characteristics on cigarettes or filters.
MC^2	A new product that encapsulates twenty-seven measurements into one single instrument. Originally designed as an "at line" measurement instrument that would operate alongside a filter or cigarette maker and sample from the finished product to allow these measurements to be obtained. MC^2 comprises the basic instrument "C^2"– software for visualization and analysis of measured data – "M", and a sampling probe that allows the instrument to sample from the mass flow outlet of a filter or cigarette maker.
C^2	The hardware part of the MC^2 instrument that forms the basis of development as a basic low cost instrument.
SM400/SM450	A manual machine that collects vapour phase and particulate matter from cigarettes to allow further laboratory analysis of the analytes contained in the collected material.
top team	The group of directors who are responsible for the running of the business within Cerulean. Also known as the "exec team".
exec team	See "top team".
Cerulean	An operating division of Molins plc.
Molins	A UK engineering plc with business operations in tobacco machinery, packaging and scientific services.
Conformance	The term used in Cerulean for improvement activities on existing products.
Design/Development	The term used in Cerulean for new product design development activities. It does not include improvements or enhancements to existing products.
DIF	Discontinuous Innovation Forum. A collaborative study of discontinuous innovation capability and enabling factors undertaken between Cranfield and Bath Universities, The Oxis Partnership, Thames Valley Technology and the United Kingdom Department of Trade and Industry.

Term	Definition of term
Decision Explorer	*Decision Explorer* is a package that allows the drawing of cognitive maps. It was developed to help members of a team map their view of a problem and more effectively negotiate a consensus for action. It displays constructs and linkages between constructs that represent the meaning of the construct in terms of the explanations and consequences. These links are not taken to be causal in a precise way. The link is in the form of an arrow to show the nature of the linkage. An arrow out of a construct shows a consequence and an arrow into a construct an explanation. Each arrow gives explanatory meaning to one construct and consequential meaning to another (Eden, 1988).
NVivo	*NVivo* is a package that facilitates analysis of qualitative data. This software permits the coding and subsequent analysis of attributes within a series of documents.

1 Introduction

The research described in this thesis responds to a growing concern that the flow of new products at the researcher's company, Cerulean, was not forthcoming and so putting its future survival at risk. The researcher's industrial experience revealed that most companies are effective in pursuing incremental innovations in their new product and service developments. Whilst in general, radically new products espoused to provide a significant competitive advantage are a rare occurrence, in some larger organizations such as Hewlett Packard (Stringer, 2000) radical innovation is more common. This mostly large company phenomenon prompted an interest in whether established and mature small-to-medium sized (SME) companies, in this case Cerulean, could also facilitate a culture for radical innovation. At the time of this research commencing Cerulean's senior management team were actively communicating the urgency for radically innovative products to ensure the organization's future survival. This practitioner need subsequently drove the research process.

The objective of undertaking the research was to understand what aspects of organizational culture enable and inhibit radical innovation n, to better facilitate radical innovation in new product development. Bringing the research resource and faculty experience from Cranfield School of Management to bear on this problem was perceived as a benefit in managing such a change. An effective and complementary way of doing this was to propose a practitioner issue for doctoral enquiry through the Executive Doctorate programme. The desired outcome from the research is an outline of a plan of interventions designed to create the conditions of an organizational culture that will facilitate radical innovation.

1.1 Background and rationale for the research

1.1.1 *The company*

Cerulean is an international company that designs, manufactures, markets and supports a range of quality measurement equipment and specialized packing machines worldwide. It has a head office in Milton Keynes in the United Kingdom. Design, development and manufacturing are all carried out exclusively at the Milton Keynes head office. This facility also contains the administration functions, Sales and Customer Service for the Europe, Middle East and Africa regions. There are service, or sales and service centres in the USA, in Richmond and Winston Salem, Mexico, Brazil, Venezuela, South Africa, Germany, Russia, Italy, India, Malaysia, and China in Shanghai and Kunming. As at September 2005, there were 110 people employed by the company with around 70 of these being based at the Milton Keynes head office. Cerulean is an operating division of Molins plc. An organization chart for the company as at June 2005 is shown in Appendix A.

The company was established in 1961. It grew out of a requirement to produce cigarette filter packing machines and measurement equipment for the mainstream business of filter making. As this requirement grew, the opportunity to market this capability was recognized and a separate company established. Until October 2000 the company was part of a division of Bunzl plc. The division, Filtrona, designed and marketed filters for the tobacco industry on a worldwide basis. The instrument and packing business was known as Filtrona Instruments and Automation. However, Bunzl

was developing itself as a business-to-business consumables operation and Filtrona Instruments and Automation was the only capital goods manufacturing part of the group. The business was sold to Molins plc in October 2000. Molins is a UK engineering plc that produces making and handling machinery for the tobacco industry, specialized packing machines for food and consumer goods industries, and scientific analytical services for the tobacco industry. As the name "Filtrona" was no longer appropriate for the company it was rebranded as "Cerulean" during the summer of 2001. The instruments produced by the company are a deep blue colour and tend to stand out against the beige and green of making machines on the factory floor. Building on this attribute, the name of "Cerulean", a word also meaning a deep blue colour, was chosen for the business.

The company launched a modular range of instrumentation (the QTM range) in the early 1990s, and this led to a long run of successful sales. The modularity of the QTM instruments and the ability to stack modules to provide multiple readings of product characteristics were features that were new to the industry. The QTM range had been a significantly new product when it was launched – a radical innovation. This product had been enhanced over many years, developing incremental improvements and variants of the original core product. This QTM range of products was still generating significant sales in 2005. In 1999, the company launched another new product, the ASM smoking machine, with several new technologies used in the instrument. This product was less successful in the market, meeting significant resistance, due to inadequate development of some of the new technologies. Since the launch of this product, incremental enhancements have been made to the instrument and there is now greater acceptance of this product in the market. There has only been one radical product innovation since the ASM product, and this was developed initially through external consultants, prior to bringing the project in-house.

1.1.2 The researcher

The researcher is the current Managing Director of Cerulean. At the outset of the research he held the position of Operations Director, being promoted to Managing Director midway through the research. He is a Chartered Engineer with management experience in manufacturing and product development with a number of firms. Over several years prior to joining Cerulean, he had experience of implementing change in these firms to improve production or product development performance. He was recruited to Cerulean specifically to implement a lean manufacturing system as part of the overall change programme the company was undertaking during 1999. After completing this part of the change programme he took responsibility for the product development area in Cerulean in 2000. He became interested in the reasons why the company could no longer develop new radical products, despite having a history of developing such products in the past. The company's recent development history, at the outset of this research, had been predominantly incremental improvements to the existing product range. The issue of radical innovation was a focus because the researcher's experience in a number of mature small design and manufacturing companies has been that radically innovative products are the exception. Many companies are effective in developing incremental innovation in their new product development, albeit in many cases in an intermittent manner. However, radically new products, which are considered to be essential to the survival and growth of companies, appear to be relatively rare, in contrast to some larger organizations, such as Hewlett

Packard, where they are a more common occurrence. This prompted an interest in why some smaller established companies appear to be less successful in radical or discontinuous innovation in new product development. For Cerulean innovative new products are perceived to be essential for the future survival of the organization, so the research issue is relevant to the future operation of the business. With the requirement to regain the ability to develop radically new products becoming more important to the business, the researcher began examining the reasons why the company had lost this capability and what would be required to regain it. From this interest, the research described in this thesis evolved.

1.1.3 Problem statement

Over many years the company had grown to be a dominant player in its international market sectors but found itself unable to provide the "stream of innovative new products" that the company believes is necessary to survival and growth. It had a strong new product introduction process that had been used to generate "me too" products that were responding to a competitor offering or an evolution of an existing product. Some incremental innovation was taking place as seen from the new product introductions over these years, but the new products represented an evolutionary progression. The last example of a product that included a radical innovation was conceived about three years prior to the start of this research investigation. This radical innovation came from the use of an external consultancy to create the concept that was later developed and productionized within Cerulean. PA Consulting was retained to provide a solution to a particular set of measurement requirements. This consultancy created a sensor application, instrument layout and packaging that represented a radical innovation. The remaining sensor applications in the instrument were examples of incremental innovation, doing what was done before, but doing it better. At the time the decision was taken to retain the consultants, the belief of the Managing Director was that the Cerulean Development Team would produce only an incremental improvement of the existing product range as a solution to the measurement requirements. The radical step forward was not believed to be capable of being created internally. Once the outline proposal and feasibility had been completed satisfactorily by the consultants, the development and productionization of the design took place within Cerulean. Terziovski (2002) argues that a continuous incremental improvement strategy is the major driving force behind any improvement effort, and that radical innovations should be used to jump-start critical products, services and processes intermittently. Both incremental and radical innovation are necessary for long-term business success.

   The reasons associated with the lack of radical innovation in product development at Cerulean were discussed with key personnel at varying levels within the organization. The new product created through the external consultancy generated interest in why the company was unable to generate radical innovation internally. These informal discussions took place with senior managers and development personnel, during the eighteen months prior to the start of this research. The issues that emerged were representative of risk-aversion, a tendency to blame for mistakes and missed due dates; and a Development Team desire to build on existing products rather than develop new ones. These were suggested as fundamental problems within Cerulean's culture. The underlying problem appeared to be one of organizational culture inhibiting innovation (Kanter, 1988).

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1.2 The need for radical innovation

Innovation matters and it is important for success in design and manufacturing firms (DTI, 2003). Utterback (1994) states that innovation is a central determinant of longer-run success and failure for manufacturing firms. Successful companies are generally effective at responding to evolutionary changes in their markets. Where they run into trouble is in handling or initiating revolutionary changes in their markets or in dealing with disruptive technologies (Christensen and Overdorf, 2000). If a company is looking for growth levels that are significantly larger than the growth of the industry then it must take discontinuous or radical innovation seriously (Bessant, Birkinshaw and Delbridge, 2004). This perspective is supported by McDermott and Handfield (2000) who argue that in order to achieve long-term growth firms need either novel replacements, new to the market products, or breakthrough products. Firms that focus only on incremental innovation are avoiding risk, but at the same time are missing opportunities. Utterback (1994) and Christensen (1997) note how firms that dominate one generation of technology often fail to maintain leadership in the next. Radical innovation has one main benefit over incremental innovation which is that it creates products that do not replace or supplant other products, but adds something new; 'it takes you out of the "zero-sum" game that characterises many industry battlegrounds' (Bessant *et al*., 2004: 29). Radical innovation is associated with breakthrough ideas (Gundling, 2000; O'Connor and Rice, 2001) and with the development of new business or product lines based on new ideas or technologies or substantial cost reductions that transform the economics of a business (Leifer, McDermott, O'Connor, Peters, Rice, and Veyzer, 2000). Companies are increasingly required to combine operational effectiveness and strategic flexibility. Operational effectiveness requires excellent exploitation – incremental innovation – capabilities. Strategic flexibility requires excellent exploration – radical innovation – capabilities (Boer and Gertsen, 2003). An alternative perspective is posited by Getz and Robinson (2003). They suggest that innovation is not essential and that companies can prosper without innovation. However they also posit that continuous improvement is essential for the success of the company and cite GE as an example of an organization that has prospered without a clear innovation strategy. In recent times however, the new CEO at GE has adopted a more conciliatory approach to risk taking. This is described as unlocking the curiosity yet retaining the rigour (Brady, 2005).

1.3 Research question

The research agenda is developed from literature on innovation, creativity aspects of innovation, organizational culture's effect on innovation and changing the organizational culture to promote innovation. The research gap identified is in determining aspects of innovation culture that facilitate radical innovation and in developing interventions that can create conditions conducive to supporting radical innovation. The gap poses a research question that is sub-divided into constituent parts that address the research gap. Although the research question focuses on Cerulean, the investigation can be considered as an experiment that explores a more widespread phenomenon rather than a company specific issue.

 The research question is formulated as, "*What aspects of organizational culture facilitate radical product innovation and how can change be planned to leverage potential improvement?*" The research question is broken down into the following sub-questions:

1. *What* are the cultural enablers and inhibitors to radical innovation in mature small to medium sized design and manufacturing firms?
2. *What* are the perceptions of Cerulean employees and their extant position of the company's culture for encouraging radical innovation?
3. *What* is the gap between the Cerulean current organizational culture and the desired future state for radical innovation?
4. *What* change can be effectively planned to encourage a culture that will develop a radical innovation capability at Cerulean?

1.4 Thesis format

The Cranfield Executive Doctorate research format comprises three projects that are inter-related and a linking document that draws all three projects together. The research is driven by issues in management practice that can be translated into an academic question for the purpose of doctoral research. The outcome of the research should provide valuable insight for the organization involved in the research and for the wider community of practice. The research is focused on a practitioner issue and is intended to provide a solution of benefit to the practitioner as well as adding to domains of knowledge for an academic contribution. The researcher is a senior manager in the organization and this is recognized in the research methodology.

This thesis follows the Cranfield Executive Doctorate research format outlined above. The literature is reviewed in Chapter 2 and informs all three project stages of the research and the discussion. Chapter 3 evaluates the researcher's philosophy and the resultant methodology adopted for this research. Project One, described in Chapter 4, describes how aspects of the innovation culture that influence radical innovation are surfaced by working in a participatory manner with the Cerulean Development Team members. Chapter 4 describes Project Two which develops a composite instrument and gauges the presence and intensity of the aspects of innovation culture influencing radical innovation. This chapter also includes the results from the assessment. Chapter 6 describes Project Three which evaluates empirical examples of interventions designed to develop a radical innovation capability and develops a series of inter-linked interventions planned to create an innovation culture that is supportive to radical innovation in the Cerulean Development Team. The findings from the research are discussed in context of the literature in Chapter 7. Conclusions are drawn and further research opportunities discussed in Chapter 8. An overview of the thesis format is shown in Figure 1-1.
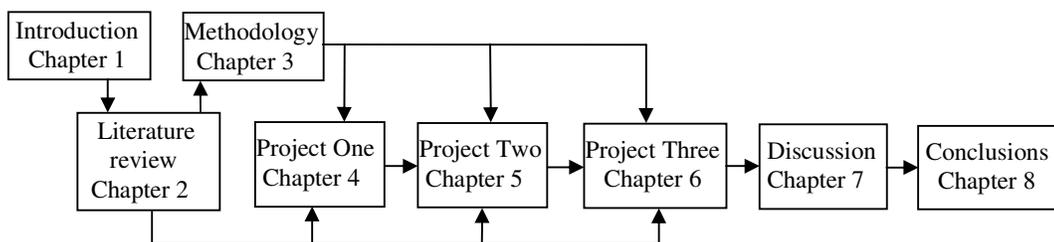
Figure 1-1 Research overview

2 Literature review
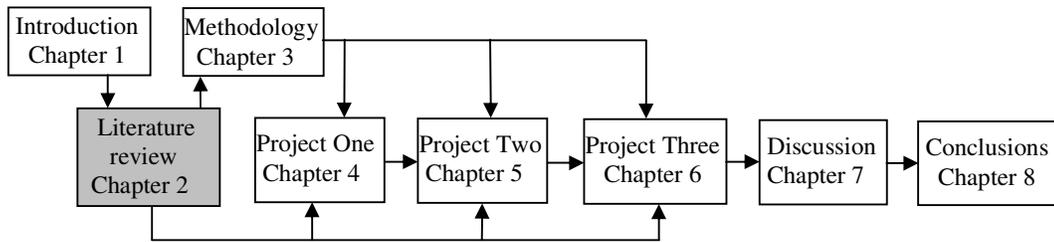
Figure 2-1 Research overview – Literature Review

2.1 The innovation landscape

To consider innovation, it is necessary to define what is meant by the term. Within this research, innovation refers to the context of product development. In this context it can be defined as the development and implementation of new ideas by people who over time engage in transactions with others within an institutional order (Van de Ven, 1988). Schumpeter's (1961) emphasis on the importance of innovation is echoed by Ouchi (1981), Peters and Waterman (1982) and Kanter (1985). Innovation is generally accepted as a necessary activity for an organization to ensure its prosperity (DTI, 2003).

Quinn (1985) suggests that innovation is non-linear, slightly chaotic, usually sloppy, sometimes random, and often up and down in nature. Ruth (2003: 230) suggests that the 'assumption that product innovation can be planned is an increasingly doubtful assumption lacking in foundation'. Hickman and Raia (2002) argue that innovation thrives on disorder, imagination and ambiguity. Tang (1998: 301) suggests that 'innovation thrives on challenge.' One suggested definition of innovation is 'the generation, acceptance, and implementation of new ideas, processes, products and services' (Kanter, 1985: 20).

Innovation is generally agreed to be composed of invention and application of the invention (Delbecq and Mills, 1985; Van de Ven, 1988; Ettlie, 2000). The concept of creativity is therefore a part of the literature on innovation and this concept is contained in some definitions of innovation. Amabile (1988b: 126) defines creativity as 'the production of novel and useful ideas by an individual or small group of individuals working together' and organizational innovation as 'the successful implementation of creative ideas within an organization'. Bruce and Bessant (2002) define innovation as the successful application of new ideas in practice in the form of new or improved products, services or processes. Delbecq (1985) argues that significant change must be successfully introduced to be considered as innovation.

Van de Ven and Poole (1989: 32) suggest that 'while innovation is defined as the introduction of a new idea, the process of innovation refers to the temporal sequence of events that occur as people interact with others to develop and implement their innovation ideas within an institutional context'. Innovation is about change (Tidd, Bessant, and Pavitt, 2001). This is a recurring theme in most definitions of innovation. The innovation process, from the creative front end to the development and implementation, is characterized by change. Innovation cannot happen without interaction and input from people. It is influenced by organization and attitude rather than nurturing solitary genius (Hargadon and Sutton, 2000).

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2.1.1 *Radical v incremental innovation*

Dahlin and Behrens define a radical invention as (1) novel, (2) unique and (3) having an impact on future technology (2005). 'The distinction between radical and incremental innovations is easier to intuit than to define or measure' (Dewar and Dutton, 1986: 1423). Innovation can be considered to exist along a continuum, from incremental innovation, that which the company tries to do better or do more of, to radical innovation, that which is new to the company or new to the industry (Nord and Tucker, 1987; Christensen and Overdorf, 2000; McDermott and O'Connor, 2002). Radical innovation is associated with break-though ideas (Gundling, 2000; O'Connor and Rice, 2001) and with the development of new business or product lines based on new ideas or technologies or substantial cost reductions that transform the economics of a business (Leifer *et al*., 2000). Hill and Rothaermel (2003: 258) differentiate between the two types of innovation in that 'an *incremental* technological innovation builds squarely upon the *established* knowledge base used by incumbent firms, and it steadily improves the methods or materials used to achieve the firm's objective of profitably satisfying customer needs. In contrast, a *radical* technological innovation involves methods and materials that are novel to the incumbents'. The negative consequences of too much attention to incremental innovation have been recognized in research (Rice, Leifer and O'Connor, 2002). Utterback (1994) and Christensen (1997), note how firms that dominate one generation of technology often fail to maintain leadership in the next. A radical innovation may use disruptive technology and in so doing require a different set of rules with which to manage the innovation process. For radical innovation the emphasis is on products that involve dramatic departures from existing products or their logical extensions (Veryzer, 1998). Delbecq and Mills (1985) differentiate radical from incremental innovation in that incremental innovation involves minimal disruption. Radical innovations involve the development of a new technological paradigm that creates new knowledge and understanding, and potentially new industrial sectors. Radical innovation requires organizations to move into unknown territory and experiment with new processes that largely elude systemization (O'Connor and McDermott, 2004). This perspective of venturing into the unknown is supported by Rose-Anderssen, Allen, Tsinopoulos and McCarthy (2005) who suggest complexity theory as a lens to examine innovation. They argue that incremental improvements are rational extensions of the present whilst radical improvements require a creative step into the unknown.

Uncertainty plagues radical projects – technical, market, organizational and resource uncertainties. The radical project is also marked by discontinuities, gaps, critical transitions and leverage points. In this arena traditional management methods may not be appropriate for radical innovation projects (Leifer *et al*., 2000). This indicates why the business practices in some larger established firms mitigate against radical innovation, as the systems and processes that ensure continuity and success (the incremental improvements) become the inhibitors to innovation (Tushman and Anderson, 1986; Ahuja and Lampert, 2001).

2.1.2 *Creativity*

Rickards suggests that 'creativity in a changing environment is a corporate necessity, not an add-on luxury' (1990: 40). Recurring themes in the definitions of innovation are creativity (Amabile, 1988a; Andriopoulos, 2001), invention (Marquis, 1988; Ettlie, 2000) and people (Van de Ven, 1988; Huizenga, 2000). People are the source of the

creativity and individual creativity leads to group creativity which can manifest itself in innovations in the appropriate environment (Kanter, 1988; Angle, 1989; Woodman, Sawyer and Griffin, 1993). An appropriate organizational culture will facilitate this creativity (Tesluk, Farr and Klein, 1997) and the organization members should be able to operate in a relatively unstructured, open and fluid environment (Kaplan, 1960; Ahmed, 1998; Amabile, Hadley and Kramer, 2002; Buhler, 2002). The requirement to have creativity at both individual and group levels is a fundamental cornerstone for innovation (Amabile, 1988a; Tesluk *et al*., 1997; Bharadwaj and Menon, 2000; Sethi, Smith and Park, 2002). Tang (1998: 298) argues that 'creativity is the personal ability to recognize unusual patterns, relations, and produce novel ideas or things. It is a prerequisite for innovation'. Bundy suggests that the 'ideal environment for an innovative company is Plato's world, in which creativity and discovery are honoured' (2002: 247). De Salvo (1999) argues that creativity is the result of inspiration and that innovative ideas are born from supportive, open and trusting environments. Two of the biggest barriers to blocking creativity are fear and lack of passion (DeSalvo, 1999). Trust overcomes fear and allows a willingness to accept vulnerability based upon having positive expectations about other people's intentions and behaviours in situations which are interdependent and/or risky (Clegg, Unsworth, Epitropaki and Parker, 2002). Creativity is considered to be widespread rather than the skill-set of a few creative individuals. Having the appropriate climate is suggested to be a key factor in what is needed to release this creativity (Humble and Jones, 1989). This is supported by Amabile and Gryskiewicz (1989) who argue that individual creativity within an organization depends, in addition to the individual's own skills and motivations, on three basic components of the organization, (1) skills in innovation management occurring primarily at the level of the local supervisor, (2) motivation to innovate, evident as a commitment to innovation at the organization level and (3) resources, including materials, personnel and time. Developing "do different" ideas depends on unusual ideas, and organizations successful in radical innovation make themselves more hospitable to the person with different ideas" (Leavy, 2005).

2.1.3 Learning and knowledge

The innovation process is knowledge intensive (Kanter, 1988). Innovation needs knowledge to develop the ideas and it creates knowledge in the process (Tidd *et al*., 2001). Much of the knowledge required for incremental innovation is local knowledge (Jelinek and Schoonhoven, 1991). For a radical innovation, the knowledge is new to the firm, and may diminish the value of the accumulated R&D knowledge of the firm (Hill and Rothaermel, 2003). Management of this knowledge, much of which is tacit (Nonaka and Takeuchi, 1995), is also part of the innovation process. Intertwined with the development of knowledge is individual and organizational learning (Garvin, 2000). The learning process is instrumental in making use of the knowledge available and results in generation of new knowledge (Senge, 1990; Bessant and Francis, 1997; Norling and Statz, 1998; Mikaelsson, 2002). Indeed, Tushman and Moore (1988: xii) argue that 'Organization learning is at the heart of managing innovation. This learning can be shaped only by an executive team that is itself flexible and adaptive over time'. The process of using existing knowledge and developing new knowledge is similar to Revans' Action Learning (1980) in that it fulfils some of his criteria for success; (a) a powerful motivation to do something about the situation, (b) being obliged to think for

themselves, (c) all suggestions are considered, no matter how ridiculous they may seem, and (d) promising suggestions are tried out many times with slight local variations.

The learning that takes place to facilitate innovation has to be both additive and subtractive (Akgün, Lynn and Byrne, 2006). Organizations must learn to forget in order to allow new knowledge to be absorbed (Chandy and Tellis, 1998; Prahalad, 1998; Vera and Crossan, 2005). The learning activity is both at individual and organizational level and, in this area also, the effect of an appropriate culture is relevant to allowing the appropriate learning to take place. The effect of organizational culture on learning is argued by Argyris and Schön who state (1996: 16) that 'Organizational learning occurs when individuals within an organization experience a problematic situation and inquire into it on the organization's behalf. They experience a surprising mismatch between expected and actual results of action and respond to that mismatch through a process of thought and further action that leads them to modify their images of organization or their understandings of organizational phenomena and to restructure their activities so as to bring outcomes and expectations into line. In order to become organizational, the learning that results from organizational enquiry must become embedded on the images of organization held in its members' minds and/or in the epistemological artifacts (the maps, memories, and programs) embedded in the organizational environment.' These "artifacts" are the same manifestations of underlying values and beliefs that Schein proposes in his model of culture (1984).

2.1.4 Innovation culture

Although the extant literature poses many questions; for example, does culture exist as an entity or is culture a characteristic of a group (Smircich, 1983; Fiol, 1991); does culture exist independently or is it a social construction (Weisinger and Salipante, 2000), organizational culture is agreed to have an influence on the propensity of an organization to be innovative (Kanter, 1988; McGourty, Tarshis and Dominick, 1996; Ahmed, 1998; Tidd *et al.*, 2001). This is supported through empirical research (Chandler, Keller and Lyon, 2000; Andriopoulos, 2001). Despite there being a munificence of definitions and perspectives on organizational culture, little consensus exists for the understanding of organizational culture (Smircich, 1983). Some of the aspects of culture enjoy broad agreement, but there is little unanimity. Most authors agree that organizational culture is something holistic, historically determined, related to rituals and symbols, created and preserved by the group, soft and difficult to change. Literature emphasises the need for the right organizational culture for innovation. Ahmed (1998: 31) argues that 'culture is a primary determinant of innovation'. Bart (1996) shows that mission statements of organizations, which specify practices in innovativeness, exert a strong influence on innovative practices and behaviour in organizations. McGourty *et al.* (1996) show that an organization's culture can be modified to encourage innovative behaviour through specific management practices that deal with strategic direction, employee selection, rewards and recognition, employee deployment, support for idea generation, and multi functional teaming.

Aspects such as leadership (Drennan, 1992; Schein, 1992; Galpin and Herndon, 2000), group history (Handy, 1985; Drennan, 1992; Johnson, 1992) and shared values (Thompson, Ellis, and Wildavsky, 1990; Schein, 1992; Hofstede, 1997; Stackman, Pinder, and Connor, 2000) are considered to be attributes of culture, but their influence and relevance are considered to be different from writer to writer. However the concept of values being fundamental to determining culture enjoys widespread support (Wiener,

1988). Most organizations have some core values that are shared across a particular group (Chatman and Jehn, 1994). This is supported by Selznick (1984) who argues that shared values are essential for organizational survival because they maintain the organization as a bounded unit and provide it with a distinct identity. Culture is not a single belief, value or assumption, but a combination of many of these (Schein, 1991). It must be viewed from multiple perspectives in order to be fully understood (Hall, 1976). It is not innate but is learnt and it is inextricably linked with the group (Hofstede, 1991; Johnson, 1992). Without a group there can be no culture (Smircich, 1983).

Research indicates that certain factors or conditions are more likely to create an environment where innovation can flourish. Kanter (1988: 170) suggests that 'innovations, like flowers, start from tiny seeds and have to be nurtured carefully until they blossom; then their essence has to carried elsewhere for the flowers to spread. And some conditions – soil, climate, fertilizer, the layout of the garden – can produce larger and more abundant flowers.' 'Innovations can grow wild, springing up weed-like despite unfavorable circumstances, but they can also be cultivated, blossoming in greater abundance under favorable conditions'. The favourable conditions combine to create an environment where creativity and thus innovation can flourish. The culture that facilitates radical innovation may be different to that which will facilitate incremental development and product introduction. A number of sub-cultures for each stage of the product innovation and development may be appropriate (Zien and Buckler, 1997). A firm that wishes to facilitate radical innovation and simultaneously pursue continuous improvement through incremental innovation may require two sub-cultures that do not comfortably co-exist – a cultural ambidexterity (Delbecq and Mills, 1985; Anderson and Tushman, 1990; Leifer *et al.*, 2000). For radical innovation, "order and clarity" (generally accepted to support incremental innovation) may be detrimental. Management must learn to loosen control and become less risk avoiding in order to develop an environment that favours the appearance of radical innovation (Ekvall, 1996). Ekvall (1996: 121) argues that 'it is a well-known phenomenon that ambiguity is not threatening to highly creative people. On the contrary they become stimulated by it; they see the possibilities in an unclear situation. But it is also known that people with above-average creative potentials, and with less self-confidence than highly creative people, often need frames and goal direction in order to realize their latent creativity.' Rewarding entrepreneurship and innovativeness, facilitating risk taking and tolerance of failure encourages idea submission and NPD participation. It creates an environment of formal and informal interdependence and communication which leads to successful innovation (de Brentani and Kleinschmidt, 2004).

On the other side of the same coin, certain aspects of organizational culture act to suppress creativity and thus innovation (Amabile, 1998; Morrison and Milliken, 2000; Perel, 2002). Bureaucracy, restricted resources, restricted freedom and confused goals all act to inhibit creative behaviour (Puhlmann and Gouy, 1999; Freel, 2000; Ogbonna and Harris, 2000; Perel, 2002). An environment that allows freedom, provides slack in resource provision, clear goals, and a participative management style encourages innovation through the fostering of creativity (Oliver, 2002). The organization that is supportive, open and trusting as opposed to bureaucratic and controlling is more likely to produce innovative products (Ahmed, 1998; DeSalvo, 1999; Jassawalla and Sashittal, 2002). This is the argument posited by Burns and Stalker (1966) who suggest an organic rather than a mechanistic organization to foster innovation.

A favourable organizational culture on its own will not guarantee an organization being innovative. Other conditions must also be in place for innovation to flourish. For example, adequate resource allocation must be available (Thomas, 1993; Cooper, 1999), good external sources of communication to provide information must be available (Oakey, Rothwell, and Cooper, 1988; Stringer, 2000), robust mechanisms to review and continue or kill innovation projects at the appropriate stage must be in place (Dornblaster, Lin, and Van de Ven, 1989; Leifer *et al.*, 2000), and sufficient skills must be available to the organization (Johne and Snelson, 1988a; Johne and Snelson, 1988b; Syrett and Lammiman, 2002). However, it is clear that an appropriate organizational culture will facilitate innovation. The creation of a culture of innovation is not about facilitating occasional radical innovation breakthroughs but about creating a culture in which innovation is a way of life (Bessant, 2003).

2.1.5 Radical and incremental innovation culture

The differentiation between the culture that supports incremental and radical is noted by several authors (Nord and Tucker, 1987; Humble and Jones, 1989; Rice, O'Connor, Peters and Morone, 1998; Tushman and O'Reilly III, 1999; Leifer *et al.*, 2000). This is supported by the argument that some of the mechanisms that support incremental innovation can be counter-productive to radical innovation. Von Stamm (2003a: 260) argues that 'radical ideas tend to need room to grow and develop, they tend to change shape and scope' and therefore suggestion schemes, which are the foundation for incremental innovation, are not good for radical innovation. Organizational cultures that facilitate radical innovation tend to be tolerant of risk taking and the uncertainty that facilitates this type of innovation (Claver, Llopis and Molina, 1998). It is the internal mindset or organizational culture rather than technological forces that act as drivers of success or failure in an organization responding to disruptive technology challenges. A visionary leadership and a willingness to embrace change characterize such organisations (Tellis, 2006).

Radical innovation is "inherently messy", fraught with uncertainty and unfamiliarity. The process is non-linear, stochastic, highly explorative and experimental, involving probing and learning rather than targeting and developing (Rice *et al.*, 1998). Attempts have been made to map the process (Veryzer, 1998; Tidd *et al.*, 2001), but the nature of radical innovation means that structure and predictability are unlikely to facilitate its management. The organizational culture and adherence to process following found in large firms tends to push efforts towards low risk incremental innovation (Dougherty and Heller, 1994). Less is known about effective management of the development process for radical than for incremental innovation. 'It is unclear what the landscape for radical NPD looks like' (McDermott, 1999: 632), and rather than being a predictable process 'developing radical innovations involves considerable risk and requires insight and foresight' (O'Connor and Veryzer, 2001: 231).

Von Stamm (2003a: 271) argues that 'incremental and radical innovation require very different business conditions, skills, structures and processes'. This is supported by McDermott and Handfield (1996: 371) who suggest that 'it is not unreasonable to expect that successful practices associated with new product development may be significantly different for discontinuous and incremental projects.' The organizational culture that supports incremental innovation may not therefore act in the same way to facilitate radical innovation.

2.1.6 Managing innovation

In organizations where technological innovation is a key component, a state of creative tension exists between those responsible for technological development of new products and the organization's need to satisfy customer demands. The need to maintain a balance between the two is clear. Too far towards R&D, and technological wizardry runs amok. When it swings too far in the direction of satisfying customer demands, innovativeness can be stifled and technological stagnation can result. Maintaining this state of creative tension is important for producing viable and technologically innovative products. A key task for managers is to foster innovation whilst at the same time controlling and channelling the business needs of the organization (McDonough III and Leifer, 1996). Managing innovation is subject to several perspectives in the literature. Managing technological innovation through normal process management methods is advocated by several authors (Tushman and Nadler, 1986; Roberts, 1988; Rothwell, 1992). Rickards (1996) suggests that the management of innovation be recast as the individuals concerned enacting new social processes. Much is known about innovation killers and how organizations deal with innovation, but less is known about how to make organizations more innovative (Pohlmann, 2005). As Gebhardt states 'there is no recipe for becoming innovative' (2005: 29). some authors argue that innovation is not a question of organization and cannot be organized permanently, suggesting that innovation management is more about managerial belief systems which are acknowledged by other actors (Pohlmann, Gebhardt and Etzkowitz, 2005). Innovation involves change and managing people in conditions of change indicates certain styles of leadership may be more appropriate than the management required for repetitive tasks involving little variability or change. At times the appropriate leadership to enable innovation can seem to be at odds with accepted best practice for running a business (Christensen, 1997; Sutton, 2001; Farson and Keyes, 2002). However, in any design context, the influence of the top management leadership on the design strategy and therefore the innovation propensity is significant (Francis, 2002; Harborne and Johne, 2003). Van de Ven (1986) argues that management of innovation has to deal with four basic problems; (1) a human problem of managing attention to the need to innovate, (2) a process problem in managing new ideas into good currency, (3) a structural problem of managing part-whole relationships and (4) a strategic problem of institutional leadership. The management of innovation is perceived to differ between incremental and radical innovations (Ettlie, Bridges and O'Keefe, 1984). Radical innovation often produces failures, and the magnitude and timing of results are highly unpredictable. Faced with these issues, it is not surprising that managers feel more comfortable with an incremental approach to innovation. Companies that succeed over the long haul punctuate incremental innovation with radical innovation (Leifer *et al.*, 2000).

2.1.7 Established innovation management and inertia

Established companies can become overly reliant on the systems and procedures that have brought them success. They become locked in to these behaviours and reliant on following systems that have worked successfully in the past (Bate, 1994). To overcome the obstacle of identifying and solving problems managers must actively encourage people to break from the past. Employees are likely to adhere to methods which may have been relevant in the past but are no longer so, and then continue with these routines, which have become outdated and no longer beneficial (Leonard-Barton, 1995).

Some authors note the difficulties established firms face in reframing the underlying "mindsets" of the organization and hence their approaches and operations to take account of radical shifts in their operating environment (Foster and Kaplan, 2002; Leonard-Barton, 1992a; Tripsas and Gavetti, 2000), whilst others discuss the need to develop different operating processes and policies which may actively conflict with those "routines" developed for handling innovation under more "steady state" conditions (Francis, Bessant and Hobday, 2003; Leifer *et al.*, 2000). The challenge of connecting innovations with routine operations has long been noted (Burns and Stalker, 1966). When market conditions change and become more turbulent and instability replaces predictability, holding fast to established systems and procedures can be counter-productive (Hill and Rothaermel, 2003; McDermott and Handfield, 2000). In this environment 'procedures take precedence over problem solving and innovation dims' (Greiner, 1998: 62). Accelerated competition means that it is no longer possible to wait for a competitor to move before deciding to react (Fleury and Fleury, 2003). The mindset of established and dependable procedures and systems in firms can inhibit "attempting the impossible". Hamel and Prahalad suggest that some companies focus on trimming their ambitions to match resources, with the result that they search only for advantages they can sustain (Hamel and Prahalad, 1989). Other, more entrepreneurial companies leverage resources by accelerating the pace of organizational learning and try to attain seemingly impossible goals. The concept of the Big Hairy Audacious Goal (BHAG), a major and ambitious target for the company to strive towards and which suggests behaviours for the employees, supports this perspective (Collins and Porras, 1996).

2.1.8 Innovation in large and small companies

Schumpeter (1961) is considered to have initiated the argument about small, entrepreneurial companies being more likely to be the source of innovation. Subsequent research has been inconclusive on this issue. There is some indication that larger companies, having access to appropriate resources are better placed to innovate (Ali, 1994; Leifer *et al.*, 2000; Leifer, O'Connor and Rice, 2001; Bommer and Jalajas, 2004). As a counterpoint, large companies are also considered to be less flexible than their smaller counterparts and thus find innovation more difficult (Dougherty and Heller, 1994). The routine operations in large companies can suppress innovation (Feldman and Pentland, 2003). The structure and processes developed over many years nurture functional fiefdoms and conservative decisions rather than encourage cross-functional activity and risk taking (Dougherty and Hardy, 1996). Radical innovation is extremely difficult to do. It is high-risk, high-return and as such runs against the natural risk-aversion of larger or established companies. It also involves a higher level of creativity and out-of-the-box thinking than typically goes on in larger companies (Bessant *et al.*, 2004). The business practices in some larger established companies mitigate against radical innovation, as the systems and processes that ensure continuity (the incremental improvements) become the inhibitors to innovation (Tushman and Anderson, 1986). However this is not a universal rule. Large companies, for example Hewlett Packard, Johnson and Johnson, 3M and Sony can be innovative in a regular and repetitive manner (Tushman and O'Reilly III, 1996; Zien and Buckler, 1997; Gundling, 2000). Chandy and Tellis (2000) argue that since World War II, large incumbent firms have introduced many radical innovations. Wagner and Hansen find that company size does impact on the innovation type pursued, at least in the wood products industry (2005).

Capital enjoyed by large companies allows them to excel in process innovation. Small companies can compete in areas of product and business system innovation, as these can offer significant gain for little resources.

2.1.9 Leadership

Innovation driven organizations have innovative and committed leaders who continually show commitment to the process of innovation and are unwilling to rely on past performance (Humphreys, McAdam and Leckey, 2005). As an influencer and developer of organizational culture, leadership plays a significant role. The concept of leadership being a key element is found in many definitions of culture (Morgan, 1997; Drennan, 1992; Schein, 1992). Culture is influenced by leadership (Selznick, 1984; Schein, 1992) in that leadership creates and promotes culture in an organization. This theme is elaborated upon by several writers (Andriopoulos and Gotsi, 2002; Kanter, 1985; Selznick, 1984). The influence of a strong leader can change or embed culture to the extent that it continues after the leader has departed (Bierly and Spender, 1995). This aspect is one of the key components in understanding the origin of culture and in making culture change (Drennan, 1992; Sharkey, 1999; Farson and Keyes, 2002). Weick (1985) suggests that culture and strategy are interchangeable, but asymmetrically, in that culture can substitute for strategic plans more easily than plans can substitute for culture. A company that has a strategy of innovation and where innovation is part of the vision is likely to produce a better innovation performance (Bryman, 1992) The view of culture, leadership and strategy being inter-linked is supported by Deal and Kennedy (1982), Peters and Waterman (1982) and Saffold III (1988). Organizational culture can act to support individuals when they are under pressure, by providing decision makers with categories, routines and examples of good and bad solutions (Weick, 1987; Bierly and Spender, 1995). The influence of leadership therefore has a similarly significant effect on the innovation capability of the individual (Amabile, 1988a; Ong, Wan and Chng, 2003) and the organization (Kanter, 1988; Cooper, 1999; Jassawalla and Sashittal, 2002). Chatman and Cha (2003: 32) argue that 'It is a leader's primary role to develop and maintain an effective culture.' This type of culture is easier to lose than it is to acquire (Leonard-Barton, 1995).

Leadership is a key aspect of both developing a radical innovation culture and sustaining it (Leifer *et al*., 2000). Managers at Hewlett Packard are low key, modest, team players who promote variation through strong efforts to decentralize, to eliminate bureaucracy, to encourage individual autonomy and accountability, and experiment to take risks (Tushman and O'Reilly III, 1996). The role is preaching and persuading rather than one of control (Tushman and O'Reilly III, 1996). Senior management must be passionate about radical innovation. The support, involvement, commitment and championing of the CEO and senior management is perhaps the most critical success factor. The role of radical innovation in accomplishing the company's long-term strategies and objectives must be clearly stated and reinforced at all levels. Adequate funding should be provided and sustained, even in difficult economic times (Simon, McKeough, Ayers, Rinehart and Alexia, 2003).

The conflicting requirements of incremental – "do better" and radical – "do different" innovation require correspondingly conflicting approaches (Tushman and O'Reilly III, 1996; Birkinshaw and Gibson, 2004; O'Reilly III and Tushman, 2004). Ambidextrous organizations build in the organizational capabilities to simultaneously explore and exploit, to decrease variance as well as simultaneously increasing variance.

Tushman and Smith state that 'ambidextrous organizations are complex organizational forms that are composed of multiple internally inconsistent architectures that are collectively capable of operating simultaneously for short-term efficiency and long-term innovation' (2004: 8). Leadership to facilitate such ambidexterity is similarly contradictory in its requirements. A clear emotionally engaging vision provides the strategic anchor from which senior management can balance the conflicting requirements of the ambidextrous organization (Tushman and Smith, 2004).

Facilitating radical innovation entails tolerating and encouraging experimentation and the inevitable failures, allowing latitude to the team, displaying a passion for radical innovation and taking an interest to signal that the leadership is on board with radical innovation and that it is acceptable to try something new, to "do different". This style sits uncomfortably with managers who are used to traditional controls and structures. They have to evaluate their own underlying beliefs and values if they are to be open and honest in supporting this type of radical innovation culture. Mobilizing and managing knowledge becomes a primary task for managers seeking to develop radical innovation. Mobilizing high levels of participation in the innovation process is unfamiliar to many managers and appears untested and apparently risky. Fear of uncontrolled change and expectations of short-term returns discourage allowing latitude for experimentation. A disbelief in the ability of the employee to contribute – "not everyone is creative" – and a belief in specialists as the problem solvers and in "big bang" solutions encourages managers to look elsewhere for the steps to developing a radical innovation culture (Bessant and Caffyn, 1997). "Cultivate" instead of "manage" epitomizes the modus operandi for this type of innovation management. Successful managers prime minds to invent through cultivation, just as farmers encourage plants to grow. Like farmers who remove impediments to the growth of plants, the manager seeking invention must remove impediments (Breton and Gold, 1987). This resonates with Kanter's horticultural analogy (1988).

2.2 Culture and climate

Although climate and culture are sometimes used interchangeably in literature, organizational climate is not the same as organizational culture. Denison (1996) suggests that climate refers to a situation and its link to thoughts, feelings, and behaviours of the organization members, whereas culture refers to an evolved context in which a situation may be embedded. Climate is temporal, subjective, and can be manipulated, whilst culture is rooted in history, collectively held and difficult to manipulate. If climate is to be included in the cultural model, it should be regarded as a manifestation of culture on what Schein (1991) has described as the level of artefacts, including visible and audible behaviour patterns (Ekvall, 1996). Ahmed (1998) argues that culture is a reflection of climate, but operates at a deeper level. However culture and climate are generally agreed to have an influence on the way things happen in an organization. 'Climate determines what and how things happen in an organization and culture explains why things happen the way they do' (Tang, 1998: 301).

Climate can be regarded as an attribute of the organization, a conglomerate of attitudes, feelings and behaviours which characterize life in the organization, and exists independently of the perceptions and understandings of the members of the organization (Ekvall, 1996). Climate is perceived as an organizational reality in the "objectivistic" sense. In the context of organizational processes, climate plays the part of an intervening variable, which affects the results of the operations of the organization.

Climate has this moderating power because it influences organizational processes such as problem solving, decision making, communications, co-ordination, controlling and psychological processes of learning, creating, motivating and commitment (Ekvall, 1996). Climate is observable in the practices and policies of the organization. Beliefs and values of culture are not visible but operate as cognitive schema which govern behaviour and actions to give environmental stimuli. Culture can be thought of as having two components. *Explicit*, representing the typical patterns of behaviour by the people and the distinctive artefacts that they produce and live with. *Implicit*, representing the values, beliefs, norms and premises which underline and determine the observed patterns of behaviour (Ahmed, 1998). Culture and climate are distinct constructs operating at different levels of meaning; yet at the same time they are closely interrelated (Tesluk *et al.*, 1997).

Cameron and Quinn (1999) argue that the concept of organizational culture differs from organizational climate in that climate refers to more temporary attitudes, feelings and perceptions of individuals, whereas culture is an enduring, slow to change attribute of organizations. Climate, because it is based on attitudes, can change quickly and dramatically. Culture refers to implicit, often indescribable parts of organizations whereas climate refers to more overt, observable aspects of organizations. Culture includes core values and consensual perceptions about how things are whilst climate includes individualistic perspectives that are modified frequently as situations change and new information is encountered.

Culture is recognized as having a significant influence on the propensity of the organization to be capable of innovation (Kanter, 1988; Soriano de Alencar and Bruno-Faria, 1997; Bommer and Jalajas, 2002; Perel, 2002). Radical innovation is generally accepted to be facilitated by an organizational culture that is different to the culture that facilitates incremental innovation (Judge, Fryxell and Dooley, 1997; Tushman and O'Reilly III, 1999; Leifer *et al.*, 2000; O'Reilly III and Tushman, 2004). In the same manner literature refers to climate enhancing and facilitating innovation (Dougherty and Heller, 1994; Utterback, 1994; Harborne and Johne, 2003; Al-Beraidi and Rickards, 2003), with a discretely different climate being perceived as facilitating radical as opposed to incremental innovation (Humble and Jones, 1989; Ekvall, 1996; Chandy and Tellis, 2000).

The constructs of culture and climate have developed in parallel, but they have been driven by researchers from different disciplines and using different methodologies. There has been little cross-fertilization of methods and ideas. There has also been considerable debate amongst researchers about the relationship between the two constructs. For climate researchers the frame of organizational reference is psychological schema based on latent personal values. These are individual or personal constructs that may be aggregated across the organization. For culture researchers the frame of organizational reference is group understandings – interpretative schema (Sparrow and Gaston, 1996). Denison (1996) argues that the differences in research approach are best viewed as differences in interpretation rather than differences in the phenomenon. Ekvall (1996) differentiates between the concepts of culture and climate. He defines climate as the observed and recurring patterns of behaviour, attitudes, and feelings that characterize life in the organization. Culture provides the foundation for these patterns of behaviour that are readily observable, described and changed. Using Schein's model the perspective of climate can be reflected in the artefact level of the model. In this context, climate is represented by the visible and audible behaviour

patterns and the organizational processes. Climate has a moderating power because it influences organizational processes such as problem solving, decision making, communications, co-ordination, controlling and psychological processes of learning, creating, motivating and commitment.

2.3 Assessing climate

Schein (1991) suggests that evaluation of culture should be undertaken at all three levels, starting with artefacts. This indicates that the visible manifestations of culture, the climate (Ekvall, 1996) is a starting point for gauging organizational culture. Several common instruments used to assess climate are reviewed in this section. These are known and validated instruments that have support in literature. They represent typical tools used to gauge climate but do not represent an exhaustive list of such instruments. The instruments evaluated have tended to focus on innovation and creativity climate. Operationalization of the definition of organizational climate has proceeded along two lines, objective and perceptual. Objective approaches have attempted to characterize organizational differences in terms of objective variables such as size, levels of authority, ratio of administrative personnel to production personnel, quantity of formal rules. These studies call attention to the importance of the environment in influencing behaviour and generally subscribe to the view that situational or environmental measures must be obtained independently of the individual's perceptions of them. Perceptual refers to a set of measurable properties of the work environment, perceived directly or indirectly by the people who live and work in this environment and assume to influence motivation and behaviour (Sims Jr and LaFollette, 1975). Several authors have suggested instruments for assessing the climate that facilitates innovation or creativity. Amabile (1988b: 126) suggests that 'organizational innovation is the successful implementation of creative ideas within an organization'. It is further suggested that 'creativity is the first step in innovation' (Amabile, 1997: 40). From an empirical perspective, 'few differences seem to exist between those instruments measuring work environments for innovation and those measuring work environment for creativity' (Mathisen and Einarsen, 2004: 136). The following climate assessments were reviewed for suitability to this research.

2.3.1 Litwin and Stringer Organizational Climate Questionnaire (LSOCQ)

Litwin and Stringer (1968) constructed an assessment based on nine separate *a priori* scales which they defined as:-

1. Structure – the feeling that employees have about the constraints in the group, how many rules, regulations, procedures there are; is there an emphasis on "red tape" and going through channels, or is there a loose and informal atmosphere?
2. Responsibility – the feeling of being your own boss; not having to double-check all your decisions; when you have a job to do, knowing that it is your job.
3. Reward – the feeling of being rewarded for a job well done; emphasizing positive rewards rather than punishments; the perceived fairness of pay and promotion policies.

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4. Risk – the sense of riskiness and challenge in the job and in the organization; is there an emphasis on taking calculated risks; or is playing safe the best way to operate?
5. Warmth – the feeling of general good fellowship that prevails in the work group atmosphere; the emphasis on being well liked; the prevalence of friendly and informal social groups.
6. Support – the perceived helpfulness of the managers and other employees in the group; emphasis on mutual support from above and below.
7. Standards – the perceived importance of implicit and explicit goals and performance standards; the emphasis on doing a good job; the challenge represented in personal and group goals.
8. Conflict – the feeling that managers and other workers want to hear different opinions; the emphasis placed on getting problems out in the open, rather than smoothing them over or ignoring them.
9. Identity – the feeling that you belong to a company and that you are a valuable member of a working team; the importance placed on this kind of spirit.

Over a period of operation the nine scales were modified to combine Warmth and Identity, Identity and Support and Warmth and Support. Conflict showed poorest consistency. This was dropped from the measure or used only to show presence of conflict. The scales were then reduced to:-
1. Structure -
2. Responsibility
3. Reward
4. Risk
5. Identity, Warmth and Support
6. Standards
7. (Conflict)

Four factor analytic studies of the LSOCQ were compared to assess the consistency of the instrument's factor structure when administered to different organizational populations. In addition, separate factor analytic results of the questionnaire for three functional sub-groups of a single organization were compared to investigate the LSOCQ's factor consistency within a single organization. Although there is somewhat more intra- than inter- organizational replicability of factors, both comparisons raise considerable doubt about the validity of the Litwin and Stringer instrument (Rogers, Miles Jr and Biggs, 1980).

These results indicate considerable doubt exists that the original climate *a priori* scales were able to measure what they purported to measure. While the instrument was supposed to be measuring specific facets of an organization such as structure and standards, the climate instrument was actually measuring a general affect tone toward other people, and a general affect tone toward management (Sims Jr and LaFollette, 1975).

2.3.2 Creative Climate Questionnaire (CCQ)
The CCQ (Ekvall, 1983; Ekvall, Arvonen and Waldenstrom-Linblad, 1983; Ekvall, 1996) was designed to measure organizational conditions that may facilitate or inhibit creativity and innovation. It is a questionnaire measuring the climate for creativity. Climate influences organizational processes such as problem solving, decision making,

communications, co-ordination, controlling and psychological processes of learning, creating, motivating and commitment (Ekvall, 1996). The items on which the questionnaire construction is based came from an interplay between theory, field research and experiences of consultancy in organizational psychology. The ten dimensions measured in the questionnaire are:-

1. Challenge - the emotional involvement of the members in the organization's operations and goals.
2. Freedom - the independence in behaviour exerted by the people in the organization.
3. Idea Support - the way new ideas are treated.
4. Trust/Openness - the emotional safety in relationships.
5. Dynamism/Liveliness - the eventfulness of life in the organization.
6. Playfulness/Humour - the spontaneity and ease that is displayed.
7. Debates - the occurrence of encounters and clashes between viewpoints, ideas, and differing experiences and knowledge.
8. Conflicts - the presence of personal and emotional tensions, in contrast to conflicts between ideas.
9. Risk Taking - the tolerance of uncertainty.
10. Idea Time - the amount of time people can use and do use for elaborating new ideas.

The instrument is an organizational measure, not an individual one. The respondent is addressed as an observer of life in the organization and asked to tell how people in the workplace usually behave. He/she does not report his/her own behaviour nor communicate personal feelings. Mathisen and Einarsen (2004) suggest that there is some uncertainty about the psychometric quality of this instrument arguing that 'better documentation of its psychometric properties is required before it can be recommended as a reliable and valid instrument' (2004: 125).

2.3.3 Business and Organization Climate Index (BOCI)

This survey instrument was developed by Payne and Pheysey (1971) by reconceptualizing the Organizational Climate Index developed by G. G. Stern. It consists of a four point response scale measuring seventeen dimensions including, orientation to information technology, sociability, intellectual orientation and readiness to innovate. The 17 dimensions of climate used in the BOCI are:-

1. Leader's psychological distance
2. Questioning authority
3. Customer service
4. Quality issues
5. Open-mindedness
6. Information technology
7. Future orientation
8. Science and technical orientation
9. Intellectual orientation
10. Managing culture
11. Industriousness
12. Sociability
13. Interpersonal aggression
14. Rules orientation

15. Administrative efficiency
16. Readiness to innovate
17. Orientation to the wider community

Based on this questionnaire Sparrow and Gaston (1996) suggest eight climate maps representing the spectrum of organizations. Their research has shown that a typical cross-section of British organizations can be classified into eight generic underlying "climate maps". These maps fall along a spectrum of negative to positive climates. The maps are shown in Table 2-1.

Table 2-1 Generic Climate Maps

Cluster	Unique characteristics	Associated or shared characteristics
Endangered Species	Poor administration and organization systems Poor communication Inefficient work practice Low identification with corporate image No discernable shared values and beliefs	Slow to implement change Discourage experimentation Discourage conceptual thinking about purpose and activity
Cope with the present but don't expect change	Antipathy to research and analysis of own activities Internal focus, low attention to external business world	Reluctance to change Low critical thinking about the future Slow to implement change Discourage experimentation Discourage conceptual thinking about purpose and activity
Don't think it, don't say it, and don't try it	Undemanding work Low emphasis on quality of processes and outputs No challenge to existing practices High managerial authority accepted	Reluctance to change Low critical thinking about the future Slow to implement change Discourage experimentation
Research and development driven by a social conscience	High scientific and technical orientation	Customer service emphasis built into management systems Open-minded, intellectual, future-oriented work style Complex problems dealt with by reasoning and logic Free expression of personal viewpoints Discussion of failures, basic goals and purposes Strong identity with corporate image Clear product or service philosophy External pride Ethos of service and connection to the wider community

Table 2-1 Generic Climate Maps

Cluster	Unique characteristics	Associated or shared characteristics
Flexibility of thought and action	Strong attention to work High sustained levels of work effort and activity Quick decision-making Management traditions encourage autonomy over work	Customer service emphasis built into management systems Open-minded, intellectual, future-oriented work style Complex problems dealt with by reasoning and logic Free expression of personal viewpoints Discussion of failures, basic goals and purposes Strong identity with corporate image Clear product or service philosophy External pride Ethos of service and connection to the wider community
The future is quality, but do it our way	None	Clear product or service philosophy Strong identity with corporate image Discussion of failures, basic goals and purposes Customer service emphasis built into management systems Future-oriented work style Not strongly innovative, open minded, limited logic and rationality
Have we really got a culture?	None	None
Isolated boffins	Little contact with colleagues and other work groups Low team orientation Individual work focus	High emphasis on research Value placed on expert knowledge Focus on up-to-date technical developments and application

Despite methodological concerns with the measurement of climate, this instrument produces high levels of inter-rater reliability within a meaningful collective sample of individuals in an organization (Sparrow and Gaston, 1996).

2.3.4 Siegel Scale of Support of Innovation (SSSI)

This instrument assesses perceptions of leadership, ownership, norms for diversity, continuous development and consistency. The SSSI was developed to assess organizational climate factors assumed to be present in innovative organizations. The definition of organizational climate is based on Litwin and Stringer's (1968) understanding of the concept as a 'set of measurable properties of the work environment that are perceived by those working in the environment and influence their motivation and behaviour' (Siegel and Kaemmerer, 1978: 554). The theoretical dimensions used in the SSSI are:

Leadership – leadership for innovative organizations is postulated to be that which supports the initiation and the development of new ideas throughout the system and ensures the diffusion of power throughout the system. It supports the personal development of individual members, and respects members' capacity to function creatively.

Ownership – this is defined as existing when group members feel they originate and/or develop the ideas, processes and procedures with which they work. It is posited that when ownerships exist, group members do not limit themselves to the application of previously determined solutions or solutions of others, but are committed to their own work.

Norms for diversity – when members of the system have a positive attitude toward diversity, the system responds positively toward creativity, and few behaviours are judged as being deviant.

Continuous Development – in an innovative organization, change is continuous. As part of this, members of the organization maintain a questioning attitude toward the fundamental assumptions of the system. An innovative organization continuously experiments with alternative conceptions of its approaches, problems and/or tasks. Concurrently, its members cope with the frustration inherent in dealing with new approaches, problems or tasks.

Consistency – between the innovative organization's processes and desired products. Members of the innovative system are sensitive to the notion that the way in which something is accomplished can have immediate and unintended consequences that may conflict with the objective of the activity.

Members' perception of the climate within the organization was used as the basis for measurement, as opposed to objective variables. An innovative organization was defined as one that 'fosters the creative functioning of its members' and a traditional organization was defined as 'one that is not specifically oriented toward fostering the creative functioning of its members' (Siegel and Kaemmerer, 1978: 554).

The SSSI was based on retrospective analysis of two projects which attempted to develop organizations that would foster the creativity of their members, and the analysis developed the five climate dimensions that were assumed to facilitate creativity. The final version contained 61 items that are responded to across six response options – from strongly agree to strongly disagree. However, only one study on validity has been conducted using the original version of the SSSI. Little documentation exists on the reported psychometrics of the scales. In addition the SSSI was developed in schools, which raises questions about the use of the instrument in a work organization (Mathisen and Einarsen, 2004).

2.3.5 Assessing the Climate for Creativity (KEYS)

The instrument was designed to assess perceived stimulants and obstacles to creativity in organizational work environments. Three broad organizational factors are proposed and assessed over a five point response scale in a model of creativity and innovation in organizations (Amabile, Conti, Coon, Lazenby and Herron, 1996). The authors assume that the social environment can influence both the level and the frequency of creative behaviour. This departs from the traditional psychological approach to creativity, which focuses on the characteristics of creative persons. It is argued that people will be at their most creative when they are primarily intrinsically motivated, by the interest, enjoyment, satisfaction, and challenge of the work itself. This intrinsic motivation can

be undermined by extrinsic motivators that lead people to feel externally controlled in their work (Amabile *et al.*, 1996; Amabile and Gryskiewicz, 1989).

The KEYS instrument comprises 78 questions taken by an employee at any level of the organization and is used to quantitatively measure the level of support for creativity in work place conditions (Amabile, 1998). The key dimensions assessed are:-

Challenging Work – A sense of having to work hard on challenging tasks and important projects. Managers match people with the jobs that play to their expertise and skills in creative thinking, to ignite intrinsic motivation.

Freedom – Giving autonomy to people concerning the means (process) but not necessarily the ends. Clearly specified strategic goals often enhance peoples' creativity. Freedom is mismanaged when goals change frequently or are not defined clearly, or by granting autonomy in name only.

Resources – The two main resources that affect creativity are time and money. Fake or impossibly tight deadlines kill creativity. Adding resources beyond a threshold of sufficiency does not boost creativity. Below the threshold, restriction of resources dampens creativity.

Work Group Support – Managers must pay careful attention to the design of teams. Diversity is a starting point. Team members share excitement over the team's goal. Team members must be willing to help their team-mates through difficult periods and setbacks. Every member must recognize the unique knowledge and perspective that other members bring to the table. One common way managers kill creativity is by having homogeneous teams.

Supervisory Encouragement – Taking time to encourage the work of the team and its members. To sustain passion, people need to feel that their work matters to the organization, or to some important group of people. Being critical of new ideas, looking for flaws kills creativity. The supervisor encourages experimentation, sets goals appropriately, supports intrinsic motivation and shows confidence in the work group.

Organizational Support – Creativity is truly enhanced when the whole organization supports it. Mandating information sharing across the organization supports creativity. The organizational culture encourages creativity through fair constructive judgement of ideas, reward for creative work, mechanisms for developing new ideas and a shared vision of what the organization is trying to do.

KEYS also assesses two management practices that inhibit creativity.

Organizational Impediments – An organizational culture that impedes creativity through internal political problems, harsh criticism of new ideas, destructive internal competition, an avoidance of risk and an overemphasis on the status quo.

Workload pressure – Extreme time pressures, unrealistic expectations for productivity and distractions from creative work.

In addition KEYS includes data on how productive and creative the organization is perceived to be.

Productivity – An efficient, effective and productive organization or unit.

Creativity – A creative organization or unit where a great deal of creativity is called for and where people believe they can actually produce creative work.

Mathisen and Einarsen (2004) suggest that studies carried out indicate that the KEYS is a promising instrument for assessing the work environment for creativity. However,

the authors caution that that a revision of the instrument is needed to improve the factor structure, and that more studies are recommended to assess its validity. Nevertheless the KEYS instrument has widespread acceptance and is used in empirical research (Bommer and Jalajas, 2002).

2.3.6 Situational Outlook Questionnaire (SOQ)

Isaksen and Kaufman (1990) performed an exploratory study that sought to determine if a relationship exists between cognitive style and individual perceptions of climate for creativity and change. They explored this relationship by examining how people of strongly different cognitive styles perceived the climate for creativity and change in their organizations. Clapp and Kirton (1994) responded to this study by challenging the theoretical relationship of the two instruments used in the original study. Their response argued that both theoretical and methodological points required further explanation and investigation. The outcome was the SOQ. This is a 50 item instrument. It is constructed to assess how much any particular context will support creativity and change. The measure is a derivation of the creative Climate Questionnaire originally developed by Ekvall (1983), and is used as a tool for organizational diagnosis and development (Isaksen, Lauer and Ekvall, 1999). The SOQ is a paper and pencil self-report measure. It assesses nine of the ten dimensions measured in Ekvall's Creative Climate Questionnaire.

Factor analysis of the SOQ showed that one of Ekvall's dimensions, Dynamism/Liveliness, did not clearly emerge as a separate dimension in the English speaking cultures (Isaksen *et al.*, 1999). Very few studies on validity have been conducted using the original version of the SSSI. Little documentation exists on the reported psychometrics of the scales and the SSSI was developed in schools, posing questions about the use of the instrument in a work organization (Mathisen and Einarsen, 2004).

2.3.7 Team Climate Inventory (TCI)

The TCI is a four factor, 38 item questionnaire using a ten point response scale (Anderson and West, 1998).

The four dimensions used are:

Vision - To what extent are the team's objectives and visions clearly defined, shared, valued and attainable? The dimension is divided into the subscales, clarity, visionary nature, attainability and sharedness.

Participative safety - How participative is the team in decision making procedures and to what extent is the environment perceived as interpersonally non-threatening so that it is safe to present new ideas and improved ways of doing things? This dimension is divided into the subscales, information sharing, safety, influence and interaction frequency.

Task orientation - To what extent does the team have a shared concern with excellence of quality of task performance in relation to shared vision or outcomes characterized by evaluations, modifications, control systems, and critical appraisals? This dimension is divided into the subscales, excellence, appraisal and ideation.

Support for innovation - To what degree is there expectation, approval and practical support for attempts to introduce new and improved ways of doing

things in the work environment? This dimension consists of two subscales, articulated support and enacted support.

The TCI is an instrument that reflects an explicit measure of climate within teams. The individual responses on the TCI should be aggregated to team level. However the analyses conducted when exploring the psychometric properties have been done at an individual level, with the exception of confirmatory factor analyses. People who work together on a daily basis will develop a common understanding of the work environment. It is likely that other factors such as personality, cognitive style, personal values, informal group membership; and demographic factors such as education, gender and age, as well as specific work tasks, will also influence individual perceptions. Several studies indicate that the psychometric quality of the TCI is acceptable. Because validity studies of the instrument have been conducted in different types of organization, the TCI may be used within different teams, making it highly useful (Mathisen and Einarsen, 2004).

2.3.8 Team Factor Inventory (TFI)

The TFI assesses seven team factors, leadership factors and performance criteria, along a five point response scale (Rickards, Chen and Moger, 2001). The seven team factors assessed are:-

Platform of understanding – how well the team works at understanding each others' job requirements, personal needs and developing a common understanding of situational requirements

Shared vision – the extent to which the team tends to have a shared view (vision) of team purpose, the extent to which the team has strong loyalty to its team purpose and team members have no confusions over its team purpose.

Creative climate – The extent to which the team climate is warm and positive, the team environment is interesting and challenging and team members trust and support one another.

Resilience – How the team responds if it hits an unexpected problem, how the team members pull together to deal with it, how they have confidence in their own abilities to sort things out and are able to bounce back after any setback to their plans.

Idea owners – To what extent people suggest ideas and then run with them, and there are willing volunteers to try out new ideas. How much people are prepared to take responsibility for making new ideas work.

Network activators – To what extent team members have contacts outside the team that are helpful, are good at mobilizing help from outside the team and are good networkers.

Learning from experience – To what extent the team is good at learning from mistakes, talk things over when things go wrong and tend to try out new ideas after things go wrong.

The team leadership factors assessed are:

Team Leadership – To what extent does the team leadership tend to be inspirational, tend to be motivational and tend to be results oriented. Transformational leadership has been shown to be associated with seven predicted team factors and with output variables designated as creativity and productivity (Rickards *et al.*, 2001).

The performance factors assessed are:
> *Performance criteria* – To what extent is the team creative and to what extent is it productive.

The TFI has a large database of information (Al-Beraidi and Rickards, 2003).

2.4 Assessing Culture

Having evaluated the artefact level of culture through a climate assessment, a more holistic perspective of organizational culture can be made using an instrument designed to assess culture. Organizational culture surveys focus on aspects of how things get done in the organization rather than the more visible aspects (Sleezer and Swanson, 1992). In the same manner as for climate, several instruments used to assess culture were reviewed. These are also known and validated instruments that have support in literature and are supported with empirical examples of their use.

Definitions of culture reflect three different kinds of ontologies. The most common is structural realist ontology, where organizations exist as structures that have a variety of properties, including culture. Second is social construction ontology that places emphasis on the varying regularity in events that happen and gives observers room to select which set of events to group together into a culture. An organization in this view is a kind of culture. A third ontology treats organizations and cultures both as linguistic conveniences. Concepts such as organization and culture serve the heuristic purpose of helping people to think. Definitions also reflect three epistemological approaches. Deductive approaches emphasize broadly applicable cultural dimensions or analytic categories. Here, knowledge is gained by constructing these dimensions, and evolving them to account for previously unrecognized phenomena. Inductive approaches emphasize researchers' capabilities to derive categories by directly observing particular groups. Here, relationships among variables and the variables themselves may be unique to particular groups. This approach tends to recognize the presence of tacit elements that always shape the experience of specified constructs. A third approach is the view that observers are less dispassionately interested in accuracy than they are in producing constructions that reflect their own interests (Ashkanasy, Wilderom, and Peterson, 2000). More literature discusses the organizational culture qualitatively (Deal and Kennedy, 1982; Barney, 1986) than assesses organizational culture quantitatively (Hofstede, 1997; Reigle, 2001). This is unsurprising as organizational culture is a difficult concept to gauge and can sometimes be confused with management ideology (Elsmore, 2001). Some authors have attempted to gauge it both qualitatively and quantitatively (Hofstede, Neuijen, Ohayv and Sanders, 1990).

'Organizational culture is the pattern of beliefs, values, ritual, myths, and sentiments shared by the members of an organization. It influences the behaviour of all individuals and groups within the organization' (Harrison and Stokes, 1992: 1). As such, it is more difficult to ascribe a quantification to than climate. The underlying values and beliefs are more difficult to uncover and more resistant to change than the more visible aspects of climate. 'Managers who seek to guide the process of changing organization cultures are generally compelled to gather from employees information about the system and the culture in which they work.' (Sleezer and Swanson, 1992: 22).

Sleezer and Swanson (1992) suggest that for a successful culture survey the instrument should be designed to collect specific information. The survey should consist of a set of written items that require employees to respond in some meaningful way. Every item on the survey should focus on an aspect of how work gets done within

the organization. The broader purpose of the culture survey is to use the results to improve the organization's performance. For this broader purpose to be achieved, the data must be shared with all employees. Problem areas must be openly and honestly discussed in a non-threatening environment, solutions to problems must be proposed and actions must be taken.

The following culture assessments were reviewed for suitability to this research.

2.4.1 *Nadler and Tushman*

Nadler and Tushman (1980) suggest a general approach for thinking about organizational functioning and a process for using a model to analyse organizational problems. They posit that organizations can be better understood if they are considered as dynamic and open social systems. An open system is one that interacts with its environment (von Bertalanffy, 1972). As systems, organizations display a number of basic systems characteristics. They have *internal interdependence* in that changes in one component or subpart of an organization frequently have repercussions for other parts – the pieces are interconnected. They desire *equilibrium*. When an event puts the system out of balance the system reacts and moves to bring itself back into balance. They display *equifinality*. Different system configurations can lead to the same or to the same type of input-output conversion. There is no universal or "one best way" to organize. They display adaptation. For a system to survive, it must maintain a favourable balance of input or output transactions with the environment or it will run down. These system characteristics are evaluated in the form of:-

Individual/Organization
- How are individual needs met by the organizational arrangements?
- Do individuals hold clear or distorted perceptions of organization structure?
- Is there a convergence of individual and organizational goals?

Individual/Task
- How are individual needs met by tasks?
- Do individuals have skills and abilities to meet task demands?

Individual/Informal organization
- How are individual needs met by the informal organization?
- How does the informal organization make use of individual resources consistent with informal goals?

Task/Organization
- Are organizational arrangements adequate to meet demands of the task?
- Do organizational arrangements motivate behaviour that is consistent with task demands?

Task/Informal organization
- Does the informal organization structure facilitate task performance or not?
- Does it hinder or help meet the demands of the task?

Organization/Informal organization
- Are the goals, rewards, and structures of the informal organization consistent with those of the formal organization?

The congruence model puts emphasis on the transformation process and specifically reflects the critical system property of interdependence. It views organizations as made

up of components or parts that interact with each other. The congruence model is based on how well these parts fit together. A relative degree of congruence or "fit" exists between each pair of inputs. The congruence between the two components is defined as the degree to which the needs, demands, goals, objectives, and/or structures of one component are consistent with those of another component. Congruence is a measure of how well pairs of components fit together.

2.4.2 Goffee and Jones

Goffee and Jones (1998) posit a model of organizational culture based on the two dimensions of sociability and solidarity. Sociability is a measure of the friendliness among members of the community. People in high sociability work environments rarely have a clock punching mentality. They work until the job is done because they do not want to let their friends down. The opposite is a prevalence of friendships that may allow poor performance of members to be tolerated. Solidarity, on the other hand, is based not so much in the heart as in the mind. Solidaristic relationships are based on common tasks, mutual interests, and clearly understood shared goals that benefit all the involved parties, whether they personally like each other or not. The opposite is that high-solidarity cultures can have a brutal "do-or-die" attitude. If the two dimensions are considered as vertical and horizontal, there are four cultures, eight if the negative side is considered. The four culture types are shown in Figure 2-2.
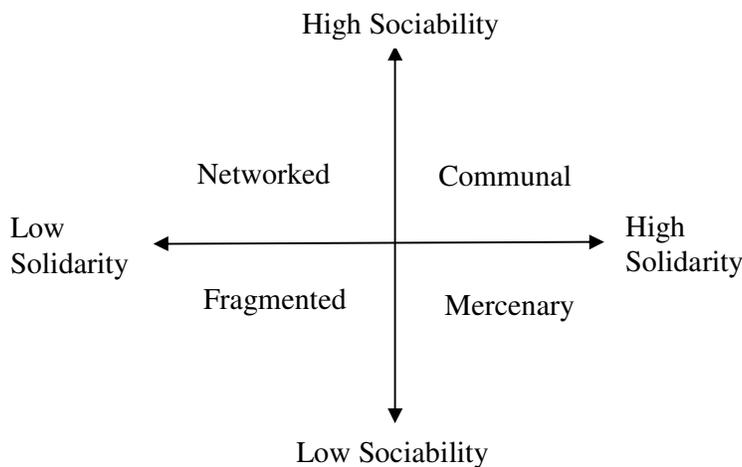
Figure 2-2 Culture types suggested by Goffee and Jones

The authors argue that the character of an organization can be illuminated by identifying its sociability and solidarity and suggest an assessment tool to determine the nature of a given organization. This solidarity/sociability model is similar to the cultural model suggested by von Stamm (2003b).

2.4.3 Harrison and Stokes

Harrison and Stokes argue that culture is to an organization what personality is to an individual (1992). Their instrument looks at how people treat one another, what values they live by, how people are motivated to produce, and how people use power in the organization. This is used as a framework to assess the organizational culture based on how people use power in the organization.

The instrument measures *Power* orientated culture, *Role* culture, culture based on *Achievement* and a *Support* orientated culture. Every organization has some basic combination of these four basic organizational cultures. The four cultures are only partly compatible with one another and the benefits of one can only be achieved at the expense of some of the benefits of the others.

- A *Power* oriented organization is based on inequality of access to resources. People are motivated by rewards and punishments and by the wish to be associated with a strong leader. At its best, leadership is based on strength, justice, and paternalistic benevolence on the part of the leader. At its worst it is ruled by fear.
- A *Role* orientated organization substitutes a system of structures and procedures for the naked power of the leaders. These give protection to subordinates and stability to the organization. At its best it provides stability, justice and efficient performance. Because it seeks to control, it inhibits innovation.
- *Achievement* orientation is when intrinsic satisfaction is part of the reward structure. This may be inadvertent or be planned as a part of the role. It is called an aligned organization as it lines people up behind a common vision or purpose. It makes use of a mission to focus and align people.
- *Support* orientation is based on mutual trust between the individual and the organization. People are valued rather than viewed as just cogs in a machine.

The assessment tool evaluates the organizational culture based on these four dimensions. These dimensions are similar to the four organizational culture types suggested by Handy (1985).

2.4.4 Reigle

Reigle (2001) proposes the Organizational Culture Assessment (OCA). This is a measurement tool that assesses organizational culture and provides a five-dimensional score, one for each of the five culture elements. The culture elements are:-

1. Language
2. Artefacts and symbols
3. Patterns of behaviour
4. Espoused values
5. Beliefs and underlying assumptions

The OCA is a 45 question survey, divided into five sections, one for each culture element. Each question is answered by marking one of eight answers on a Likert type scale with two possible answers in each of the following four categories, strongly agree, somewhat agree, somewhat disagree, strongly disagree. There is evidence to confirm validity and reliability of the instrument (Reigle, 2001). The results show four types of organizational culture based on the Organic-Mechanistic dimensions (Burns and Stalker, 1966).

2.4.5 Hofstede

Hofstede *et al*. (1990) suggest a survey based on questionnaire and interview to determine the organizational culture differences. Data on task, structure and control characteristics are collected separately. Quantitative measures are aggregated at the unit level. The results show that a large part of the differences among the evaluated units could be explained by six factors, relating to established concepts from organizational sociology. The underlying basis of the assessment is the existence of sub-cultures

within the overall organizational culture. 'One organization may include several culturally different departments, and these departments may consist of culturally different workgroups' (Hofstede *et al.*, 1990: 289). The six dimensions assessed are:-

1. Process orientated v Results orientated
2. Job orientated v Employee orientated
3. Professional v Parochial
4. Open systems v Closed systems
5. Tightly v Loosely controlled
6. Pragmatic v Normative

The study empirically shows shared perceptions of daily practices to be the core of an organization's culture. Measurements of employee values differ more according to the demographic criteria of nationality, age and education than according to membership in the organization *per se*. The study concentrates on the creation of a multi-layered model for organizational culture but this does not resonate well with the model used by Schein.

2.4.6 Cameron and Quinn

Martin (2002) differentiates among three perspectives of culture. The integration perspective assumes that culture is what people share, or the glue that holds them together. The differentiation perspective assumes that culture is manifested by differences among sub-units and that an organization's culture is fraught with conflicts of interest. The fragmentation perspective assumes that culture is ambiguous and unknowable, and that it describes not an attribute of the organization but the inherent nature of the organization itself. Martin argues that each perspective has legitimacy and must be acknowledged as individuals study or try to manage the culture. Cameron and Quinn (1999) suggest an Organizational Culture Assessment Instrument (OCAI) which is biased toward the integration approach to organizational culture. The OCAI assesses 'how things are' (Cameron and Quinn, 1999: 134) in the organization rather than how individuals feel about them. The instrument also helps identify the culture the organization members think should be developed to match the future demands of the environment and the challenges to be dealt with by the organization.

The OCAI is based on the competing values framework (Denison and Spreitzer, 1991). This was developed initially from research conducted on the major indicators of effective organizations. Two major dimensions were identified. One dimension differentiates effectiveness criteria that focus on flexibility, discretion, and dynamism from criteria that focus on stability, order and control. Some organizations are perceived as effective if they are changing, adaptable and organic. This is epitomized by companies like Microsoft and Nike. Other organizations are perceived as effective if they are predictable, stable and mechanistic. Companies like Boeing and government departments are characterized by longevity and staying power in both design and outputs. The continuum runs from organizational versatility and pliability at one end to organizational steadiness and durability at the other. The second dimension differentiates effectiveness criteria that emphasize an internal orientation, integration and unity from criteria that emphasize an external orientation, differentiation and rivalry. Organizations that typify harmonious internal characteristics are Hewlett Packard and IBM. Others, such as Honda and Toyota, are perceived to be effective if they are focused on interacting or competing with others outside their boundaries.

Together these two dimensions form quadrants. Each quadrant represents a distinct set of organizational effectiveness indicators. These indicators of effectiveness represent what people value about an organization's performance. They represent what is perceived as good and bad and define the core values on which judgements about organizations are made. These four core values represent opposite or competing assumptions. Each continuum highlights a core value that has opposites at either end of the continuum. The dimensions produce quadrants that are also contradictory or competing on the diagonal. These are shown in Figure 2-3.

Flexibility and Discretion

CLAN   ADHOCRACY

Internal focus and Integration

External Focus and Differentiation

HIERARCHY   MARKET

Control and Stability
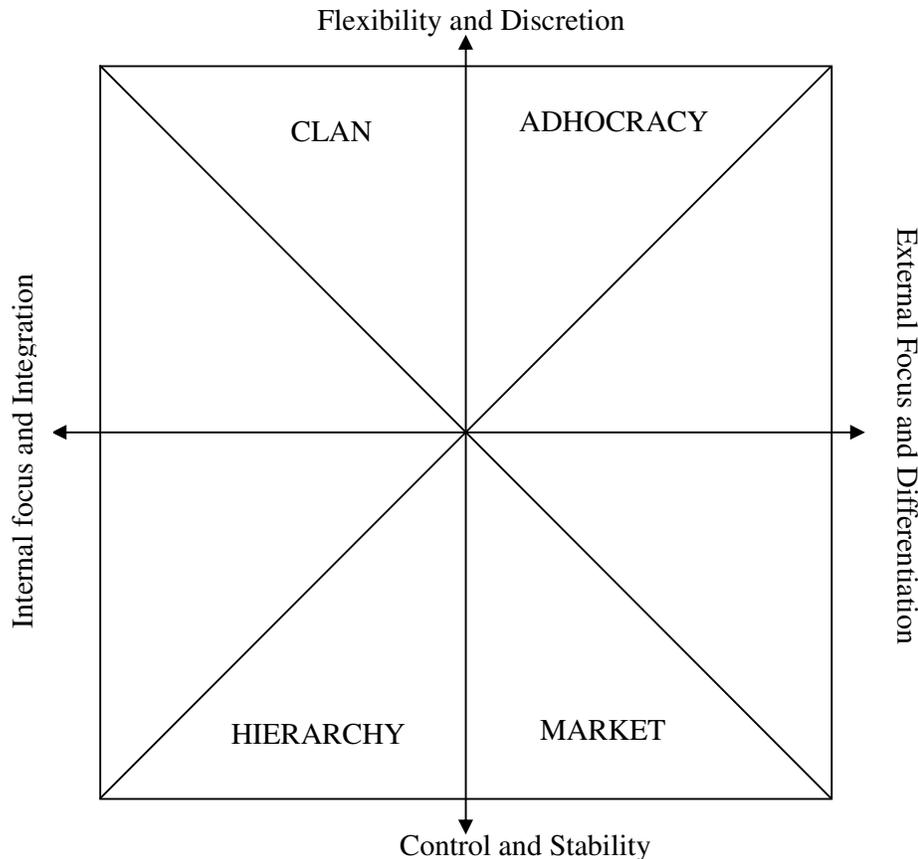
Figure 2-3 Competing Values Framework Organization Types

The four culture types are:

Hierarchy Culture

The early approach to organizing in the modern era was based on the work of Max Weber (1964). Weber suggests seven characteristics that have become known as the attributes of bureaucracy; rules, specialization, meritocracy, hierarchy, separate ownership, impersonality and accountability. These characteristics were highly effective in an environment where efficient, reliable, smooth flowing and predictable output was demanded. This form of organization leads to a stable and efficient flow of products and services. The organizational culture of this type of arrangement is characterized by a formalized and structured place to work. Procedures govern behaviour, effective leaders are good organizers and co-ordinators, and formal rules and

policies hold the organization together. Typical organizations of this type are McDonalds (Ritzer, 2000), Ford and Government Agencies.

Market Culture
As organizations faced new challenges a new form of organization evolved. This relied on a different set of assumptions. The new form was referred to as a market form. The term *market* is not synonymous with the marketing function nor with consumers in the marketplace. It refers to a type of organization that functions as a market itself. It is oriented toward the external environment instead of internal affairs. It is focused mainly on transactions with external constituencies such as suppliers, customers, contractors, licensees, unions and regulators. Unlike a hierarchy where internal control is maintained by rules, specialized jobs and centralized decisions, the market operates primarily through economic market mechanisms. The major focus of the market organization is to conduct transactions such as exchanges, sales and contracts with other constituencies to create a competitive advantage. Profitability, strength in market niches, stretch targets and secure customer bases are primary objectives of the market organization. The core values that dominate are competitiveness and productivity. These are achieved through a strong emphasis on external positioning and control. The basic assumptions in a market culture are that the external environment is not benign, but hostile; consumers are selective and interested in value for money and that the organization is interested in increasing its competitive position. The major task of management is to drive towards productivity, results and profit. Typical companies of this form are Philips and GEC. A Market Culture as assessed by the OCAI is a results oriented workplace. Leaders are hard driving producers and competitors. The glue that holds the organization together is an emphasis on winning. The long-term concerns are on competitive position and achieving goals and targets. Outpacing the competition and market leadership are important.

Clan Culture
This organizational type is so named because of its similarity to a family type organization. Shared values and goals, cohesion, participation, individuality and a sense of team-identity permeate clan type organizations. Instead of the rules and procedures of the Hierarchy, or the competitive profit centres of the Market, there is teamwork, employee involvement programmes, and company commitment to employees. Some basic assumptions of a Clan Culture are that the environment can be best managed through teamwork and employee development. Customers are best thought of as partners and the organization is in the business of developing a humane work environment. The major task of management is to empower employees and facilitate their participation, commitment and loyalty. These aspects have been advocated by writers associated with the Human Relations movement (Argyris, 1960). Companies that typify the Clan Culture are People Express Airlines and Disney. The Clan Culture as assessed by the OCAI is typified by a friendly place to work where people share a lot of themselves. Leaders are thought of as mentors or parent figures. The organization is held together by loyalty and tradition, commitment is high and the organization emphasizes the long-term benefit of individual development with high cohesion and morale being important. The organization places a premium on teamwork, participation and consensus.

Adhocracy Culture

This kind of organization emerged as the Information Age took over from the Industrial Age. This organizational type is most responsive to the turbulent and fast changing conditions that typify emerging markets in the twenty-first century. As product and service life-cycles shortened, a new set of assumptions evolved. These assumptions were that innovative and pioneering initiatives lead to success. Organizations are mainly in the business of developing new products and services and preparing for the future. The major task of management is to foster entrepreneurship, creativity and actions on the cutting edge. Emphasis was placed on creating a vision of the future, on organized anarchy and on disciplined imagination. These are the aspects that facilitate radical innovation (Quinn, 1985; Gryskiewicz, 1999; Kuratko and Hodgetts, 2001; Bessant, 2003). A major goal of an Adhocracy is to foster adaptability, flexibility and creativity in an environment where uncertainty, ambiguity and information-overload are normal. Govindarajan and Kopalle (2006) suggest that the culture best suited to dealing effectively with disruptive technology is an Adhocracy which values entrepreneurship, risk taking, flexibility, and creativity. Typical organizations of this type are epitomized by Apple in the early days. Examples can be found in some aerospace companies, for example Lockheed Skunk Works (Rich and Janos, 1994) and design consultancies, for example IDEO (Kelley and Littman, 2001). An important challenge for these organizations is to produce innovative products and services and to adapt quickly to new opportunities. Unlike Hierarchies and Markets, Adhocracies do not have centralized power or authority relationships. Power flows from individual to individual or from task to task depending on what problem is being addressed at the time. A high emphasis on individuality, risk-taking and anticipating the future exists as almost everyone in an Adhocracy becomes involved with production, customers, research and development. Adhocracies can exist as sub-units of another organization that has a different culture as a dominant type. The Adhocracy Culture, as assessed by the OCAI, is characterized by a dynamic, entrepreneurial and creative workplace where people take risks. Effective leadership is visionary, innovative and risk-oriented. The glue that holds the organization together is commitment to experimentation and innovation. The emphasis is on being at the leading edge of new knowledge, products and/or services. The organization's long-term emphasis is on rapid growth and acquiring new resources. Success means producing unique and original products and services.

The leadership and effectiveness of the OCAI culture types is shown in Table 2-2.

Table 2-2 Characteristics of Cameron and Quinn's four organizational culture types.

Culture Type	Organizational Leadership	Organizational Effectiveness
Hierarchy	Managers are good at organizing, controlling, monitoring, administering, co-ordinating and maintaining efficiency.	Efficiency, timeliness, smooth functioning and predictability.
Market	Managers are good at directing, producing results, negotiating and motivating others.	Achieving goals, outpacing the competition, increasing market share and acquiring premium levels of financial return.
Clan	Managers are parent figures, team-builders, facilitators, nurturers, mentors and supporters.	Cohesion, high levels of employee morale and satisfaction, human resource development and teamwork.
Adhocracy	Managers tend to be entrepreneurial, visionary, innovative, creative, risk-oriented and focused on the future.	New products, creative solutions to problems, cutting edge ideas and growth in new markets.

For an Adhocracy Culture the leadership characteristics accord with those considered to facilitate radical innovation (Leifer *et al*., 2000).

Mintzberg (1979) refers to an Adhocracy in his discussion about the structure of organizations. There is a strong similarity in Mintzberg's Adhocracy with the Adhocracy suggested by Cameron and Quinn. He argues that none of the structural configurations for an organization, with the exception of the Adhocracy, is capable of sophisticated innovation. He also notes that it is the most difficult structure to manage. 'Of all the structural configurations, Adhocracy shows the least reverence for the classical principles of management, especially unity of command.' (1979: 433). However, along with the ability to support innovation comes a loss of efficiency. 'No structure is better suited to solving complex, ill-structured problems than the Adhocracy. None can match it for sophisticated innovation. Or, unfortunately, for the costs of that innovation. Adhocracy is simply not an efficient structure.' (1979: 463). While it is ideally suited for the one-of-a-kind project, the Adhocracy is not competent at doing ordinary things. The Adhocracy is a custom producer, unable to standardize and so to be efficient. The root of the inefficiency is in the high cost of communication. People talk a lot in an Adhocracy. This is how they combine their knowledge to develop new ideas. This takes considerable time. A further source of inefficiency is the unbalanced workloads. A profile of each of the OCAI cultures and typical characteristics for each is shown in Figure 2-4 on the quadrants generated by the two dimensions.

Flexibility and Discretion

CLAN A very friendly place to work, where people share a lot of themselves. It is like an extended family. The leaders, or the heads of the organization, are considered to be mentors and perhaps even parent figures. The organization is held together by loyalty or tradition. Commitment is high. The organization emphasizes the long-term benefit of human resource development and attaches great importance to cohesion and morale. Success is defined in terms of sensitivity to customers and concern for people. The organization places a premium on teamwork, participation and consensus.	**ADHOCRACY** A dynamic, entrepreneurial and creative place to work. People stick their necks out and are prepared to take risks. The leaders are considered to be innovators and risk takers. The glue that holds the organization together is commitment to experimentation and innovation. The emphasis is on being at the leading edge. The organization's long-term emphasis is on growth and acquiring new resources. Success means gaining unique and new products or services. Being a product or service leader is important. The organization encourages individual initiative and freedom.
A very formalized and structured place to work. Procedures govern what people do. The leaders pride themselves on being good co-ordinators and organizers who are efficiency minded. Maintaining a smooth running organization is most critical. Formal rules and policies hold the organization together. The long-term concern is on stability and performance with efficient, smooth operations. Success is defined in terms of dependable delivery, smooth scheduling and low cost. The management of employees is concerned with secure employment and predictability. **HIERARCHY**	A results-oriented organization whose major concern is with getting the job done. People are competitive and goal oriented. The leaders are hard-drivers, producers and competitors. They are tough and demanding. The glue that holds the organization together is an emphasis on winning. Reputation and success are common concerns. The long-term focus is on competitive actions and achievement of measurable goals and targets. Success is defined in terms of market share and penetration. Competitive pricing and market leadership are important. The organizational style is hard-driving competitiveness. **MARKET**

Internal focus and Integration — External Focus and Differentiation

Control and Stability

Figure 2-4 OCAI culture profiles

Reliability and Validity

Research has shown that the OCAI is considered to be reliable (Quinn and Spreitzer, 1991; Yeung, Brockbank, and Ulrich, 1991; Zammuto and Krakower, 1991). The authors state that in every known case the reliability of the culture types has shown patterns consistent with those suggested by the authors (Cameron and Quinn, 1999). Strong evidence for concurrent validity was produced by Cameron and Freeman (1991). Evidence for convergent and discriminant validity was produced by Quinn and Spreitzer (1991) using a multitrait-multimethod analysis and a multidimensional scaling analysis. Studies by Zammuto and Krakower (1991) support the claims for validity.

The Response Scale

The OCAI uses a response scale in which individuals divide one hundred points among alternatives. This is known as an *ipsative* rating scale. The most common alternative rating scale is the *Likert* scale. The primary advantage of using the ipsative scale is that it highlights and differentiates the cultural uniqueness that actually exists in the

organization. The ipsative scale provides more differentiation than the Likert scale in the ratings. A second advantage is that respondents are forced to identify the trade-offs that actually exist in the organization. When the Likert scale is used respondents tend to rate all quadrants high or all quadrants low. Less differentiation occurs. A disadvantage is that ipsative scaling does not produce independent responses. The response to alternative A in question 1 is related to the response to alternative B in question 1. In a Likert format each response is assumed to be independent. The authors suggest using whichever method suits the research agenda.

2.5 Changing organizational culture

The methods by which organizational culture may be changed to enable an innovation-enabling environment are not clearly defined (Judge *et al.*, 1997). Three models stand as exemplars in change management literature (Mento, Jones and Dirndorfer, 2002). Kotter's model (1995) is an eight step process for transforming organizations. Kotter argues that the majority of change efforts fail and his model is constructed as a way of avoiding major errors in the change process. Two key lessons learned from his model are that the change process goes through a series of phases, each lasting a considerable amount of time, and that critical mistakes in any of the phases can have a devastating impact on the momentum of the change process. Kotter aims his model at the strategic level of the change management process. Jick (1995) proposes a tactical level model to guide implementation of major organizational change. He posits a ten-step approach which serves as a blueprint for organizations making change and as a method of evaluating progress of a change initiative that is underway. Jick argues that change implementation is both art and science. The way it is implemented is as important as the change itself. Jick suggests that change is a continuous rather than a discrete process. Garvin (2000) discusses the seven step acceleration process used within GE. This follows closely on Lewin's (1947) model of unfreezing, movement and re-freezing as the essential components of a change process. Garvin's model focuses on the leader's role in creating urgency for change, crafting and communicating the vision, leading the change, measuring progress of change along several dimensions and institutionalizing the change. This institutionalizing or re-freezing involves changes in the organizational design factors, ie, creating a fit of systems and structures to enable change. Creating a sense of urgency is supported by Akgün (2006) who suggests it as a means of facilitating unlearning, a sub process of organizational learning, in order to guard beliefs and routines against rigidity in responding to environmental turbulence.

As Bate argues (1994: 3) 'In matters of change there is rarely a clear beginning nor, for that matter, a discernible middle or end, and few people ever agree on what "really happened", or if indeed anything happened at all.' Alvesson suggests that 'cultural change calls for creativity, insight, coherence, a combination of culture-focused and more substantive material re-arrangements and considerable persistence. It also calls for luck.' (2002: 185). Morgan (1997) suggests the metaphor of chaos theory (Gleick, 1988) as one model for changing culture. Many theories about culture change describe the process as though it were independent of the kind of culture that is changing or being changed. Ouchi (1981) suggests a single strategy of moving from type A to type Z cultures. Lundberg (1985) presents a highly sophisticated view of culture change but indicates a common change process for all cultures. These represent the two approaches to organizational culture, one that it is what a company has, and the other that it is what an organization is (Smircich, 1983). Neither of these ontologically opposed approaches

takes into account the history and past culture of the organization. Schein (1992) presents one of the few departures from the concept that all cultures change in a similar fashion (Wilkins and Dyer Jr, 1988).

Changing culture is a combination of leadership and commitment, but not in a top down manner (Bate, 1994). Leadership from top managers influences discontinuous or radical innovation within the company (DeTienne and Koberg, 2002). The leadership that will create enduring culture change will engage with the members of the organization to create the culture change (Jick, 1995; Kotter, 1995; Gundling, 2000). This style of leadership is characterized by involvement with the team, supporting the innovation team, eliminating barriers, letting the team break rules on occasions, trusting and supporting the team in taking risks. Leaders cannot impose the "hows" and "whys" of building a culture. They must foster the questions and experimentation and accept the risks and uncertainty inherent in such latitude (Frohman, 1998).

Team-working is likely to play a significant role in the strategic intent to change (Tranfield, Parry, Wilson, Smith and Foster, 1999). As Leifer *et al.* (2000: 196) state, 'implementing a change process for achieving a mature radical innovation capacity demands deliberate intention, strong and sustained commitment, and courage from the firm's leadership.' Leadership that facilitates radical innovation is likely to be supportive of "bad management practices", such as tolerance of failure, encouraging experimentation and a chaotic environment (Arad, Hanson and Schneider, 1997; Thomke, 2001). Making this type of change is likely to be characterized by delays, reversals, and oscillations rather than a smooth, linear transition (Greenwood and Hinings, 1988). Recent research confirms this (Amis, Slack and Hinings, 2004).

In changing culture most writers agree that the process must at least start with top management's rethinking of its current values and deciding to be guided by other orientations (Fitzgerald, 1988). Some management literature has focused on the role of leadership in managing major corporate transformations (Beckhard, 1989; Collins, 2001). Other researchers have found envisioning skills of the executives to be critical in managing change (Carter, Giber, and Goldsmith, 2001). Tesluk *et al.* (1997) posit that the role of top management in defining a long-term vision of the organization based on concepts of creativity is one element important in changing an organization's culture. A key factor in many change efforts is the existence of a "championing" leader. Such leaders fight persistently for their ideas, are more ideological than their business-as-usual counterparts, manage by symbols and set an example of championing leadership for potential leaders in the organization (Beer and Walton, 1989). Carter *et al.* (2001) state that support from senior management is identified as a critical step in overcoming resistance to change. This form of leadership is also prevalent in organizational cultures that facilitate radical innovation. Leadership by founders in entrepreneurial firms has been found to be different to that of managers. Managers lead by using a variety of analytic tools, are conservative in their orientation and tend to follow the tenets of professional management. Entrepreneurs tend to be impulsive, highly emotional and have high needs for control. They tend to be visionaries who have the ability to create excitement and commitment among their followers. These differences in behaviour have tremendous impact on the organization members' behaviour and the culture (Dyer Jr., 2005). Any change proposed to initiate and sustain a culture for radical innovation must therefore have a strong leadership component right from the first stages of intervention.

Inertia can inhibit or slow a culture change programme. Inertia is when organizations continue to extrapolate past trends in the face of environmental change. Inertia and resistance share significant similarities as sources of friction that slow the momentums of change but at different levels of analysis. Shared resistant behaviours and attitudes contribute to organizational inertia (Wong-MingJi and Millette, 2002). This tendency for people to persist with the same approach to a problem regardless of whether that approach is productive is called the "*Einstellung effect*" and is suggested to be linked to the organizational culture (Bate, 1994). Bate argues that in changing the culture the stages include a deformation of the existing culture, then conciliation, education and adoption of the espoused culture. This is in line with the traditional unfreeze, change and refreeze model (Lewin, 1947). Lewin's model of change does not recognize that the organization's external environment at the time of "refreezing" is not necessarily the same as it was at the time of "unfreezing". Thus the model assumes a static context in which the organization operates. The model also assumes a linear conception of organization change where the first stage of the process is succeeded by another and so on (Styhre, 2002). Although there is still support for this model (Burnes, 2004), the perspective of organizational culture as dynamic and continuously evolving (Hatch, 1993) limits the applicability of a simple model based on two static positions, with a transition between them. However the notion of initiating change by creating a disruption that allows changed ways of working to be initiated and then reinforced to become "the way things are done" is still in line with Lewin's three stage model. Changes initiated at the attribute level (Schein, 1991) can be used to develop values that promote the espoused behaviour. The initial stages still require a disruption of the equilibrium – the status quo that forces a coping process that goes beyond just reinforcing assumptions. Change occurs through cognitive redefinition of key concepts, and the resulting behavioural changes become refrozen in the personalities of the individuals and in the norms and routines of the group (Schein, 1992).

Culture is slower and more difficult to change than climate, because climate is ultimately a manifestation of culture (Ekvall, 1996). The long-term success of efforts to develop organizational conditions that support creativity and innovation requires the use of strategies that are targeted at both culture and climate (Tesluk *et al.*, 1997). Small scale efforts can facilitate large changes (Goldstein, 1994) and changes in the behaviour of people in the organization can initiate and sustain culture change (Schneider, Brief and Guzzo, 1996).

2.6 Interventions to facilitate a radical innovation culture

Much literature on interventions to develop a radical innovation culture is based on examples in larger companies. There is little empirical work on smaller mature companies. Some evaluation of failure stories adds depth to the perspective of what interventions are required to move the innovation culture towards facilitating radical innovation. Advice to companies that want to be more innovative is usually in the form of developing the cultures and structures of the start-up firms. This is described as 'Just go on a diet and lose some of that excess weight, learn a few new tricks from the younger firms, and off you go' (Markides, 2004: 35) and is suggested to have a low probability of success. Developing a culture for radical innovation is a fundamental change of the way things are done and how experimentation is perceived. Change of this type is doubly difficult. Change on its own can be arduous. Niccolo Machiavelli stated in The Prince (1961: 51) that 'It should be borne in mind that there is nothing

more difficult to handle, more doubtful of success, and more dangerous to carry through than initiating changes in a state's constitution. The innovator makes enemies of all those who prospered under the old order, and only lukewarm support is forthcoming from those who would prosper under the new. Their support is lukewarm partly from fear of their adversaries, who have the existing laws on their side, and partly because men are generally incredulous, never really trusting new things unless they have tested them by experience. In consequence, whenever those who oppose the changes can do so, they attack vigorously, and the defence made by the others is only lukewarm. So both the innovator and his friends come to grief'. In addition to this, creation of the culture that facilitates radical innovation necessitates creation of some conditions that are counter-productive to incremental innovation (Ekvall, 1996; Tushman and O'Reilly III, 1996; von Stamm, 2003a). Culture serves as a social control system. For management, 'culture provides an effective way of controlling and coordinating people without elaborate and rigid formal control systems' (Tushman and O'Reilly III, 1997: 29). Organizations can develop diverse competencies both to shape and deal with radical innovation. They develop the capacity either to initiate these discontinuities or to respond rapidly (Anderson and Tushman, 1990). The following interventions that facilitate this capability were identified from the literature:

2.6.1 Resource provision

Providing adequate resources will support radical innovation. 3M has long had interventions in place to facilitate radical innovation (Gundling, 2000). Here, the "Goldilocks Principle" of not too much and not too little, is applied. There is also a balance between innovation projects with departmental targets, and long-term investments with short-term profits. The principle of having some "slack" in resources to assist experimentation and learning is also noted. Slack resources, on an ongoing basis, without significant disruptions or discontinuities promote innovation (Judge *et al.*, 1997). Delbecq and Mills (1985) argue that the process of innovation in organizations is dependent on the number of resources available to overcome or neutralize obstacles. In high innovation organizations there are separate funds for innovation, clearly mandated feasibility studies with adequate funds, and project groups to undertake the feasibility studies that are enlarged to include one or more opinion leaders other than the advocate. Access to abundant, high quality resources increases an organization's chances of coping with change (Christensen and Overdorf, 2000). Christensen (1997) states that discontinuous innovation projects that obtain funding are likely to succeed. Those that do not are less likely. He also notes that it is difficult to keep resources focused on a disruptive technology.

2.6.2 Leadership for a radical innovation culture

Top management motivates idea generation when it actively encourages the quest for new opportunities. Mechanisms include think-tanks, corporate-wide requests for proposals, technology forecasting, slack time for doodling, periodic transfer of personnel from one unit to another and technical forums geared to scientific cross-pollination (Leifer *et al.*, 2000). A common theme in making changes to facilitate radical innovation was the benefit of having top management involvement and commitment to this innovation process. Raising the profile of radical innovation and giving it equal prominence with other aspects of the business were most effectively carried out by top management involvement. 'Top management is responsible for

climate and culture' (Schneider *et al*., 1996: 18). The effect of top management on developing and sustaining a culture of radical innovation is therefore a key issue. For a mature organization this is complex, as there is a need to maintain the efficiency of the incremental improvement and interweave the disruption of the radical. 'The real test of leadership, then, is to be able to compete successfully by both increasing the alignment or fit among strategy, structure, culture and processes, while simultaneously preparing for the inevitable revolutions required by discontinuous environmental change.' (Tushman and O'Reilly III, 1996: 11). These authors cite organizations such as Hewlett Packard, Johnson & Johnson and ABB as being guided by leaders who venerate the past but are willing to change continuously to meet the future. Senior management plays a key role in leadership of radical innovation in mature companies. Encouraging experimentation, allocating resources to riskier projects and creating a vision of "what could be" help develop a radical innovation culture (Buckler and Zien, 1996). Top managers are active, not passive, in influencing discontinuous innovation within their organizations (DeTienne and Koberg, 2002). It is important to "walk the talk", otherwise there is a disconnect between the culture of the company and the culture the leaders are trying to create (Leifer *et al*., 2000). Radical innovation is borne from a maverick culture, one that is at odds with the routinized culture of process adherence. In overcoming the management resistance of such a culture, a sponsor in top management facilitates the adoption of radical innovation. This was the case in the example of the adoption of continuous aiming in gunfire at sea. Continuous aim gunfire resulted from the combination of a chance event and a prepared motivated manager. On Admiral Scott's ship, gunners were free to experiment. This trial and error led to the particular trial that Scott observed and used to develop his new gunsight. Scott's unit had a maverick culture, not one that emphasized strict hierarchical authority, but one that promoted innovation and change (Morison, 1988). Too little or too much control by management stifles innovation. A balance is necessary to promote innovation (Judge *et al*., 1997). Interventions to support radical innovation can appear to be counter-intuitive to good business practice. The contradictions inherent in the multiple types of innovation create conflict and dissent among the organizational units – between those historically profitable, large, efficient, older cash generating units and young, entrepreneurial, risky, cash absorbing units. Because the power, resources and traditions tend to be anchored in the more traditional units, these units try to ignore, trample or otherwise kill the entrepreneurial units (Tushman and O'Reilly III, 1999). Christensen suggests that top management must be prepared to distrust those managers they have previously trusted (2003). 'What is sound management practice for incremental innovation – where speed, cycle time, and quick cash recovery are primary objectives – might actually hamper the radical innovation's progress' (Rice *et al*., 1998: 52). 3M management accept risk-taking and are supportive of the Development Team (Gundling, 2000). This encourages longer-term thinking. Short-term thinking encourages incremental improvement but not radical innovation (Stringer, 2000). In developing a radical innovation culture that sits alongside an incremental one, empowered teams can be seen as an extension of the visionary leader. The leader supports and guides team members in developing their own leadership skills (Tushman and O'Reilly III, 1997). Being able to see the "art of the possible" is essential to leading radical innovation. Polaroid's difficulties in adapting to digital imaging were mainly determined by the cognitive inertia of its corporate executives (Tripsas and Gavetti, 2000).

2.6.3 Idea gathering and sharing processes

The 3M process of circulating people and ideas encourages the transfer of knowledge. This works in conjunction with the allocation of time to experiment, thus facilitating idea gathering (Gundling, 2000). External sources of knowledge facilitate the radical innovation process (Amara and Landry, 2005; von Stamm, 2004). In the case of very radical innovation involving disruptive technologies, the suggestion is to create fast, flexible and inexpensive forays into the market and the technology in order to develop ideas and gain knowledge. In this context, failure and iterative learning are therefore inherent to the search for success (Christensen, 1997). Managing innovation is about developing both the ability to scan for signals about change and a readiness to move into new areas- and let go of old ones (Tidd *et al.*, 2001). This process of going in search of new ideas facilitated the creation of a radical new product, Surlyn, at DuPont (Norling and Statz, 1998). This type of idea generation is stimulated by connecting idea generators to external sources of new knowledge (Leifer *et al.*, 2000). Radical innovation needs external input and thrives on informal networks, both internal and external to the company (O'Connor and McDermott, 2004). Volvo cars improved their radical product innovation capability by making use of external sources of innovation, new recruits, academic co-operation and the customers and supplier base (Mikaelsson, 2002). The use of external sources may be a function of national characteristics. Recent research has found that in SMEs studied to evaluate the importance of different sources of innovation, internal sources of innovation were more highly rated than external sources for both Canada and Portugal (Baranano, Bommer and Jalajas, 2005). This seems to be contradictory to other findings that promote the importance of external sources (van de Poel, 2000; Paap and Katz, 2004). Information flows most easily amongst people who have strong ties. As team members interact with the same people on a regular basis, there is little that is new to exchange as regards ideas. It is more likely that novel information and new ideas will flow from weak ties – from those who are not known as well. The people on either side of a weak tie can belong to different networks. A tie is strong when the people they both know are the same. It is a weak tie when the people they know are not known to each other. There are advantages in developing network positions that connect different technology areas (Elfing and Hulsink, 2003; Hargadon, 2003). Technology brokers take advantage of this by acting as go-betweens. Connections between people make it possible to build new communities around a new venture from the previously disparate people of different technology areas. In this respect, IDEO acts as a technology broker (Sutton and Kelley, 1997; Hargadon and Sutton, 2000).

2.6.4 Actions to encourage experimentation and learning

Learning is a key part of developing radical innovation. The creation of the radical new product, Surlyn, for DuPont was the result of learning in both market needs and technological solutions (Norling and Statz, 1998). This learning often requires a clinical appraisal of existing knowledge. In some cases this knowledge becomes the seed-corn for new knowledge. A willingness to cannibalize current product ideas in the pursuit of experimentation is suggested as a means to facilitate radical innovation (Bart, 1996; Chandy and Tellis, 1998; Cravens, Piercy and Low, 2002). This approach can also be applied to existing products in the search for radical innovation (Foster and Kaplan, 2002; Kaplan, 1999). Recent research suggests that this willingness to cannibalize is a multidimensional construct that plays an important part in predicting an

organization's propensity to radical innovation (Nijssen, Hillebrand and Vermeulen, 2005). This "nothing is sacrosanct" approach resonates with the experimentation culture necessary for radical innovation. High innovation organizations use a small pilot study conducted by early adopters (Delbecq and Mills, 1985). This approach facilitates learning and promotes radical innovation. Mosey argues that learning in cross-functional teams who can learn from external sources is necessary for a small company which wishes to facilitate radical innovation (2005). He further argues that such an approach is context-specific and cannot be applied by copying best-practice from exemplar firms. The hiring of appropriate people will facilitate the continuous experimentation required to promote the continuous challenging of the status quo and experimentation (Leonard-Barton, 1992b).

2.6.5 Team skills

Wolff (1988) suggests guidelines based on twelve outstanding breakthroughs, to facilitate radical innovation; select those people for the radical innovation projects who are most likely to be successful in breakthrough innovation, provide management backing, and do not rely on market research. Selection of appropriate team members who can think outside-the-box is considered beneficial. In 3M particular emphasis is placed on recruiting innovative people and supporting the innovation process (Gundling, 2000). 'Radical innovation will not happen without the right people. People with risk taking propensity, drive, and out-of-the-box thinking were involved in every project we followed' (Leifer *et al.*, 2001: 110). A team comprising curious entrepreneurial people who are solution finders not problem solvers is necessary for radical innovation (Simon *et al.*, 2003; Kelley, Neck, O'Connor and Paulson, 2004). Selection of team members based on psychological profiles by using Myers Briggs Type Indicators (MBTI) in order to facilitate radical innovation is suggested by Stevens and Burley (2003). Empowered teams need to be given the autonomy and resources to serve effectively. Members of the team should not be clones of the leader. The leader supports and guides team members in developing their own leadership skills (Tushman and O'Reilly III, 1997). O'Connor and McDermott (2004) found that for success in radical innovation, radical innovation team composition is different from incremental team composition both at the initiation of a project and as the project matures. Project teams were small, five to six people, who were central to the project. During periods of discontinuous innovation organizations require loose decentralized product structures, experimental cultures, strong entrepreneurial and technical competencies and relatively young and heterogeneous employees (Tushman and O'Reilly III, 1999).

2.6.6 Product champion

Product champions overview the course of a radical innovation process. In the case of continuous aim gunfire at sea, the innovation was implemented solely because a product champion, in this case the President, was willing to jeopardize his career for the principle involved (Morison, 1988). Lessons from large Fortune500 firms suggest that a strong product champion is necessary for a radical innovation process (Veryzer, 1998). "While innovation can start anywhere in a company, it can't survive without the evangelism and a lot of push from the executive suite." (Leifer *et al.*, 2000; 160). Marketing speaks for the customer. R&D speaks for the technology and managers. Top manager champions are those who integrate these voices and who speak for the future of the firm (Ettlie and Subramaniam, 2004). A complementary role to that of a

champion is suggested by Vincent (2005). He argues that "midwives" serve as translators between the language, culture and needs of the sponsor's world and the champion's world, performing the function of justifying the innovation, reducing risks and resolving conflict

2.6.7 Segregation from the routine

A commonly quoted example of radical innovation facilitation is the Lockheed Skunk Works (Rich and Janos, 1994). This approach segregates the do different group from the "do better" organization and provides higher degrees of autonomy and less control than the parent organization. This approach of keeping the discontinuous part of the development separate from the main organization is supported by Bower and Christensen (1995), who argue that this facilitates innovation when faced with disruptive technologies. Discontinuous innovation is facilitated by relatively small units that have loose decentralized product structures and experimental cultures (Tushman and O'Reilly III, 1999). Companies attempting discontinuous innovation can separate their exploratory units from the traditional exploitative ones – to facilitate different processes, structures and cultures. They can then manage this organizational separation through a tightly integrated senior team (O'Reilly III and Tushman, 2004). Organization for innovation appears to work best in the highly uncertain "fuzzy front end" of the process when it is separated from ongoing business activities (Rice *et al.*, 1998: 56). A variation on the skunk works type of segregation is the use of hubs. Hubs serve as a home base for the firm's cadre of experienced radical innovators (Leifer *et al.*, 2001; O'Connor and Rice, 2001). Hubs can help implement mechanisms for capturing radical ideas. Terry Fadem, DuPont's corporate business development director, described it as being able to grab lightning everyday (Leifer *et al.*, 2000). Boeing-Rocketdyne adopted segregation in the form of a virtual team to achieve a radical innovation success (Malhotra, Majchrzak, Carman and Lott, 2001). The use of segregation can be taken further in terms of internal venturing where discontinuous innovation opportunities are promoted to become spin-off companies. This works for larger firms (Loutfy and Belkhir, 2001; Macher and Richman, 2004), but is considered inappropriate for a small mature organization. Ambidexterity is a goal for many mature firms, retaining the "do better" capability and adding a do different competency. Ambidextrous organizations reconcile these paradoxical demands by developing internally inconsistent architectures within the company. These retain the advantages of experimentation and variability, alongside the benefits of exploitation and process control (Benner and Tushman, 2003).

2.7 Literature summary

Literature suggests that organizational culture enablers and inhibitors have an effect on the propensity of an organization to be innovative in new product development (Kanter, 1988; Ahmed, 1998; Martins and Terblanche, 2003). It indicates that mature firms often lose this propensity to be innovative, as the mechanisms that allow them to be successful become inhibitors to innovation (Leonard-Barton, 1992a; Dougherty and Heller, 1994; Leifer *et al.*, 2000; Leifer *et al.*, 2001). Empirical research has concentrated on incremental innovation or innovation in general (Leifer *et al.*, 2000; Stringer, 2000; McDermott and O'Connor, 2002). As a result there appears to be little literature on the organizational culture aspects that facilitate radical innovation. More literature focuses on innovation in larger firms (Edwards, Delbridge and Munday,

2005). It is assumed that smaller firms are more agile and therefore more innovative (Oakey *et al.*, 1988; Chandler *et al.*, 2000; Freel, 2000). This is reflected in the long-running concern with managing innovation in two different modes – what March terms "exploitation" and "exploration" (1996).

Creativity is a key component of radical innovation (von Stamm, 2003a). Developing and sustaining a climate that supports creativity will facilitate radical innovation (Ekvall, 1996). Creativity operates at group level to facilitate this type of innovation. There are important differences between the process of individual creativity and the process of organizational innovation. The individual process models something that occurs within the mind and activity of a single person or within the minds of a small number of people working together on the same specific problem. The organizational process occurs at the level of a system with a larger number of individuals working together in different units on different aspects of the very general problem of implementing a new idea. Leadership and management of the individual and group to support creativity is therefore important to facilitate the process of radical innovation (Amabile, 1988a).

Culture is the foundation on which innovation management methods, routines and idea handling systems can be built. No single culture is best for innovation and no single culture can claim a superiority of ideas (Westwood and Low, 2003). Climate is one aspect of organizational culture that is more visible than the underlying values and beliefs. Assessment tools exist for both climate and culture and some that are relevant for assessing the innovation climate culture have been examined.

Literature indicates a number of interventions that have been successful in facilitating radical innovation in firms. The interventions identified encourage a segregated area and systems that facilitate new ideas and the sharing of ideas. Experimentation and learning within the team is a visible and rewarded behaviour – part of "the way things are done" in the area responsible for radical innovation. Leadership is visible from top management and a top management sponsored champion is used to drive the projects and overcome organizational obstacles. Top management support is visible through allocation of adequate resources for the radical projects, either officially or semi-officially along with encouragement to experiment. Top management actively demonstrates that "it is acceptable to be different" when doing radical innovation projects, that failure is a normal part of the learning process and that many blind alleys have to be explored before finding the "do different" solution. These aspects of experimentation, learning and trying out ideas are key aspects of a radical innovation culture. In addition, the team composition has to be modified to include "can-do" people who bring together diverse skills and backgrounds. Taking a different approach and thinking the un-thinkable are behaviours that are rewarded, intrinsically or overtly, by the organization. Here again, top management support and encouragement is essential for ensuring the resourcing of the team with the right mix of people and encouraging this type of behaviour are key aspects to developing this type of culture.

3 Methodology
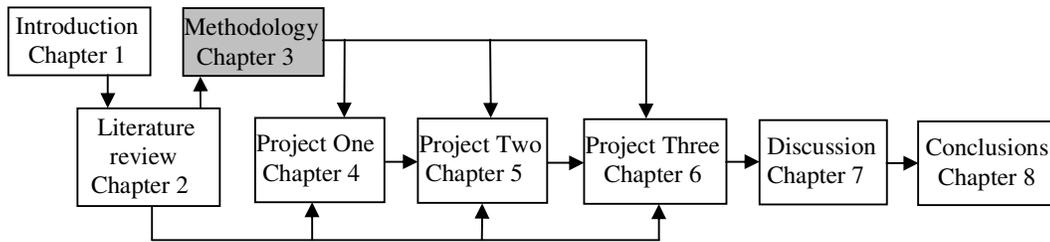
Figure 3-1 Research overview- Methodology

3.1 Researcher's philosophy

The researcher's view of social reality is a composite of elements of natural laws and mechanisms embedded in a perspective of social reality that is partly subject to laws and partly constructed by the actors. This perspective is similar to the postpositivism of Guba and Lincoln (1998: 205) in that social reality is viewed as 'being imperfectly apprehendable because of flawed human mechanisms and the fundamentally intractable nature of phenomena.' The researcher's view is an amalgam of the perception that there can be a degree of objectivity in some circumstances but that this must be viewed in an environment where the understanding of reality is also a construction of the perceptions of the actors. A tension is perceived between these two poles of perception and the researcher's view is located between them, moving towards either pole depending on the contextual situation.

According to Guba and Lincoln (1998) human behaviour cannot be understood without reference to the meanings and purposes attached by human actors to their initiatives. The authors suggest that 'Precise quantitative approaches that focus on selected subsets of variables necessarily "strip" from consideration, other variables that exist in the context that might, if allowed to exert their effects, greatly alter findings', and therefore 'their outcomes can be properly applied only in other similarly truncated or contextually stripped situations' (1998: 197). This perspective is in resonance with the researcher's view of understanding the organizational culture in Cerulean.

Interpretation of the organizational culture is essential to understanding the underlying values and basic assumptions that influence the attitude towards innovation. Therefore the constructivist or interpretivist approach to understanding the reality of the social situation in Cerulean has some appeal. The constructivist or interpretivist believes that to understand the world of meaning one must interpret it.

Schwandt (1998: 236) suggests that 'Knowledge and truth are created, not discovered by mind'. Reality is apprehendable in the form of multiple, intangible mental constructions, socially and experientially based, local and specific in nature, and dependent for their form and content on the individual person holding the construction. However this constructivist perspective is constrained by a view that some regularity, that may be transposable between organizations, exists in the organizational culture. Therefore, following this perspective, an ontology of realism may be closer to this perception of reality. Although reluctant to position a philosophical approach "positivistically" into one or another category, the researcher's philosophical approach indicated by the above perspectives is closest to that of critical realism (Bhaskar, 1978).

Bhaskar's critical realist ontology is concerned with a reality that is claimed to consist of three overlapping domains. His critical realism has three basic contentions. First, the reality to which scientific theories primarily aim to refer is the structures and mechanisms of the world, rather than empirical events. Structures are defined as sets of internally related objects and mechanisms as ways of acting. Objects are internally linked in a structure in the sense that their identity depends on their relationship with the other components of the structure. Second, the underlying structures and mechanisms are only contingently related to observable empirical events. Third, although scientific knowledge of reality, especially social reality, is never infallible, it is still possible to acquire such knowledge through the creative construction and critical testing of theories. The combined effects of structures and mechanisms may generate observable events. The absence of an observable event does not necessarily mean that the underlying mechanisms do not exist. They may just counterbalance one another (Tsang and Kwan, 1999).

This multi-level ontological perspective acknowledges the existence of the real domain or the mechanisms that produce observable events in the empirical world. The concept of natural regularities is embedded in a broad perspective that social reality is to some extent, but not completely, determined by the actors. The social constructionist perspective is rejected as the existence of the regularities is precluded from this ontology. The pure interpretivist view is considered to be inappropriate because it does not allow researchers to add their own theories through social mechanisms and causal tendencies. In the same manner, positivism is precluded due to the perception of a constructed reality in certain circumstances; 'management actions are not always observable in an objective way, and because social processes are rarely reducible to absolute laws' (Partington, 2000: 98). This is the dichotomy between positivism and phenomenology (Easterby-Smith, Thorpe, and Lowe, 2002). The researcher's philosophical perspective is therefore closest to critical realism.

The epistemology flowing from this ontological perspective is based on the building of models of mechanisms such that, if they exist and act in the postulated way, would account for the phenomena being examined (Blaikie, 2000). These models include hypothetical descriptions that reveal the underlying mechanisms. The mechanisms can only be known by constructing ideas about them. Unlike positivism, which advocates conjunction of events, the epistemology of critical realism is one of laws expressing tendencies of things. This epistemology is suggested by Blaikie to indicate a retroductive strategy in research. This strategy commences with an observed regularity that requires an explanation and is followed by producing an explanation for the regularity. Explanation is achieved by identifying the generative mechanisms that produced the regularity (Blaikie, 2000).

The retroductive research strategy attempts to discover appropriate structures and mechanisms in order to explain observable phenomena. The use of a model developed from existing sources will facilitate causal explanation of the observed phenomena since these structures and mechanisms will typically be unavailable to observation. This is tested by developing further consequences of the model that can be stated in a manner open to empirical testing. Suitable instruments may be of use in confirming the validity of the model. The retroductive strategy attempts to explain by means of mechanisms which have already been established (Blaikie, 2000). This strategy seeks to provide explanation, offer ways to change, and evaluate and assess impacts of this change. As the research issue is focused on understanding the aspects of organizational culture and

suggesting mechanisms to change the culture, this strategy is considered to be appropriate for the research.

3.2 Conceptual framework

A useful framework for understanding innovation culture is Schein's model of organizational culture (1984). Schein suggests that culture is what a group learns over a period of time as the group solves its problems of survival. He argues that culture is a pattern of underlying assumptions that have been evolved, discovered or developed by a given group as it learns to cope with its problems of external adaptation and internal integration. Schein (1992) suggests organizational culture exists at three levels, artefacts, values and underlying assumptions. Schein's model for organizational culture is shown in Figure 3-2.

Artefacts and Creations
- Technology
- Art
- Visible & Audible Behaviour Patterns

Visible but often not decipherable

Values
- Strategies
- Goals
- Philosophies (espoused justifications)

Greater level of awareness

Underlying Assumptions
- Relationship to environment
- Nature of Reality, Space and Time
- Nature of Human Nature
- Nature of Human Activity
- Nature of Human Relationships

-Taken for granted
-Invisible
-Preconscious

Figure 3-2 Schein's model of organizational culture

Artefacts are the visible organizational structures and processes. They include written and spoken language, the physical space and layout of the organization and the overt behaviour of the individuals. Schein divides these into three levels. The first is concerned with the physical artefacts like company logos. The second level is

concerned with behaviour including organizational rituals. The third level is concerned with organizational anecdotes, stories and myths, and organizational heroes and villains. *Values* are the social principles, goals and standards held within the culture to have intrinsic worth. They define what the members of the organization care about. They are unwritten rules that allow members of a culture to know what is expected of them. The organizational culture reflects the values of its employees. By using these values the members are able to make decisions in order to tackle problems, issues and to develop solutions. *Underlying Assumptions* are at the most invisible level of the model. These assumptions are taken for granted beliefs and habits of perception, thought and feeling. They are rarely made explicit. When a solution to a problem works repeatedly it becomes taken for granted. These assumptions become learned responses that guide behaviour and determine how members think, act and feel.

A second complimentary framework is that of archetypes (Greenwood and Hinings, 1993). An archetype is defined in terms of two general statements. First, organizational structures and management systems are best understood by analysis of overall patterns rather than by analysis of narrowly drawn sets of organizational properties. This is the holistic perspective. Second, patterns are a function of the ideas, beliefs and values – the components of an "interpretative scheme" – that underpin and are embodied in organizational structures and systems. An archetype is thus a set of structures and systems that reflects a single interpretative scheme. Defining an archetype in this way is a departure from the more common treatment of structures and systems as disembodied attributes of organizations in an adaptive way to context and performance. Structures and systems are not neutral instruments but embody wittingly or otherwise intentions, aspirations and purposes.

The concept of an archetype implies some form of classification. The idea of coherence between elements of organizational arrangements is central to typologizing. This classification of organizations is made according to differences and similarities in overall patterns. Organizations will develop structures and systems consistent with a single interpretative scheme. Using the concept of "momentum" (Miller and Friesen, 1984) organizations can be considered as evolving toward archetypal coherence because for any firm it is better to be one thing consistently than to be a combination of ill fitting parts. In effect they recognize the economic benefits that flow from coherence. Organizations evolve towards archetypal coherence as advantaged groups seek consolidation of political position and control over the distribution of resources.

The term culture is often used to refer to both values and beliefs expressed through structures and systems and the degree to which actors accept and act in accordance with those values and beliefs. In contrast Greenwood and Hinings (1993) posit that the pattern of commitments to one or more interpretative schemes is a potential dynamic for change. For example the organization's prevailing interpretative scheme (the one embodied in structures and schemes) need not be supported by any actors in the organization. At some point in the organization's history it may have been supported but over time this commitment has waned. However the structures and systems have remained unchanged because of the organization's tendency towards known inertia. Such a situation is amenable to change. The interpretative scheme posited by Greenwood and Hinings is of archetypes that reflect the holistic view.

The development of archetypes, based in organizational design, represents a central thrust of organizational theory, which is the need to understand organizational diversity through typologies (Weber, 1964; Ouchi, 1981). Greenwood and Hinings advocate the

typologizing of organizations be 'made according to differences and similarities in overall patterns' (1993: 1054). Organizational culture emerges from the organization and in this respect is a manifestation of organizational design.

To position innovation in the context of archetypes it is necessary to define the researcher's perspective of incremental and radical innovation. Innovation can be considered as two types: incremental – "do better" and radical – "do differently" (Bessant, 2003). Either type can be conceived as an ideal state at opposite ends of a continuum (Hage, 1980). Along the continuum an innovation may exhibit some degree of both types. At one end is incremental innovation, in which effort is focused on trying to "do better, yet more of the same", at the other end is radical innovation in which ideas that are new to the company or new to the industry are actively being considered. Essentially this is a degree of resonance with McFadzean's (2000) notions of paradigm preserving to paradigm breaking activities happing in this context. For incremental innovation much is known about the management of the process, the innovation process is routine and systematic and can be modelled relatively simply. For radical innovation less is known about its management, the process is ill-defined and modelling it is more complex. This is represented as in Figure 3-3.
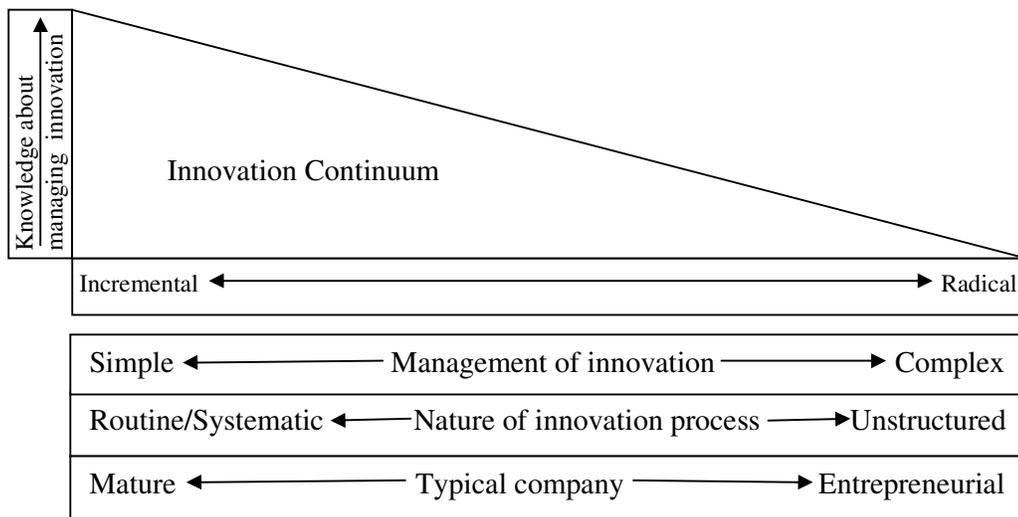
Figure 3-3 Innovation continuum

The archetypes proposed reflect the "ideal" positions at the ends of this continuum. Different kinds of innovation require different kinds of organizational hardware – structures, systems and rewards and different kinds of software – human resources, networks and culture. During periods of incremental change organizations can rely on units with relatively formalized roles and responsibilities, centralized procedures, functional structures, efficiency-oriented cultures, strong manufacturing and sales capabilities and relatively homogeneous, older and experienced human resources. These units are characterized by a high degree of inertia, emphasizing efficiency, teamwork and continuous improvement. During periods of discontinuous innovation, organizations may require entrepreneurial "skunkworks" type of units. These units are relatively small, have loose decentralized product structures, experimental cultures,

strong entrepreneurial and technical competencies and relatively young and heterogeneous employees. They build new experience bases and knowledge systems (Tushman and O'Reilly III, 1999). Incremental innovation usually emphasizes cost or feature improvements in existing products or services largely depend on *exploitation* competencies. In contrast radical innovation concerns the development of new business or product lines, based on new ideas or technologies or substantial cost reductions that transform the economics of a business and require *exploration* competencies (Leifer *et al*., 2000). Table 3-1 summarizes some of the basic differences between incremental and radical innovation.

Table 3-1 Characteristics of incremental and radical innovation

Type I Incremental		Type II Radical
• Formalized • Centralized • Systematic	**Procedures** ↔ (Tushman and O'Reilly III, 1999)	• Contingent • Decentralized • Loosely structured
• Functional • Efficiency oriented	**Structure** ↔ (Tushman and O'Reilly III, 1997)	• Facilitating knowledge gathering • Supporting risk taking and experimentation
• Homogeneous • Older and Experienced	**People** ↔ (Tushman and O'Reilly III, 1999)	• Heterogeneous • Younger and Entrepreneurial • Technical • Questioning
• Mature • High Inertia • Focus on efficiency • Focus on team-working • Continuous Improvement	**Aspects of the organization** ↔ (O'Reilly III and Tushman, 2004)	• Entrepreneurial • Focus on discovery • Individual co-operation • Frame-breaking improvement
• Cost reduction • Feature addition • Efficiency improvement	**Focus** ↔ (Tushman and O'Reilly III, 1997)	• New methods and technologies • Experimentation • New ideas • Creation
• Mostly existing	**Products / Technologies** ↔ (Veryzer, 1998)	• Mostly new
• Exploitation	**Management** ↔ (Benner and Tushman, 2003)	Exploration

3.3 Research methodology

This research is insider action research (Coghlan and Brannick, 2001), and a single case study that investigates a contemporary phenomenon within its real-life context (Yin, 2003). Action research has traditionally been defined as an approach to research that is based on collaborative problem solving between researcher and practitioner. It aims at both solving a problem and generating new knowledge. It has developed largely from the work of Kurt Lewin (1946) and his associates and involves a cyclical process of diagnosing a change situation or a problem, planning, gathering data, taking action, and then fact finding about the results of that action in order to plan and take further action (Foster, 1972; Peters and Robinson, 1984; Argyris, Putnam, and McLain Smith, 1985; Schein, 1987; Elden and Chisholm, 1993; Eden and Huxham, 1996; Greenwood and Levin, 1998; Gummesson, 2000). The nature of this research is involving and working with Cerulean employees and the unit of analysis is the Cerulean Development Team. The research falls into three parts corresponding to Projects One, Two and Three. The first part was to establish the aspects of organizational culture acting to enable or inhibit radical innovation in the Cerulean organization. The second was to assess the presence and intensity of the innovation culture. The third was to develop a suitable set of interventions that would be applicable to Cerulean in the form of a strategic action plan, based on empirical examples of interventions designed to develop a radical innovation culture. The methodology adopted for each project is described below.

3.4 Project One methodology

A grounded approach was used in Project One in order to surface the perceptions of the members of the organization (Glaser and Strauss, 1967; Partington, 2002). Wilkins and Dyer Jnr argue that they 'cannot imagine how any instrument designed by researchers prior to their encounter with a culture can capture the particular frames [of culture] and apprehend change' (1988: 530). This perspective supports a grounded approach to surfacing the organizational culture aspects prior to attempting to gauge the culture. The method of surfacing the organizational culture aspects was to use an issue (Sackmann, 1991) to focus the members' attention on a specific action or event. This enables both the surfacing of the tacit components of culture and comparisons across individuals and research settings. Given the ubiquitous nature of culture, organizational members cannot immediately reflect on their culture and describe it. A key concern in eliciting tacit aspects of culture is to provide a stimulus to respondents so that they are forced to make an interpretation that is based on their cultural framework rather than on the researcher. The stimulus should provide a specific context but leave enough latitude for interpretation. Faced with ambiguity people tend to draw on pre-existing categories already available to them for sense making. The tacit components of culture become apparent in the specific interpretations attributed by the respondents. In addition, an issue focus enables comparisons because it introduces a specific context that forces respondents to draw on their existing knowledge. It channels the attention of the respondents to the same cultural aspects within a given organization and reveals the perceptual framework they are using to conceptualize the issue.

   Interviews that tended towards an unstructured form were used to explore the issues. The use of this type of interview is supported by Fontana and Frey (1998) who describe unstructured interviewing as going hand in hand with participant observation, as many

of the data gathered in participant observation come from informal interviewing in the field. Unstructured interviewing aims to understand the complex behaviour of members without imposing any *a priori* categorization that may limit the field of enquiry, in contrast to structured interviewing which aims to capture precise data of a codeable nature, in order to explain behaviour within pre-established categories. Narration by the Development Team members of their experience with products that had aspects of radical innovation was used to produce transcriptions that were analysed using content analysis using NVivo. The codes derived, representing aspects of innovation culture influencing radical innovation, were checked by feeding back to each narrator to facilitate development and understanding. These were conflated into a single list of codes and this was also validated with the Development Team during workshop reviews. These workshops involved Development Team members who had participated in the interviews, and promoted discussion and reflection on the results of the codification of the transcripts. This participative process of review and refinement enabled the team members to negotiate their view of the issue. This facilitated the understanding and interpretation of the aspects of organizational culture influencing the radical innovation, and also promoted participation in the research process. A model of "ideal" innovation culture archetypes based on Greenwood and Hinings (1993) was developed in this participative manner during the workshops. In this workshop activity, members of the organization participated in the experiential learning cycle (Coghlan and Brannick, 2001) with the diagnosis becoming a collaborative activity (Coghlan, 2001) of action research. Action research implies a team of practitioners who cycle through a spiral of steps including planning, action, reflecting or evaluating the results of actions, and taking further action, continually monitoring the activity of each step in order to adjust as needed (Dickens and Watkins, 1999). De Guerre (2002: 337) argues that 'the local existing, often tacit knowledge of the insiders needs to be understood by the researcher, who can make it visible to the researched, and, finally it gets reframed in some new way through a dialogue with social science'. In contrast to a programme of development, action research unfolds in a conversation over time, and it is this emergent aspect that makes some people feel uncomfortable, by making the management of this process difficult or impossible.

The issue of validity of action research is subject to discussion in literature. Ottoson (2003) argues that it has strong scientific support in modern science from quantum physics and complexity theory. It many ways this contradicts the classical (Newtonian) view of how "good" science should be performed. Traditional research demands that researchers should not be involved in the studied object in a way that could affect their objectivity. However, the quantum paradigm suggests that true objectivity does not exist, only relative objectivity, and the subjectivity of each individual. This resonates with the researcher's ontological perspective of critical realism (Bhaskar, 1978). The object of action research is a total social system with people in different situations with their own individual feelings, thoughts and perspectives. Thus, in action research, the researcher takes part in a complex psycho-dynamic and cultural process that applies to the quantum holistic thinking and not the classical Newtonian thinking.

The fluid nature of action research requires that emphasis be placed on achieving rigour in the research. The opportunity for triangulation was taken where possible. Action research provides an opportunity to seek out triangulation between (i) observation of events and social processes, (ii) the accounts each participant offers, and (iii) the changes in these accounts and interpretation of events as time passes (Eden and

Huxham, 1996). In terms of providing knowledge outside the members of the organization, the research must at least achieve a situation in which it is *recoverable* by interested outsiders. To do this it is essential to consider the epistemology of the researcher and so define what counts as acquired knowledge (Checkland and Holwell, 1998).

Rigour in this research was demonstrated by following the guidelines suggested by Coghlan (2002). He argues that practitioners must demonstrate; (a) how they engaged in the steps of multiple and repetitious action research cycles and how these were recorded to reflect a true representation of what took place, (b) how they challenged and tested their own assumptions and interpretations of what was happening continuously through their research, (c) how they accessed different views of what took place which produced both confirming and contradictory interpretations and (d) how they grounded their interpretations and diagnoses in solid theory rigorously applied, and how the research outcomes were challenged, supported or dis-confirmed by the theories underpinning these interpretations and diagnoses. He further argues that quality can be demonstrated in terms of degree of collaboration, degree of reflexive concern for a practical outcome, degree to which the work includes differing ways of knowing (Reason, 1999) and degree to which the research led to change and could be considered as "significant".

The researcher kept a journal of significant events and observations. This journal is used as suggested by Coghlan and Brannick (2001) to record thoughts and reflections on observed events, to record comments made and to provide a timeline for the events that occur during the duration of the research. This provided an opportunity to record observations from the Development Team and others about events and actions that were relevant to the research. The use of a journal facilitated triangulation of observations on aspects of organizational culture.

3.5 Project Two methodology

Project Two gauged the presence and intensity of the innovation culture in the Cerulean Development Team. In order to reflect both the deeper level values and the more visible artefacts of the innovation culture a combination of culture and climate assessments were considered to be more suitable than a single instrument. Assessment tools for both climate and culture were evaluated from literature. The evaluation was restricted to widely used instruments that had been validated and were suitable for use with the Development Team. Specific instruments for gauging organizational culture and climate were considered. The objective for this project was to have an assessment of the presence and intensity of the innovation culture in Cerulean in order to begin developing a plan of interventions suitable for moving the culture from the extant position to the desired position. Using Schein's model as a template, a model of innovation culture embedded in the organizational culture of the organization is proposed. The top level of artefacts is represented as the creative climate in this model. The model is shown in Figure 3-4.
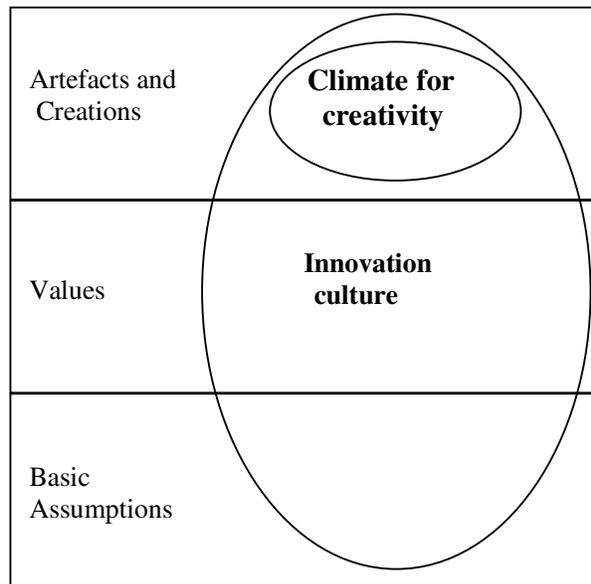
Figure 3-4 Model of innovation culture based on Schein's model

Assessment tools were evaluated with a view to combining a culture and a climate assessment into a composite instrument. This assessment provided an overview of the organization culture and aspects of the creative climate. In the model proposed in Figure 3-4, innovation culture is a sub-set of organizational culture. To assess this innovation culture more specifically, workshops were used to discuss and review the climate and culture assessment results. This led to the participative development of an assessment tool based on the model of innovation culture archetypes developed in Project One. The Development Team self-assessed their team's position, measured against the ideal position of a radical innovation culture.

3.6 Project Three methodology

Project Three took the output from Project Two as a starting point to allow participative development of interventions suitable to develop a radical innovation culture. Workshops were held with the Development Team members to discuss the assessment results. The discussions developed a series of suggested interventions for developing an innovation culture more supportive of radical innovation. An evaluation of empirical examples of interventions to facilitate radical innovation in new product development teams was made using sources outside the company. A review of literature, searching for radical innovation and intervention-specific terms yielded a number of interventions. Evaluation of empirical examples, both from case examples and from other companies, yielded a number of interventions that had been applied in other organizations. These interventions were related to the interventions suggested by the Development Team based on the output from the assessments in Project Two. This allowed the development of a planned series of inter-linked interventions suitable to move the Development Team innovation culture to be more supportive of radical innovation.

3.7 The researcher as a practitioner

One issue that dominated the research was that the researcher was also a practitioner in the company. The influence of this was recognized and care was taken by the researcher at each stage of the process to avoid personal perceptions and viewpoints distorting gathering and interpretation of the data. In some cases the influence of the researcher as a senior manager in the organization may have been significant enough to cause distortion of data gathered by the researcher. The question of team members divulging information that may be perceived as "detrimental" to their position in the company was also an issue. This was an insider action research inquiry and therefore the researcher was a part of the organization that was undergoing the reflection and change that is part of action research. To reduce bias associated with the researcher being a practitioner, care was taken to build confidence with the Development Team so that they could speak openly about their thoughts. The researcher's perceived style has been described by recent recruits to the Development Team as "open" and this style facilitated building a confidence in the team about speaking openly. Care was also taken by the researcher not to appear to be detached and acting as a third party observer. By accepting that the researcher was a senior manager, but also attempting to participatively uncover aspects of innovation culture in the team, the team members were more likely to accept the presence of the manager as a researcher and be forthcoming in providing rich data about their perceptions. This openness and transparency of purpose was discussed with the team members from the initial stages of the research. This participation as both practitioner and researcher allows uncovering of the deeper aspects that may be missed by an outside observer.

To compensate for the possible bias of the researcher as a practitioner, three alternative perspectives of the research were developed. Firstly, a journal was kept by the researcher to provide a record of observations and reflections about the research. Secondly, observations by Cerulean employees outside the Development Team were sought in order to provide validation of the data developed with the Development Team as part of the participative process. Thirdly, the research was presented to other research groups for critical discussion and evaluation. These included internal Cranfield presentations, conference doctoral track presentations and conference presentations. This opened up the research to external academic evaluation.

4 Project One
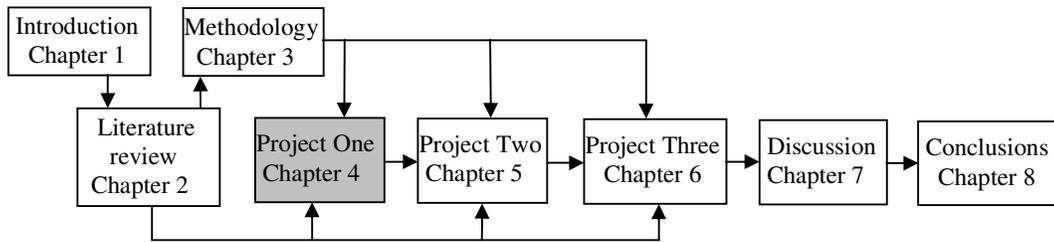
Figure 4-1 Research overview – Project One

4.1 Introduction to Project One

Uncovering aspects of innovation culture that influenced radical innovation in the Development Team was the focus for the first stage of the research. A participative approach was adopted in order to work with the Cerulean Development Team to surface these aspects. Two previous instances of a product introduction that included a radical technological aspect were proposed as examples around which the team members could narrate their experiences. These two product introductions, one an example of a comparatively successful implementation of radical innovation and the other an example of less successful implementation of radical innovation acted as a mechanism for the employees to tell a story of their view of what happened and why it happened. For this research, radical innovation is considered as the use of a technology that is new to the company and new to the industry (Walsh, Kirchoff and Newbert, 2002; Hill and Rothaermel, 2003). The plan for Project One is outlined in Figure 4-2.
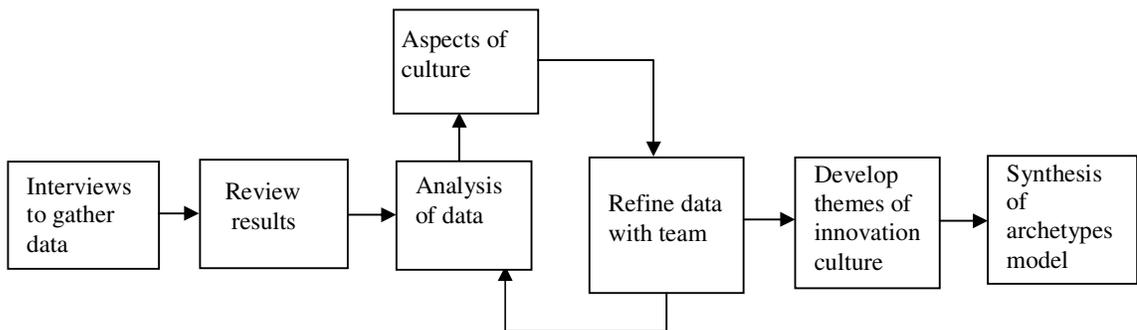
Figure 4-2 Project One plan

The context of Project One in the overall research is shown in Appendix B.

The members of the Development Team are shown in Table 4-1.

Table 4-1 Cerulean Development Team members involved in the research

Development Team member	Age @ July 2005	Month/ Year started	Length of employment at July 2005	Comment
Development Manager	58	12/1973	31	
Project Manager	45	07/2002	1 year 9 months	Left company in March 2004
Design Engineer	58	09/1969	36 years 3 months	Retired from company in December 2004
Software Engineer	37	01/2001	4 years	
Software Engineer	41	05/1999	6 years	
Mechanical Engineer	44	03/1988	17 years	
Conformance Engineer	31	06/1996	8 years 2 months	Left company in August 2004
Design Engineer	50	04/1982	23 years	
Software Engineer	37	09/1985	19 years	
Design Engineer	56	08/1992	12 years	
Design Engineer	33	08/1999	5 years	
Technical Author	42	06/1999	4+6 years	(with 1 year break)
Software Engineer	47	09/1987	17 years	
Design Engineer	53	09/1969	35 years	
Software Engineer	27	11/2003	1 year	
Electronics Engineer	55	01/2004	1 year	
Electronics Engineer	38	01/2004	1 year	
Technical Director	38	05/1988	16 years 5 months	Technical Director from March 2004 until he left company in October 2004.
Technical Director	45	10/2004	10 months	

4.2 Surfacing aspects of innovation culture

In order to avoid contaminating the data with the researcher's perceptions and to provide a focus for the team members to describe their thoughts, an issue focus was used to surface the innovation culture aspects that influenced the radical innovations selected. The objective was to take a good, and a less successful, example of products containing a radical innovation experienced by the Development Team and allow team members to talk about their experience of the innovation. The selection of the examples of radical innovations was made by the Development Team. Their choice was of a product sampling probe from MC^2 as the example of a better product innovation and the ASM500 vision system as an example of a less successful product innovation. These products contained features that could be considered as radical innovation, ie, new to the company, new to the industry (Hill and Rothaermel, 2003) and as a clear departure from what had gone before (Delbecq and Mills, 1985; Dewar and Dutton, 1986).

The ASM500 is an automated machine that gathers particulate and vapour phase matter from differing smoking regimes for laboratory analysis. This leads to a determination of the tar, nicotine and CO (carbon monoxide) present in the smoke from the cigarette. It is this information that appears on cigarette packets in some countries. MC^2 is an instrument that sits alongside a cigarette making line and automatically samples product from the mass flow. It produces twenty-four measurements on the internal and external characteristics of each product sampled.

Twenty six interviews were carried out. Each was recorded and transcribed. Each of the interview transcripts was analyzed using NVivo and coded to elicit aspects of organizational culture that influenced radical product innovation. Table 4-2 shows the total number of interviewees, time spent interviewing and number of pages of transcription resulting from all the interviews.

Table 4-2 Interviews

Number of interviewees	Number of interviews	Duration of interviews (Hours)	Number of pages of transcription
14	26	20	325

The list of aspects of organizational culture influencing radical innovation identified using NVivo codification from the interview transcripts is shown in Table 4-3.

Table 4-3 Aspects of organizational culture influencing radical innovation

Code No.	Aspects of organizational culture	Development Team description of aspect
1.	Acceptance of failure	Accepting that failure is part of the development process of a radical innovation.
2.	Allow adequate time	Providing sufficient time to carry out the development tasks.
3.	Autocratic management	Dictatorial style in managing people. Issuing instructions. Command and control approach to dealing with people.
4.	Autonomy to make decisions	The ability and scope to take decisions without referring upwards to management.
5.	Belief in the product's worth	Having confidence in the value and worth of the product. Believing that the product is a suitable Cerulean offering. Having belief in the need to develop the product. Accepting that the product has a place in the Cerulean product offering.
6.	Bureaucratic management	Management style characterized by adherence to rules and regulations. Management that is unwilling to bend the rules, or show flexibility.
7.	Changing objectives	Moving the goalposts during the project. Changing the desired outcomes, the specification during the course of the project.
8.	Clear objectives	Unambiguous outcomes desired from the project.
9.	Common objective	Everyone on the team and in management having the same goal or desired outcome for the project. Having the same understanding of the products desired performance capability.
10.	Conflict in top team	Visible fighting and disharmony amongst the managers who are directing the company. Some members of the top team taking a differing approach to others in the top team. Verbally negating comments made by others in the top team. Verbal attacks on members of the top team by others in the top team.
11.	Creative skills in the group	Members of the Development Team having creative skills.
12.	Customer involvement	Having input from the customer to the product development and having the customer influence the design of the product.
13.	Desire for a "safe" solution	Wanting to produce a solution that is known to be acceptable to all concerned. Using accepted methods and technologies to achieve the product development.

Table 4-3 Aspects of organizational culture influencing radical innovation

Code No.	Aspects of organizational culture	Development Team description of aspect
14.	Desire to grow and develop	The wish of the members of the Development Team to be able to expand their skills, abilities and knowledge. To learn of new systems, technologies and experience different methods of use in product development.
15.	Desire to push the boundaries	Development Team wish to push the capability of the Development area into new arenas, new technologies, into gaining new knowledge. Wanting to learn more about known technologies and to discover new technologies. Wanting to go beyond that which exists currently.
16.	Discrete team identity	Feeling amongst the Development Team that their team is separate and detached from the rest of the company.
17.	Environment for creativity	A location and atmosphere that enhances or facilitates creativity. Quiet uninterrupted time in which to be creative.
18.	Experience of technology	Having Development personnel with knowledge of technologies that may be of use in the product development. A broad skills base within the Development Team.
19.	External technologies	Looking outside the company at what technologies are available and being aware of their possible application in product development. Keeping abreast of external developments that may influence or assist product development
20.	Fear of failure	Concern at an attempted solution or experiment not providing a successful outcome. Frightened about a negative outcome to an attempted activity, project, experiment. Worrying about the negative effect of an unsuccessful outcome to a task.
21.	Feedback to team from management	Management taking an interest in the development project, commenting on the team's progress, providing guidance as the next stages develop. Feeling that management has listened to proposals and then have responded with a thought through reaction. Management listen and question the team, take an interest in what is happening and offer suggestions to the team. There is a dialogue between management and the Development Team.
22.	Front-end opportunity to be radical	The ability to be radical at the early stages of a project.
23.	Homogeneous team	A team with all members having the same views and same opinions about problem resolution.

Table 4-3 Aspects of organizational culture influencing radical innovation

Code No.	Aspects of organizational culture	Development Team description of aspect
24.	Identification with the company	The feeling the employees have about the company. How they identify with the company, its objectives, goals and way of working.
25.	Inter-dependency of teams	Appreciation of other teams within the company, their objectives, their constraints, their limitations. How these teams work together for the good of the company.
26.	Learning from failure	Ability to learn from mistakes. To build knowledge based on experimentation. To learn through trial and error. Accepting that each failure leads to a learning experience.
27.	Management confidence in team	Management trust the Development Team. They understand the constraints and limitations the team operate within and appreciate what is possible or feasible in terms of product development.
28.	Past successes	Because the company has been successful in the past with product development, there is a belief or an expectation that it will be successful on the current development project.
29.	Project champion	A senior level person who is committed to the project and lends support when necessary to ensure continuity of the development process.
30.	Provide adequate resources	Make sufficient resources available to the Development Team, ie, labour, cash, equipment.
31.	Recognizing the skills of team members	Appreciating the contribution and ability of each Development Team member. Understanding their skills, contribution and input and displaying awareness of these.
32.	Respecting individuals	Treating Development Team members with respect. Displaying appropriate courtesy to each team member and recognizing their contribution to the Development Team.
33.	Self-confidence of team members	Each team member feels a sense of security and awareness of their own worth to the Development Team.
34.	Speaking openly	Team members speak out with their views, present their own opinions and argue their case in an open and non-adversarial manner. Team members can openly criticise management decisions and Development Team opinions and in turn present their perspective in an open and participative way.
35.	Team commitment	A shared objective within the team, held by all team members. The feeling from each team member that they are willing to support the team in its objectives.

Table 4-3 Aspects of organizational culture influencing radical innovation

Code No.	Aspects of organizational culture	Development Team description of aspect
36.	Team confidence in management	The team feel that management knows what it is doing and has a clear considered objective. The team feel that management understands the Development Team objectives, the complexity of product development and the obstacles to be overcome during the development process.
37.	Trusting the team	The perception that the Development Team is trusted to undertake the development process. The feeling that the Development Team can be left alone to achieve the development objective.
38.	Using external Development	The use of an external service for product development. This is not just access to the technology, but also includes part of the development process.
39.	Apathy to target achievement	Lack of concern about not achieving targets due to perceiving no detriment to not achieving the target.
40.	Autonomy v Set objectives	A tension between open discussion and having autonomy to define direction, and providing clear, unambiguous objectives to the team.
41.	Customer conservatism	The desire of the customer to retain what is known and "safe" in an instrument solution. Degree of comfort with change.
42.	Degree of comfort with change	Reluctance or discomfort in the team in responding to conditions of change.
43.	Desire for an easy solution	Desire to have a solution that is easy to bring about.
44.	Desire to explore what is possible	Desire to evaluate the art of what is possible or what is feasible with new technologies or methods.
45.	Desire to try new technology	Willingness to spend time and resources evaluating potential technologies which may or may not lead to possible solutions to product problems. Willingness to accept the use of time and resources in evaluating these alternatives.
46.	Encouragement to be radical	Management encouragement for the Development Team to be radical in their approach to problem solving.
47.	Holding information back	Keeping back selected pieces of information or knowledge that may be useful to the recipient. Being frugal in providing assistance in resolving problems. Tending to provide just enough help to resolve the immediate issue and not enough to provide a better understanding of the problem drivers and solutions.
48.	Ideas from top management	The view that new product ideas and specifications should be provided by top management, rather than from the Development Team.

Table 4-3 Aspects of organizational culture influencing radical innovation

Code No.	Aspects of organizational culture	Development Team description of aspect
49.	Maintaining power	Retaining, maintaining and strengthening the individual's position, status, or position within the development group. This leads to withholding information or ideas to prevent others from gaining knowledge and thus jeopardizing the position of the individual.
50.	Opportunity for experimentation	Opportunity to experiment with new ideas or technologies or seek out new technologies or concepts.
51.	Peer perception	How members of the Development Team perceive each other. The degree of respect and credibility an individual has from the rest of the Development Team.
52.	Problem led solution	Using the problem to determine which technologies should be used to achieve a solution, instead of evaluating potential technologies and adapting these to resolve possible problems. ie, Problem led instead of Technology led.
53.	Short v Long-term focus	The tension between taking a short-term, immediate perspective as opposed to a longer-term, future, perspective.
54.	Team delivery of radical solution	Radical solutions coming from a team effort as opposed to an individual's effort.
55.	Technology led solution	Evaluating available technologies in order to determine which problems may be resolvable using those technologies, instead of using the available technology to resolve encountered problems. ie, Technology led instead of Problem led.
56.	Tension between safe and new	The conflict between going for the safe, tried and trusted solution, and the new, untried solution.
57.	Trigger for new ideas	The triggers that generate new ideas in the Development Team.
58.	Unstressed environment	An environment that is unstressed and permits lateral thinking.

4.3 Emergence of themes influencing radical innovation

A collective decision was taken to further validate and refine the aspects identified in the coding structure into higher level codes. This involved participation of the Development Team members in grouping the aspects into themes. This resulted in the clustering of the fifty eight lower level codes reflecting individual aspects of organizational culture into aggregate themes (higher level codes) that represented broader aspects of the innovation culture which were collectively considered to be associated with the facilitation of radical innovation. The aggregate themes and key constructs were empirically derived through an inductive process in which the Development Team members continuously refined their meaning, and hence their internal validity, in a collective manner. The nine themes were:

- Company Infrastructure
- External confidence
- Clear objectives
- Team constitution
- External perspectives
- Freedom/Latitude
- Attitude to Risk
- Internal confidence
- Growth/Development

The full list of themes and associated aspects obtained from all interview data is shown in Table 4-4.

Table 4-4 Themes developed from all interview data

Higher level theme	Aspect code	Aspects grouped together into higher level theme	Development Team statements used to describe the higher level theme
Company infrastructure	6 3 17 29 30 2 58	Bureaucratic management Autocratic management Environment for creativity Project champion Provide adequate resources Allow adequate time Unstressed environment	This relates to the structure of the company around the Development Team, the resources made available to the team, the management style in which the team operates. This theme groups aspects that are company related, that originate from outside the team and make resource allocation or restriction decisions that the team responds to. It is termed "company" as it relates to the broader company that the team operates within. This theme is concerned with aspects that are external to the team and which the team perceives itself as having no influence over. The aspects tend to be reasonably tangible.
External confidence	10 36 27 21 25 16 37 31 48 46 34	Conflict in top team Team confidence in management Management confidence in team Feedback to team from management Inter-dependency of teams Discrete team identity Trusting the team Recognizing the skills of team members Ideas from top management Encouragement to be radical Speaking openly	This theme relates to the perception of the Development Team as an entity by company members who are outside the Development Team, in particular the top management. The aspects are perceived to originate outside the Development Team, but the team perceives that it has some choice on whether to respond or ignore them. These aspects cross the team boundary and act upon the team. The aspects are more intangible than the aspects grouped in Company Infrastructure.
Clear objectives	9 7 8 53	Common objective Changing objectives Clear objectives Short v Long-term focus	This theme refers to the concept of having a clear and well defined objective for the development project and having an unmoving target during the time the development project is active. The aspects relate to having a fixed specification prior to commencing the development project. The team perception is that there should be a clear, well defined specification at the outset of the project that is unchanging throughout the life of the project. The team felt that these aspects were external in that the specification would be provided from outside the team, most team members considering it top management's job to come up with the idea for a product and to provide a clear unambiguous specification.

Table 4-4 Themes developed from all interview data

Higher level theme	Aspect code	Aspects grouped together into higher level theme	Development Team statements used to describe the higher level theme
Team constitution	23 11 18	Homogeneous team Creative skills in the group Experience of technology	This theme refers to skills and attitudes of the Development Team. The aspects refer to the nature and composition of the team. These aspects were also seen as tangible and easily identified within the team members. The aspects refer to the team as a whole and to the individual team members. They are considered to be internal to the team but the composition and manifest of team skills and experiences was perceived as being outside the control of the team. Again top management was perceived as the controller of these aspects.
External perspectives	12 38 41 57	Customer involvement Using external Development Customer conservatism Trigger for new ideas	This theme links the aspects that relate to the team's interfacing with the environment outside the company. The aspects grouped in this theme are associated with links to outside agencies and organizations that influence the radical innovation capability of the Development Team. The aspects, although referring to external entities, can originate from within the Development Team or may originate from outside the Development Team but still within the company. These aspects are perceived as being associated with external sources of information that are related to product needs or to available technologies.
Freedom/Latitude	4 22 40 50	Autonomy to make decisions Front end opportunity to be radical Autonomy v Set objectives Opportunity for experimentation	This theme relates to the freedom and opportunity to take autonomous action as perceived by the Development Team. It groups together the aspects associated with freedom to make decisions, to experiment, to define the team's own direction as opposed to having a pre-defined direction provided for it. It provides the opportunity to be self-managing and self-directing.

Table 4-4 Themes developed from all interview data

Higher level theme	Aspect code	Aspects grouped together into higher level theme	Development Team statements used to describe the higher level theme
Attitude to risk	13 20 26 1 43 42 56 55 52	Desire for a "safe" solution Fear of failure Learning from failure Acceptance of failure Desire for an easy solution Degree of comfort with change Tension between safe and new Technology led solution Problem led solution	This theme refers to the perceptions held by the Development Team about taking risks. The aspects relate to attitude to taking risk, being adventurous, to new and untried avenues and solutions to problems' and to the attitude to making and learning from mistakes. This theme is influenced by the other themes but relates to the behaviour of the team members when confronted with choices relating to unknown versus known and therefore safe options.
Internal confidence	33 32 24 35 49 47 51 54 28 5	Self-confidence of team members Respecting individuals Identification with the company Team commitment Maintaining power Holding information back Peer perception Team delivery of radical solution Past successes Belief in the product's worth	This theme groups together aspects associated with the team's belief in itself and the internal dynamics of the team. The aspects are less tangible and relate to how the team members interact, how they support each other, how they perceive each other. The theme refers also to the confidence the team has in its own capability to produce solutions that are radical. This theme is influenced by the external aspects acting on the team, by history and the team members' perception of how they operate and interact.
Growth/Development	45 44 14 15 19 39	Desire to try new technology Desire to explore what is possible Desire to grow and develop Desire to push the boundaries External technologies Apathy to target achievement	These aspects refer to the internal dynamics of the Development Team that are related to pushing boundaries, growing knowledge, gaining experience and exploration of potential solutions. The theme relates to the desire to learn and explore. There is a requirement that forces the crossing of the team boundary to look outside the team to achieve this learning.

4.4 Analysis

4.4.1 The themes in relation to innovation literature

The occurrence of each of the nine themes in each of the twenty-six interviews is shown in Table 4-5 and the themes are discussed below in relation to literature.

Table 4-5 Occurrence of themes in the interviews

Interview	Company Infrastructure	External confidence	Clear objectives	Team constitution	External perspectives	Freedom/ Latitude	Attitude to risk	Internal confidence	Growth/ Development
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	■	■	■		■	■	■		
Total	24	19	24	13	11	11	19	16	22

Freedom/Latitude

Freedom to develop is widely recognized as a prerequisite for innovation (Rickards, 1985; Prather, 2000; Nijhof, Krabbendam and Looise, 2002). Freedom in this context refers to deciding what to do or how to accomplish the task, a sense of control over one's own work and ideas. The most important type of freedom is operational autonomy – freedom in the day-to-day conduct of one's work, freedom in deciding how to achieve the overall goal or mission. Organizational characteristics such as openness are supportive of innovation success (Huizenga, 2000). Prather (2000) also argues that trust and openness are important in shaping the climate for innovation. This is in resonance with Kaplan (1960) who suggests that freedom to choose problems and

change direction (within restricted limits of programmes and projects and goals of the organization) is one of the essential factors that positively influence creativity.

In an incremental environment the degree of freedom can be reduced and replaced with systems and procedures. These systems and procedures are those which are appropriate for successful operation of a business – the "do better" activities. The routines and systems that work well for normal business operation become inhibitors when applied to radical innovation development (Christensen, 1997; Sutton, 2001; Farson and Keyes, 2002). Abetti (2003) argues that over management can be as much an inhibitor to radical innovation as under management. Over management, ie, arbitrary decisions, too many inputs and too much attention to detail may cause loss of creativity and enthusiasm, or worst, departure of the best contributors. Under management may allow innovators to take off in the wrong market or strategic direction, overspend their budgets, make unrealistic commitments and even compromise the company's future. Unnecessary bureaucracy prevents adaptation to changing environments and slows the innovation process down (Katila and Shane, 2005). Management of radical innovations requires balancing the natural desire of control with the realization of insufficient technical and market knowledge in order to guide and assist, rather than interfere with the innovators. Harborne and Johne suggest that 'an informal, open, and entrepreneurial climate requires continuous attention from senior management if it is not to revert to a formalised, hierarchical and risk-averse one' (2003: 126). Risk is more likely to be taken if there is freedom to explore (Amabile, 1988b; Ekvall, 1991).

Attitude to risk

'Attempts at radical innovation produce more failures than successes, and the magnitude and timing of results are highly unpredictable. Faced with these double-barrelled negatives, it is not surprising that executives feel more comfortable in other approaches to future growth; sticking to their knitting; gaining access to innovative technologies through acquisitions; or being a "fast follower" as new concepts enter the competitive arena.' (Leifer *et al.*, 2000: 4). Management systems and procedures set the environment which in turn influences the attitude to risk (Schmitt, 2003). Groups that are risk-averse will inhibit radical innovation (Ekvall, 1996; Harborne and Johne, 2003; Simon *et al.*, 2003). Risk can be to both personal career development within the company as the radical innovation can be unsuccessful and also to the progress of the radical development in achieving an acceptable solution. Risk taking is one of the climate dimensions that make the crucial difference between the creative climate that supports radical innovation and the creative climate that allows only incremental improvements. There is need for more of these climate aspects when big leaps are aimed at than when small step improvement is the innovation strategy (Ekvall, 1996). The predilection towards conforming acts and rewards for conforming – risk aversion – is argued by Bouwen and Fry (1991) to inherently kill innovative ideas. Group members must therefore be willing to be tolerant of risk and management of such a group must operate in a risk-tolerant manner. Small losses, more than either major successes or failures, contribute to effective learning. Success often fails to engage managers' attention sufficiently so that they learn from experience. Major failures raise defences that block learning. Small failures cause individuals to pay greater attention to the process, but do not create defensiveness that impedes learning (Eisenhardt and Martin, 2000). A tolerance of risk is at odds with the approach to business management as suggested by standards such as ISO 9000. 'Practices such as continuous

improvement and ISO 9000, while valuable, are designed to operate in a smooth, low risk environment' (McDermott and Handfield, 2000: 42). Managers should be wary of using concurrent approaches to new product development if the product itself is not well defined and the market is uncertain (McDermott and Handfield, 2000). In a similar manner the application of standard control, top down decision making, focus on decisions rather than evolution of ideas and a too rigid QFD system can inhibit creativity in product development (Rose-Anderssen *et al.*, 2005).

The pursuit of knowledge is the rationale behind experimentation (Thomke, 2003). It is an iterative process of understanding what works and what does not work. Both results are equally important for learning. Learning is the goal of any experiment. In the book "In Search of Excellence" (Peters and Waterman, 1982) excellent companies are conspicuous for their tendency to try things out, to experiment. An informal, open, and inquiring environment that values experimentation, with leaders promoting innovation by creating a shared belief that team members are safe to take interpersonal risks will facilitate radical innovation (Claver *et al.*, 1998; Andriopoulos and Gotsi, 2002; Gudmundson, Tower and Harman, 2003; Harborne and Johne, 2003). When employees feel psychologically safe, they engage in learning behaviour – they ask questions, seek feedback, experiment, reflect on results and discuss errors or unexpected outcomes openly. Leaders can create these norms by influencing the way creative ideas and errors are handled, which in turn, leads to shared perceptions of how consequential it is to make a mistake (Chatman and Cha, 2003). Mistakes are seen as lessons to learn from, and learning is expected and celebrated (Frohman, 1998). The confidence of the team in its own ability (Amabile, 1988b) and its view of how it is perceived (Simon *et al.*, 2003) influence its willingness to take risk.

Growth/Development

This theme concerns learning within the team by individuals in the team. It relates to pushing the team's knowledge and experience and about discovering other technologies that are available. 'The training and experience of the people right in your own firm are the principal sources of information for successful innovations' (Marquis, 1988: 85). Freel finds that innovation flows from intermediate levels of the organization and that more innovative organizations carried out more training of staff (2005). Learning from mistakes is a part of the growth of the group and development of both individual and group skills and experiences (Frohman, 1998; Andriopoulos and Gotsi, 2002; Chatman and Cha, 2003). Group members should be encouraged and stretched beyond their comfort zone. A managed learning process assigns challenging projects, and assists and monitors the individual participants (Andriopoulos and Gotsi, 2002). Cohen and Levinthal argue that 'problem solving and learning capabilities are so similar that there is little reason to differentiate their modes of development' (1990: 130).

Engaging in shared learning and development across organizational boundaries, and increasingly across regional and national ones, facilitates the growth and development of the group and individuals and facilitates "do different" innovation (Bessant, 2003). This development can take the form of a knowledge brokering cycle, where the best innovators systematically use old ideas as the raw materials for one new idea after another (Hargadon and Sutton, 2000). Challenge, the emotional involvement of the members in the organization's operations and goals is part of the growth and development of the group. This challenge is an enabler to both incremental and radical innovation (Ekvall, 1996). Routines, systems, structures and strategy are elements of

organizational learning that can become institutionalized. This institutionalized learning may impede new learning when it no longer serves the situation. In these circumstances it is necessary to learn to "unlearn" in order to learn again (Vera and Crossan, 2005). By encouraging conflict, creativity can grow and develop (Sutton, 2001).

External confidence

One factor that differentiates radical innovation from incremental is senior management having belief in the team. This can be a major enabler for radical innovation. An example is the development of the Polaroid Land camera. With weeks to go before the deadline, it was Dr Land's unwavering support that drove his team beyond their limits to achieve a breakthrough innovation (Mascitelli, 2000). The External confidence theme relates to the perception of the team as to how they are viewed by those outside the team. A large component of this is the perception of the top management team about the Development Team. Feeling valued and secure helps people relax enough to be creative (Kanter, 1988). Management practices that permit freedom in conduct of work, provision of challenging interesting work, clear strategic goals, and teams with diverse skills and perspectives facilitate creativity (Amabile *et al*., 1996). Senior management must be passionate about supporting radical innovation. The support, involvement, commitment and the championing of the CEO and senior management is a critical success factor. The role of radical innovation in accomplishing the company's long-term strategies and objectives must be clearly stated and reinforced at all levels (Simon *et al*., 2003). However although top management's support is strongly related to technical performance there is no indication that this becomes more important when the innovation is radical (Lee and Na, 1994).

Pride in the team, in the company, coupled with knowing that innovation is mainstream rather than counter-cultural helps to stimulate innovation. Organizations with "cultures of pride" in the company's achievements and in the achievements and abilities of individuals will find themselves more innovative (Kanter, 1988).

Internal confidence

This theme is similar to the External confidence theme in that it relates to the perception the members of the team have about themselves and their team, and how they relate one to another. Self-motivation, being self-driven, excited by the work itself, enthusiastic, attracted by the challenge of the problem, having a sense of working on something important and a belief in or a commitment to the idea also facilitate innovation of both types (Amabile, 1988b).

Organizational characteristics such as openness, respect and teamwork are assumed to be supportive for innovation success (Huizenga, 2000). Creative thinking depends to some extent on the personality characteristics related to independence, self-discipline, tolerance for ambiguity, perseverance in the face of frustration, and a relative lack of concern for social approval. It is the "something extra" of creative performance (Amabile, 1997). This is supported by Hauser who argues that a culture that enables conflicts concerning discussion and prevents emotional conflicts will facilitate the early stages of innovation (1998).

Employees who acknowledge and support each others' work and do not waste time protecting their own ideas or feeling threatened by others will facilitate this type of environment (Heilmeir, 2000; Andriopoulos and Gotsi, 2002). Nemeth (1997: 72)

argues that 'dissent is a very economical mechanism for producing innovation.' In this environment people trust that others will listen to, learn from and inform them in order to facilitate innovation (Frohman, 1998). For radical innovation, breakthroughs occur when thinking outside the box – making strategic trade-offs between conflicting priorities, attempting to reconcile the seemingly irreconcilable (Syrett and Lammiman, 2002). Having confidence about their own capability will allow a team to evaluate technologies and applications outside the organization that will facilitate radical innovation (Kovach, 2000).

External perspective

Looking outside the organization means looking away from the focal points- "scanning the periphery". Day and Schoemaker suggest that the periphery is where your attention is not (2004). When you shift attention to this area it is no longer the periphery. It becomes the focal point. Thus it is necessary to continuously scan away from the main areas of focus for the business, but not to the extent that focus on the key parts of the business is lost. As more resources are devoted to scanning the periphery, information overload can become a serious problem. There is a trade-off between scope and intensity. Day and Schoemaker liken it to a flashlight or a laser. A laser has an efficient narrow focus whilst a flashlight has a broader less intense view.

Successful innovation requires the ability to harvest ideas and competencies from a wide array of sources. If a company stays locked within its own four walls it will be unable to uncover and exploit opportunities outside its existing businesses or beyond its current technical or operational capabilities. This may satisfy incremental innovation but is unlikely to be of benefit for radical innovation (Wolpert, 2002). 'The need for external perspectives seems almost self evident.' (Wolpert, 2002: 78) The exposure to experience and technology outside the team or the company is a necessary component for innovation (Sutton and Kelley, 1997). Huizenga (2000) found that external sources are used more than internal sources to create knowledge and that co-operation with universities is positively correlated with innovation success. Cooper and Kleinschmidt (1990) find that in a study into new product innovation in 100 companies, one of the major factors that separates winners from losers is the effective use of outside technology and external scientific communication. Willingness to communicate with external stakeholders (Hauser, 1998) and linkages with external sources (Rothwell and Dodgson, 1991; Rothwell, 1992) will facilitate innovation. Formal and informal structures of firms and their external linkages have an important bearing on the rate and direction of innovation (Teece, 1996).

All technology firms have organizational processes and infrastructures that facilitate the capture of customer requirement information and its integration into the new product's design. Most of these processes and infrastructures are designed for products that are in the latter stages of their life cycle, or are incremental and continuous innovations. It appears that the development process for radical new products, including the manner in which users are involved, differs markedly from the incremental new product development process (Callahan and Lasry, 2004). While von Hippel (1988) and von Hippel *et al.* (2000; 2002) propose that users are an important source of new product ideas and Florida and Goodnight (2005) suggest customers as creative partners, others have argued that being too close to the customer or being "customer led" may prove detrimental to innovation and firm performance (Bower and Christensen, 1995; Christensen and Overdorf, 2000). This is supported by

Trott who argues that market research constrains rather than facilitates innovative thinking and creativity (2002). Veryzer argues that it may be possible to create a valid context for collecting market information so as to avoid unduly discouraging radical innovation (2005).

Resource dependency theory (Pfeffer and Salancik, 1978) suggests a firm's strategies are constrained by external forces that provide critical resources to the firm, such as customers, suppliers and investors. These external constraints explain why a firm focuses on satisfying its established customers in existing markets. The firm's resource allocation processes are designed to optimize the profitability of the firm's current operations. This dependency and focus on customers can, however, inhibit radical innovation. Companies listen to customers, give them the product performance they are looking for, and in the end, get hurt by the very technologies their customers led them to ignore (Bower and Christensen, 1995). A high degree of co-operation with suppliers and customers is negatively correlated with innovation success (Huizenga, 2000). Callahan and Lasry (2004) suggest that the importance of customer input increases with the market newness of a product up to a point and then drops off for very new products, whereas the importance of customer input increases with the technological newness of a product without dropping off.

A major success factor in facilitating innovation is when individuals try to assimilate and internalize knowledge from external sources (Terziovski, Sohal and Howell, 2002). Scientists, engineers and firms from outside the organization may trigger radical technological change that transforms current technological regimes (van de Poel, 2000). Developing radical or disruptive innovations requires the meshing of actual sophisticated technological and market knowledge with visions about the future. Both knowledge re-use (exploitation) and the search for new knowledge (exploration) are taking place in an ambiguous world, and require certain types of sense making dynamics to be successfully executed (von Wartburg, Teichert and Rost, 2003).

Clear objectives

Clarity of goals is generally agreed as an enabler of innovation (Arad *et al.*, 1997; Frohman, 1998; Gundling, 2000). This is refined to suggest that goals that are tight at mission level and loose at the level of employee autonomy, at procedural level will facilitate innovation (Amabile, 1988b; Amabile *et al.*, 1996). Simon *et al.* (2003) argue that goals should be consistent with and enable the accomplishment of the organization's business objectives and strategies (2003).

The effect of clear objectives on radical innovation is considered to be different from incremental innovation. General direction and strategic clarity are required for both types of innovation. Having very clear and specific objectives is considered to be an enabler for incremental innovation only. The confused uncertain aspect of radical innovation is inhibited by having clearly defined objectives at a tactical level (Humble and Jones, 1989; Martins and Terblanche, 2003). Clarity of the desired outcome as well as the project specification for the innovation project can shift over time. Innovation success criteria can also shift over time, differ between groups, and trigger power struggles between innovation managers and resource controllers (Poole and Van de Ven, 1989). For radical innovation, "order and clarity" (generally accepted to support incremental innovation) may be detrimental. 'It is a well-known phenomenon that ambiguity is not threatening to highly creative people. On the contrary they become stimulated by it, they see the possibilities in an unclear situation. But it is also known

that people with above-average creative potentials, and with less self-confidence than highly creative people, often need frames and goal direction in order to realize their latent creativity.' (Ekvall, 1996: 121).

Team composition

This theme relates to the team itself, the skills and experience of the team members and their heterogeneity. The composition of a radical innovation team is suggested as comprising people with superior technical capability. In addition team members should be inquisitive, passionate, not afraid to be different, broadly educated, extremely bright, integrative, aggressive, flexible, able to take risks, goal-orientated, entrepreneurial and eager to learn the business. Types of people not recommended include, people who cannot communicate, people who want to pursue a lifetime career in one thing, people who are too oriented towards "group process", politicians (as opposed to network builders) and those who are overly risk averse (Leifer *et al*., 2000). Innovators are the idea generators who initiate idea generation. They tend to be non-conformers and will disregard or violate existing organizational rules and norms as the need arises (Glynn, 1996).

People appropriate for radical innovation are curious entrepreneurial people, solution finders not problem solvers (Simon *et al*., 2003). Humble and Jones (1989) suggest that whilst most managers can achieve incremental improvements, radical innovation requires dedicated full-time staff with appropriate qualifications and personal commitment. Team composition should be characterized by breadth of experience in addition to depth, a combination of product development skills and functional sophistication (Heine, 2001; McDermott and O'Connor, 2002). Creative people are generally agreed to facilitate radical innovation (Amabile, 1988a; Cummings and Oldham, 1997; Stringer, 2000). However, there must be more than just the presence of creative people. 'For creativity to occur, chaos is necessary but a structured and focused chaos.' (Kuratko and Hodgetts, 2001: 122). The theme of chaos acting to enable creativity is supported by Quinn (1985).

The composition of the radical innovation team is generally agreed to benefit from inclusion of non-conforming individuals and lateral thinkers. These people add the ability to think of "do different" solutions to problems. Sternberg, O'Hara and Lubard (1997) argue that the type of personality required is one of determination and persistence in overcoming obstacles. They argue that creativity requires a risk-taking personality, someone who can take a stand and be a contrarian. Group diversity is a major influence upon technical performance. A group that stabilizes its membership for too long not only decreases its productivity but tends to become insular and to evidence "Not Invented Here" behaviour (Roberts, 1988). Tushman and O'Reilly III (1999) support this perspective that team heterogeneity facilitates discontinuous innovation.

Company infrastructure

This theme reflects the company environment in which the team operates and influences the team. The concept of an organic organization that can react to change as opposed to a mechanistic one that is bureaucratic and fixed has long been established (Burns and Stalker, 1966; Gresov, 1984). Organizations that are structurally complex, formal and decentralized are likely to introduce new products and adopt only incremental departures from process technology when they are innovative. Incremental innovation processes that lead to new product introduction appear to be dependent on more

traditional structural arrangements and market oriented strategies. An aggressive technology policy and unique structural arrangements appear to be necessary precursors to pre-innovation conditions that support radical innovation (Ettlie *et al.*, 1984). High innovation companies in USA, Europe and Japan have flatter organization structures, smaller operating divisions and smaller project teams (Kanter, 1988). Centralization and formalization should be reduced in order to facilitate radical innovation (Ekvall, 1996). Highly innovative organizations can become trapped by their own success. The same factors that create a successful innovative company often plant the seeds of complacency and failure as competitive conditions change (Tushman and Nadler, 1986).

Making resources available is a management responsibility. Managers who believe in innovation, provide the necessary resources and support and make time available for innovation will enable incremental innovation and continuous improvement (Irani and Sharp, 1997). When a creative climate is aimed at, centralization and formalization should be minimized (Ekvall, 1996). Yet these resources can act as both enabler and inhibitor for radical innovation. The provision of too many or too few resources will inhibit radical innovation. This perspective of "not too much" and "not too little" applies to several resources required for innovation (Nohria and Gulati, 1996). Gundling (2000) refers to this middle ground of resource provision as a "Goldilocks" principle.

The systems and procedures operated within the company have an influence on the propensity to deliver radical innovation. Practices such as continuous improvement, QFD and ISO 9000, already discussed in the Attitude to risk theme, while valuable, are designed to operate in a smooth, low risk environment (McDermott and Handfield, 2000) and are therefore inappropriate for enabling radical innovation (Leifer *et al.*, 2000).

Management of the radical innovation team is also part of the Company infrastructure. Radical technological innovations are developed by highly creative engineers, scientists and other skilled persons. These persons are difficult to "manage" either individually or in teams (Abetti, 2003). In managing the people side of radical innovation, one of the leadership roles that facilitates innovation is that of a sponsor (Roberts, 1988; Dougherty and Heller, 1994; McDermott and O'Connor, 2002).

Style of management can enable or inhibit a risk tolerance within the team. Harborne (2003: 126) argues that 'an informal, open, and entrepreneurial climate requires continuous attention from senior management if it is not to revert to a formalised, hierarchical and risk-averse one'. Creation of an entrepreneurial climate that encourages the crises, dissatisfaction, tension and significant external stresses that are the major preconditions for stimulating people to act (Van de Ven, 1986) is the opposite requirement for management running normal business practices. The management practices required to facilitate radical innovation are very different from those considered to be good business practice. The familiar and often prescribed practices are more appropriate for incremental than for radical innovations (Kuratko and Hodgetts, 2001; Rice, Kelley, Peters and O'Connor, 2001; Sutton, 2001).

4.4.2 Themes located on Schein's model

The themes do not exist as stand-alone entities but as inter-related representations of aspects of the radical innovation culture in the Cerulean Development Team. They reflect the perceptions of the Development Team members and were developed through participative analysis with the team members. Barley (1991) argues that focusing on

symbolic phenomena that lie on the surface of organizational behaviour, stories, myths, logos, heroes, and assorted other verbal or physical artefacts concentrates on the obvious while failing to reveal the core of the interpretive system that lends a culture its coherence. In Schein's model, artefacts may be easy to observe but difficult to decipher and values may only reflect rationalizations or aspirations. To understand a group's culture it is necessary to get at its shared underlying assumptions (Schein, 1992). However, unconscious taken for granted beliefs, habits of perception, thoughts and feelings that constitute the underlying assumptions are unlikely to be fully understood and made explicit by insiders of that culture (Schein, 1991). Thus representation of the themes as aspects of the innovation culture using Schein's model are only shown at the level of either visible manifestations (artefacts) or as perceived (values). The underlying assumptions are the ultimate source of these artefacts and values (Schein, 1992). This is shown in Figure 4-3.

Artefacts (visible)	• *Company infrastructure* • *External perspective* • *Clear objectives* • *Team composition*
Values (perceived)	• *External confidence* • *Freedom/Latitude* • *Attitude to risk* • *Internal confidence* • *Growth/Development*
Underlying Assumptions (hidden)	Taken for granted and not visible to team members

Figure 4-3 Representation of themes as internal/external and visible/perceived

4.4.3 Using Greenwood and Hinings' concept of archetypes

Using the innovation continuum represented in Figure 3-3 and the characteristics of incremental and radical innovation shown in Table 3-1 as representing the two ends of the continuum, a model representing archetypes of these two "ideal" types of innovation was participatively developed. The descriptions applied to each of the archetypes were developed through participatory analysis with the Development Team, using the nine themes as the basis for description. These descriptions are supported in the literature. The two archetypes proposed reflect the perspective of innovation culture "ideal" types based on Greenwood and Hinings (1993) archetypes. Type I is an incremental approach to innovation where there is a tendency to maintain or improve in small incremental steps – a "do better" attitude. Type II is a radical approach to innovation where there is a desire to explore, to push the boundaries – a "do different" attitude. The model of the two archetypes of "ideal" innovation culture is shown in Table 4-6.

Table 4-6 Archetypes of radical and incremental innovation

Theme	ARCHETYPE	
	Characteristics of a Type I incremental innovation culture	Characteristics of a Type II radical innovation culture
Freedom/ Latitude	Systems and procedures can be used to control continuous improvement. A process driven environment where incremental improvement is encouraged and rewarded. (von Stamm, 2003a)	Allows thinking to go beyond what currently exists. Exploration and discovery are part of the way things are done. (Amabile, 1988b)
Attitude to risk	Risk is minimized or avoided. Following processes and procedures ensures that there is minimal exposure to uncertainty. (McDermott and Handfield, 1996)	Taking risks is encouraged. Uncertainty is a part of the environment and discovery is accepted as being linked to taking risk. (Leifer et al., 2001)
Growth/ Development	Unnecessary for the pursuit of incremental improvement activities. May hinder the procedures being followed. (McDermott and Handfield, 2000)	A desire to grow and develop the ability and knowledge of the group. A hunger to know more and know why. (Leonard-Barton, 1992b)
External confidence	Unnecessary for the pursuit of incremental improvement activities. The incremental improvements are generated and controlled from within the group and are unaffected by external perception of the team. (McDermott and Handfield, 2000)	Having confidence and believing in the team supports the team's ability to "do differently" in pursuit of radical solutions. (Mascitelli, 2000)
Internal confidence	Confidence is based in belief that following the system or working to a defined specification will lead to incremental improvements. Peer support and respect, whilst beneficial, is not essential. Following the system is more important. The team members are components of the system. (McDermott and Handfield, 2000)	Confidence among the team members that they can find a radical solution. Working with and respecting the individual talents of each team member. Questioning, challenging but also supporting and nurturing the other team members. Team members are an autonomous unit that believes it can "do differently" to provide the radical solutions. (Amabile, 1988b)

Table 4-6 Archetypes of radical and incremental innovation

| Theme | ARCHETYPE | |
	Characteristics of a Type I incremental innovation culture	Characteristics of a Type II radical innovation culture
External perspective	Some relevance from the point of benchmarking. However, this tends to provide a target for the team to match. It reinforces the "do better" mentality of the team. (Hill and Rothaermel, 2003)	Provides alternative perspectives and awareness of new technologies. These may not solve the problem but may trigger a "do different" solution that leads to radical innovation. (von Stamm, 2004)
Clear objectives	Provides a target to work towards and guidelines to operate within. (McDermott and Handfield, 2000)	Too specific objectives may inhibit the discovery of alternatives. Objectives that are not specific and clearly defined will encourage questioning and permit knowledge advancement. (Ekvall, 1996)
Team constitution	Individuals who can and are willing to follow the processes are required. Experience of technology is only necessary for application of known tools and methods. Preferable if the team members are like-minded individuals who will work well together. (Leifer et al., 2000)	The team must have a mix of creative individuals who have sufficient experience inside or outside the subject area such that they can apply lateral thinking to provide a radical solution. The team should comprise different minded individuals who can work with some degree of uncertainty and conflict as part of the day-to-day activities. (Leifer et al., 2000)
Company infrastructure	A management style that encourages conformance to rules and procedures. Resources and time are necessary to complete the improvement tasks. An environment that is supportive of a "do better" or "continuous improvement" approach is beneficial. (McDermott and Handfield, 2000)	A management style that encourages risk taking. Bureaucracy or autocracy are likely to inhibit this group. Some restriction in resources is necessary for creativity – Goldilocks principle – not too little and not too much. Having a champion to provide support at a high level is beneficial. (Tushman and O'Reilly III, 1997)

4.5 Rigour in the research

Coghlan and Brannick (2001) suggest that establishing rigour in action research must be shown to demonstrate quality of the research. Rigour in action research refers to how data are generated, gathered, explored and evaluated, and how events are questioned and interpreted through multiple action research cycles. The heart of the research is the story of what took place. Taking the requirements suggested by Coghlan and Brannick, rigour for this stage of the research was established by:-

- *Use of action research learning cycles.*
  This was demonstrated in the repeated refining that took place following data gathering. The involvement and participation of the Development Team was sought from the first stages of the research. The findings in each of the group sessions were developed and built upon at each subsequent session. Each stage of the research process was discussed with the Development Team and their input sought. The results were fed back to them and again their response solicited and used to develop the next stage of the process.

- *How multiple data sources were assessed to provide contradictory and confirming interpretations.*
  The data gathered during the interviews provided one source. Observations and reflections made in the researcher's journal provide a second perspective that supported the data from the interviews. Comments made by the Technical Director provide a third perspective.

- *Evidence of how the researcher challenged and tested assumptions and interpretations continuously throughout the research.*
  This has happened in three ways. Firstly, the participation of the Development Team to refine the gathered data provided one aspect of the testing process. Secondly, reflection and discussion with Cerulean employees outside the Development Team provided an additional perspective. Thirdly, the research has been presented to the researcher's Executive Doctorate peer group, doctoral colloquia and at conferences. These presentations provided feedback and tested the findings from the data.

- *How the interpretations and outcomes are challenged, supported or dis-confirmed by existing literature.*
  An evaluation of the themes in context with the literature has been undertaken, with the literature being generally supportive to the outcomes. One area where literature dis-confirms the finds is in clear objectives. Development Team comments made during the interviews indicated that having clear and unchanging specifications for a project was considered desirable. Literature indicates that objectives should be clear at an overview or objective level and relatively loose at a detail level. The nature of radical product innovation is such that the detail specifications may have to change to accommodate any changing understanding and awareness of potential solutions. This desire to have clear specification is perceived by the researcher and other organization members outside the Development Team to reflect a strong aversion to taking ownership for defining product specification. For many years the Development Team were provided with a detailed product specification and asked to develop the product that met the specifications.

4.6 Key points from Project One

The key points arising from Project One can be summarized as:-

- Nine themes influencing radical innovation have emerged from the data.
- These themes represent the extant innovation culture in the Cerulean Development Team.
- The themes group aspects of organizational culture influencing radical innovation together. The nine themes are:
  1. *Freedom and Latitude* within the team.
  2. *Attitude to risk* within the team.
  3. *Growth and Development* of the team.
  4. *External confidence* in the team by those outside the team.
  5. *Internal confidence* of the team to undertake radical innovation.
  6. *External perspective* by the team outside their immediate area.
  7. *Clear objectives* about the project for the team.
  8. *Team constitution*, skills and attitudes of the team members.
  9. *Company infrastructure* that the team works within.
- The themes can be represented as visible/perceived to reflect Schein's artefacts and values in his model of organizational culture.
- The innovation culture that facilitates incremental and radical product innovation can be represented as archetypes representing characteristics of each "ideal" type.
- The Cerulean Development Team exhibits strong tendencies towards an incremental "do better" pattern of product development.

Having developed the nine themes and a model to reflect aspects of incremental and radical innovation culture "ideal" types, the research turned to the issue of gauging this innovation culture. The development of an instrument to assess the presence and intensity of the radical innovation culture in the Cerulean Development Team was the focus for Project Two.

5 Project Two
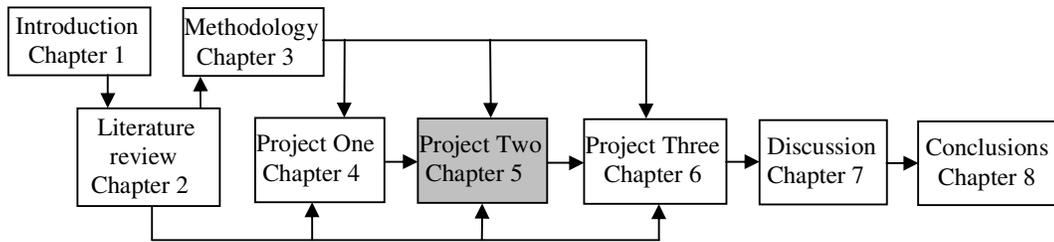
Figure 5-1 Research overview – Project Two

5.1 Introduction to Project Two

This chapter describes the development of an instrument to gauge the degree to which the innovation culture facilitates radical innovation. Innovation culture can be considered as a sub-set of organizational culture. Existing assessment tools were evaluated with a view to combining a culture and a climate assessment into a composite instrument. Two were chosen and an assessment carried out. Using the output from this assessment and the themes developed in Project One, a third self-assessment tool was developed with the team members. The relationship between the instruments and the themes is discussed. The results from the assessment provided an input into the plan of interventions suitable for developing aspects of a radical innovation culture. The research plan for Project Two is outlined in Figure 5-2.
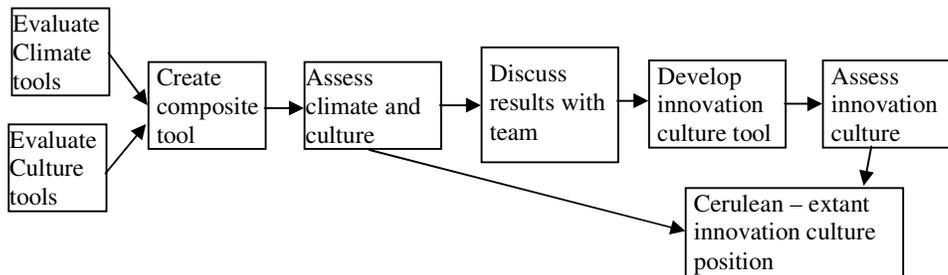
Figure 5-2 Project Two research plan

The context of Project Two in the overall research is shown in Appendix B.

5.2 Instruments to assess climate

Several instruments were evaluated that were considered suitable for assessing organization climate. The requirements were for a readily available, validated and reliable instrument that could be used as a composite with the cultural assessment instrument to obtain both a holistic and detailed assessment of the innovation culture in the Cerulean Development Team. The instruments examined with these requirements in mind are tabulated in Table 5-1.

Table 5-1 Climate assessment tools evaluated

Climate Assessment Instrument	Key evaluative comments
Litwin and Stringer Organizational Climate Questionnaire (LSOCQ) (Litwin and Stringer, 1968)	Some doubt exists about the validity of the instrument (Rogers *et al.*, 1980).
Creative Climate Questionnaire (CCQ) (Ekvall, 1996)	Reliability and validity concerns about the instrument (Mathisen and Einarsen, 2004).
Business and Organization Climate Index (BOCI) (Payne and Pheysey, 1971)	Produces reliable results (Sparrow and Gaston, 1996).
Siegel Scale of Support of Innovation (SSSI) (Siegel and Kaemmerer, 1978)	Developed in a school environment (Mathisen and Einarsen, 2004).
Assessing the Climate for Creativity (KEYS) (Amabile *et al.*, 1996)	Assesses the creative climate specifically. Widely used with very large database of results (Bommer and Jalajas, 2002).
Situational Outlook Questionnaire (SOQ) (Isaksen *et al.*, 1999)	Based on the Creative Climate Questionnaire (Ekvall, 1996).
Team Climate Inventory (TCI) (Anderson and West, 1998)	Reliable instrument with widespread use (Mathisen and Einarsen, 2004).
Team Factor Inventory (TFI) (Rickards *et al.*, 2001)	Recently developed instrument with large database of information (Al-Beraidi and Rickards, 2003).

Two traditions in defining climate are evident; the cognitive schema approach and the shared perception approach. The first approach regards climate as an individual perception and cognitive representation of the work environment. From this perspective climate assessments should be conducted on an individual level. KEYS is based on the cognitive schema approach. The instrument measures individual perceptions of environmental factors on different levels: group, organization, individual and supervisory level. The authors of SSSI also regarded climate as a psychological process (Mathisen and Einarsen, 2004). Both the TCI and the CCQ were based on a view of climate as shared perceptions, although they operate to different levels of aggregation. Although the CCQ was developed to assess climate at the organization level, the TCI assesses team climate. Both the CCQ and TCI are responded to by the individual before the individual responses are subsequently aggregated to the appropriate level. The aggregation has been tested using inter-rater agreeableness for the TCI but not for the CCQ. Mathisen and Einarsen (2004) suggest that TCI and KEYS are the most useable

instruments for assessing the environmental factors affecting creativity and innovation. The widespread use of KEYS and the use of both enabling and inhibiting factors in the questionnaire tend to suggest that such an instrument would be most appropriate for gauging the organizational climate within the Cerulean Development Team.

Schneider *et al.* (1996) suggest that culture can be changed through a focus on climate. Climate reflects the tangibles that produce a culture. By altering the everyday practices, policies, procedures and routines that impact on the beliefs and values that guide employee reactions change can be initiated and made durable. Change will not occur through new mission statements, speeches, newsletters, or big kick-off parties. To communicate new values and beliefs requires changing tangibles, the thousands of things that define climate, that define daily life in an organization. It is important therefore to address the climate that exists and to have some form of assessment in order to initiate change. However, climate is at best represented by the artefacts level of culture (Ekvall, 1996) and as such it cannot be viewed or addressed in isolation to the underlying values and beliefs that underpin the organizational culture (Schein, 1984). The instrument considered to most closely reflect the climate level of the innovation culture was KEYS.

5.3 Instruments to assess culture

Several widely used organizational culture assessment instruments were evaluated for practicality of use, validity and availability. The broader purpose of the culture survey was to use the results to improve the organization's performance. For this broader purpose to be achieved, the data must be shared with all employees. Previous research suggests that problem areas must be openly and honestly discussed in a non-threatening environment, solutions to problems must be proposed and actions must be taken (Sleezer and Swanson, 1992). This is in accord with the participative nature of the action research and consistent with the methods adopted in the first stage of the research to uncover the aspects influencing radical innovation in Cerulean.

The objective was to identify an instrument that provided a holistic perspective of an organizational culture that would indicate a present and desired position for the organizational culture and that would be suitable for feedback and discussion by the Development Team. The instruments evaluated for suitability to the research are defined in Table 5-2.

Table 5-2 Organizational culture assessment instruments evaluated

Culture Assessment Instrument	Key evaluative comments
Hadler and Tushman (1980)	Overview of organizational culture based on open systems theory. Similar perspective to the concept of "congruence" posited by Nadler and Tushman (1980)
Goffee and Jones (1998)	Assessment of organizational culture based on sociability and solidarity. Similar to the culture model suggested by von Stamm (2003b)
Harrison and Stokes (1992)	Focused on the power and control aspect of organizational culture
Reigle (2001)	Output based on Burns and Stalker's (1966) Mechanistic-Organic paradigm
Hofstede *et al.* (1990)	Evaluates sub-cultures embedded within cultures
Cameron and Quinn (1999)	Displays current and desired position. "Adhocracy" culture similar to desired innovation culture

The quadrants of the OCAI clearly display the current and desired positions for organizational culture. The quadrant described as "Adhocracy" in this assessment tool is a close approximation to the radical innovation culture of a Type II "ideal" type. The ability to provide a visual display of results that indicate current and desired positions of organizational culture was also considered to be advantageous in maintaining the participation of the team members. Tukey (1977) states that 'except when learning the numerical part of a new technique, no problem of exploratory data analysis is "solved" without something to look at.' The OCAI was considered to be the most appropriate assessment of organizational culture for this research.

5.4 Composite assessment instrument

Initial gauging of Cerulean's radical innovation culture using existing assessment instruments was carried out by using a composite of KEYS for creative climate and OCAI for organizational culture. The OCAI is particularly attractive from the perspective of identifying extant and desired organizational culture. The Adhocracy culture (Cameron and Quinn, 1999) attributes of creativity, entrepreneurship, adaptability and dynamism, combined with the emphasis on innovation, growth and new resources (Cameron and Freeman, 1991), has resonance with the Type II archetype of innovation culture defined in Project One as one that facilitates radical innovation. In addition, market and adhocracy cultures are statistically correlated with innovation (Ahmed, 1998). To provide target areas for improvement in the form of interventions to create a radical innovation culture, the KEYS instrument was considered to be most appropriate. This is a climate specific tool that gauges six dimensions and offers the opportunity for planned interventions based on specific responses. In addition the

KEYS tool is widely used with established reliability and validity credentials. The use of the tool was subject to copyright approval being obtained, since instructions for the analysis are not in the public domain.

The assessment of the Cerulean Development Team organizational culture can be represented by considering Schein's model of three levels being examined at the artefact level by the KEYS component and the overall level by the OCAI component. This is represented in Figure 5-3.

Artefacts and Creations
- Technology
- Art
- Visible & Audible Behaviour Patterns

Visible but often not decipherable

Assessed using KEYS

Values
- Strategies
- Goals
- Philosophies (espoused justifications)

Greater level of awareness

Assessed using OCAI

Basic Assumptions
- Relationship to environment
- Nature of Reality, Space and Time
- Nature of Human Nature
- Nature of Human Activity
- Nature of Human Relationships

-Taken for granted
-Invisible
-Preconscious

Figure 5-3 Assessing climate and culture based on Schein's model

The structure adopted for the composite instrument was to use the questions as formatted in the original KEYS and OCAI instruments. The KEYS part of the composite instrument is in the questionnaire booklet provided by the Center for Creative Leadership (CCL) in Greensboro. This is a copyright questionnaire and permission was obtained for its use from both Professor Teresa Amabile and CCL, who are the administrators of the KEYS tool. Both OCAI and KEYS questionnaires were provided along with an explanation and instruction sheet. This detailed the method of completing the questionnaires and the logistics of returning them for analysis. Both assessments are a paper and pencil tool that can be completed within sixty minutes. The instructions distributed for completion of the OCAI part of the composite instrument are shown in Appendix C.

5.5 Relationship between the themes and the composite instrument

The dimensions of KEYS and OCAI both encompass many issues relating to the creative climate and organizational culture. The themes surfaced from Project One also group together a number of innovation culture aspects influencing radical innovation. Links between the nine themes, the KEYS and OCAI dimensions are discussed in the following section. These linkages have been supported by references to the innovation management literature.

5.5.1 The nine themes and the KEYS dimensions

The questions used in the KEYS assessment can be related to the nine themes developed in Project One as discussed below.

Freedom/Latitude

The theme Freedom and Latitude is related to the KEYS dimension Freedom. This dimension relates to the freedom the team members have in deciding what work to do or how to do it and to the sense of control they have over their own actions. This sense of control over one's own work is recognised to be necessary for facilitating "do different" innovation (Ekvall, 1996; Gundling, 2000).

Attitude to risk

Risk taking is a fundamental part of facilitation of radical innovation (Andriopoulos and Gotsi, 2002). (Gudmundson *et al*., 2003; Harborne and Johne, 2003)The Attitude to risk theme is related to two dimensions in the KEYS survey. The dimension Organizational Encouragement relates to the encouragement of creativity through constructive judgement of ideas and a shared vision of what the organization is trying to do. Risk taking is encouraged in this environment. The second dimension – an inhibitor, Organizational Impediment – relates to how new ideas are criticized, an avoidance of risk, and an overemphasis on the status quo.

Growth/Development

The desire to grow knowledge and to push the boundary of understanding supports the development of radical innovation (Roberts, 1988; Nonaka and Takeuchi, 1995). The KEYS dimension Challenging Work is related to this theme. The uncertainty inherent

in a radical innovation project that challenges the team members relates to this dimension.

External confidence

The external perspective of the team, the confidence and belief in the team's capabilities supports their ability to "do differently" in pursuit of radical solutions (Mascitelli, 2000). Belief in the team can be a major enabler for radical innovation. Team members' perception about this external confidence relates to three of the KEYS dimensions. The Organizational Encouragement dimension relates to the encouragement given by the company to the team to do differently and to solve problems creatively. The Workload Pressure dimension relates to extreme time pressures, unrealistic expectations for productivity and distractions from creative work. The Organizational Impediment dimension relates to politics, criticism of new ideas, destructive interdepartmental competition and avoidance of risk.

Internal confidence

Creative thinking depends to some extent on the personality characteristics related to independence, self-discipline, tolerance for ambiguity, perseverance in the face of frustration, and a relative lack of concern for social approval. It is the "something extra" of creative performance (Amabile, 1997). Employees who acknowledge and support each others' work and do not waste time protecting their own ideas or feeling threatened by others will facilitate a radical innovation culture (Heilmeir, 2000; Andriopoulos and Gotsi, 2002). This theme relates to three of the KEYS dimensions. The first, Challenging Work, relates to there being a sense of working on important projects and undertaking challenging tasks. The second dimension, Work Group Support, relates to the team being open to new ideas and constructively challenging each other's work. In this situation the team trust and help each other and feel committed to the work they are doing. The third dimension, Supervisory Encouragement, relates to supervisory support for the team and encouragement for them in being creative.

External perspective

Cooper and Kleinschmidt (1990) find that in new product innovation, one of the major factors that separates winners from losers is the effective use of outside technology and external scientific communication. There are no KEYS dimensions that relate to this theme. Although some dimensions, (Organization Encouragement, Supervisory Encouragement and Work Group Supports) are associated with openness to new ideas and support for new ideas assists the External Perspective theme, these items do not refer to an external perspective specifically. In a similar manner, the Sufficient Resources dimension relates to access to all data and material required for project completion. This is necessary to facilitate access to outside ideas and information, but again does not refer to an external perspective.

Clear objectives

As radical innovation is invariably a confused, uncertain process (Humble and Jones, 1989), some lack of clarity in the project specification is likely to facilitate radical innovation. 'Radical ideas tend to need room to grow and develop, they tend to change shape and scope' (von Stamm, 2003a: 260). This relates to the KEYS dimensions

Freedom and Supervisory Encouragement. The Freedom dimension also links to the freedom to decide how the projects should be carried out. There is therefore autonomy to decide the course of action within these goals.

Team composition

People appropriate for radical innovation are curious entrepreneurial people, solution finders not problem solvers (Leifer *et al*., 2001; Simon *et al*., 2003). This theme relates to the KEYS dimension Work Group Supports. This dimension relates to a team comprising a diversely skilled group of people who communicate well with each other and are supported by each other.

Company infrastructure

This theme relates to the infrastructure of the company and its support for radical innovation, the team and provision of adequate resources. This theme is linked to five KEYS dimensions. The first, Sufficient Resources, relates to the funds, materials, facilities and information necessary for the team. The second dimension, Workload Pressure – an inhibitor to creativity – relates to extreme time pressures, unrealistic expectations for productivity and distractions from creative work. The third dimension, Organizational Encouragement, relates to management style and mechanisms that encourage creativity. The fourth, the other KEYS inhibitor – Organizational Impediments – relates to management style and mechanisms that encourage avoidance of risk, are critical of new ideas and an overemphasis on the status quo. The final dimension, Supervisory Encouragement, relates to encouragement of the work of the team and its members. With this dimension, the perception that team members feel, ie, that their work matters to the organization and that the organization is open to new ideas and not looking for flaws, is assessed.

Representation of the Themes and the Keys dimensions

Using aspects of a Type II radical innovation culture (from Table 4-6) grouped in the context of the nine themes, sample KEYS questions informing the KEYS dimension and related to the themes are shown in Table 5-3. This is used to indicate where the KEYS dimensions relate to the nine themes.

Table 5-3 KEYS dimensions in relation to the nine themes

Theme (from Table 4-4)	Type II radical innovation culture characteristics (from Table 4-6)	Sample KEYS questions informing the dimension (Amabile, Burnside, and Gryskiewicz, 1999)	KEYS Dimension relating to the theme (Amabile *et al.*, 1999)
Freedom/ Latitude	Allows thinking to go beyond what currently exists. Exploration and discovery are part of the way things are done.	Q1. I have freedom to decide how I am going to carry out my projects. Q23. I do not have the freedom to decide what projects(s) I am going to do. Q44. In my daily work environment I feel a sense of control over my own work and my own ideas.	Freedom. Giving people the means and process but not necessarily the ends to derive a solution.
Attitude to risk	Taking risks is encouraged. Uncertainty is a part of the environment and discovery is accepted as being linked to taking risk.	Q45. Failure is acceptable in this organization, if the effort on the project was good. Q62. People are encouraged to take risks in this organization.	Organizational Encouragement. The organization encourages creativity through constructive judgement of ideas and a shared vision of what the organization is trying to do. Risk taking is encouraged.
		Q43. Top management does not want to take risks in this organization. Q66. People are too critical of new ideas in this organization.	Organizational Impediment. New ideas are criticized, there is an avoidance of risk, and there is an overemphasis on the status quo.

Table 5-3 KEYS dimensions in relation to the nine themes

Theme (from Table 4-4)	Type II radical innovation culture characteristics (from Table 4-6)	Sample KEYS questions informing the dimension (Amabile, Burnside, and Gryskiewicz, 1999)	KEYS Dimension relating to the theme (Amabile et al., 1999)
Growth/ Development	A desire to grow and develop the ability and knowledge of the group. A hunger to know more and know why.	Q53. I feel challenged by the work I am currently doing.	Challenging Work. There is a sense of working on important projects and undertaking challenging tasks.
External confidence	Having confidence and believing in the team supports the team's ability to "do differently" in pursuit of radical solutions.	Q28. In this organization top management expects that people will do creative work.	Organizational Encouragement. The company encourages the team to do differently and to solve problems creatively.
		Q31. There are unrealistic expectations for what people can achieve in this organization.	Workload Pressure. Extreme time pressures, unrealistic expectations for productivity and distractions from creative work.
		Q43. Top management does not want to take risks in this organization. Q78. Destructive criticism is a problem in this organization.	Organizational Impediment. Politics, criticism of new ideas, destructive interdepartmental competition and avoidance of risk discourage creativity.

Table 5-3 KEYS dimensions in relation to the nine themes

Theme (from Table 4-4)	Type II radical innovation culture characteristics (from Table 4-6)	Sample KEYS questions informing the dimension (Amabile, Burnside, and Gryskiewicz, 1999)	KEYS Dimension relating to the theme (Amabile et al., 1999)
Internal confidence	Confidence among the team members that they can find a radical solution. Working with and respecting the individual talents of each team member. Questioning, challenging but also supporting and nurturing the other team members.	Q2. I feel that I am working on important projects. Q7. The tasks in my work are challenging. Q38. The organization has an urgent need for successful completion of the work I am now doing.	Challenging Work. There is a sense of working on important projects and undertaking challenging tasks.
	Team members are an autonomous unit that believes it can "do differently" to provide the radical solutions.	Q15. There is a feeling of trust among the people I work with most closely. Q19. Within my work group, we challenge each other's ideas in a constructive way. Q29. In my work group, people are willing to help each other. Q67. There is free and open communication within my work group.	Work Group Support. The team is open to new ideas and constructively challenges each other's work. They trust and help each other and feel committed to the work they are doing.
		Q68. My supervisor values individual contributions to project(s). Q73. My supervisor is open to new ideas.	Supervisory Encouragement. The supervisor supports the team and encourages them in being creative.

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Table 5-3 KEYS dimensions in relation to the nine themes

Theme (from Table 4-4)	Type II radical innovation culture characteristics (from Table 4-6)	Sample KEYS questions informing the dimension (Amabile, Burnside, and Gryskiewicz, 1999)	KEYS Dimension relating to the theme (Amabile et al., 1999)
External perspective	Provides alternative perspectives and awareness of new technologies. These may not solve the problem but may trigger a "do different" solution that leads to radical innovation.	None.	None.
Clear objectives	Too specific objectives may inhibit the discovery of alternatives. Objectives that are not specific and clearly defined will encourage questioning and permit knowledge advancement.	Q9. My supervisor clearly sets overall goals for me.	Supervisory Encouragement. The supervisor sets clear strategic goals.
		Q1. I have the freedom to decide how I am going to carry out my projects. Q12. I feel considerable pressure to meet someone else's specifications in how I do my work.	Freedom. There are clearly defined strategic goals that do not change frequently. There is autonomy to decide the course of action within these goals.
Team composition	The team must have a mix of creative individuals who have sufficient experience inside or outside the subject area such that they can apply lateral thinking to provide a radical solution. The team should comprise different minded individuals who can work with some degree of uncertainty and conflict as part of the day-to-day activities.	Q6. My co-workers and I make a good team. Q41. There is a good blend of skills in my work group.	Work Group Supports. The team is a diversely skilled group of people who communicate well with each other.

Table 5-3 KEYS dimensions in relation to the nine themes

Theme (from Table 4-4)	Type II radical innovation culture characteristics (from Table 4-6)	Sample KEYS questions informing the dimension (Amabile, Burnside, and Gryskiewicz, 1999)	KEYS Dimension relating to the theme (Amabile *et al.*, 1999)
Company infrastructure	A management style that encourages risk taking. Bureaucracy or autocracy are likely to inhibit this group. Some restriction in resources is necessary for creativity – Goldilocks principle – not too little and not too much. Having a champion to provide support at a high level is beneficial.	Q26. The facilities I need for my work are readily available to me. Q32. Generally I can get the resources I need for my work. Q46. The budget for my project(s) is generally adequate. Q57. I can get all the data I need to carry out my projects successfully. Q63. I have trouble getting the materials I need to do my work. Q75. The information I need for my work is easily available.	Sufficient Resources. Funds, materials, facilities and information are provided to the team.
		Q3. I have too much work to do in too little time. Q11. I have sufficient time to do my project(s). Q70. I feel a sense of time pressure in my work.	Workload Pressure. Extreme time pressures, unrealistic expectations for productivity and distractions from creative work.

Table 5-3 KEYS dimensions in relation to the nine themes

Theme (from Table 4-4)	Type II radical innovation culture characteristics (from Table 4-6)	Sample KEYS questions informing the dimension (Amabile, Burnside, and Gryskiewicz, 1999)	KEYS Dimension relating to the theme (Amabile *et al.*, 1999)
Company infrastructure (continued)		Q18. New ideas are encouraged in this organization. Q22. Performance evaluation in this organization is unfair. Q49. People are encouraged to solve problems creatively in this organization. Q50. People are rewarded for creative work in this organization. Q61. This organization has a good mechanism for encouraging and developing creative ideas.	Organizational Encouragement. A management style, and mechanisms that encourage creativity.
		Q4. This organization is strictly controlled by upper management. Q10. There is much emphasis in this organization on doing things the way we have always done them. Q30. Procedures and structures are too formal in this organization.	Organizational Impediments. Management style and mechanisms that encourage avoidance of risk, are critical of new ideas and an overemphasis on the status quo.
		Q37. My supervisor plans poorly. Q59. My supervisor does not communicate well with our work group.	Supervisory Encouragement. Taking time to encourage the work of the team and its members. People feel that their work matters to the organization. Being open to new ideas and not looking for flaws.

5.5.2 *The nine themes and the OCAI dimensions*

The linkages between the nine themes and the OCAI dimensions are less clearly mapped as there are only two dimensions assessed in the OCAI. There is broad overlap along the themes relating to an Adhocracy culture. This culture is one that is best suited to facilitate radical innovation. The aspects of this culture type, ie, dynamic, entrepreneurial and creative, where people take risks and the leaders are considered to be innovators and risk takers, represent the Type II radical innovation culture. In this culture the organization is committed to experimentation and innovation and it encourages individual initiative and freedom. The two dimensions of the OCAI represent the degree of control or discretion applied to the organization's members and the focus of the organization's members towards an internal or an external perspective. The themes' positions on the two dimensions are considered from the perspective of the radical archetype for each theme as defined in Table 4-6.

The Attitude to risk and Freedom/Latitude themes sit at the Flexibility and Discretion end of the vertical axis. These themes are related to higher degrees of flexibility and discretion in the management of radical innovation projects. The close control and stability at the opposite end of the dimension tends to inhibit radical innovation. The Clear Objectives theme can be considered to sit midway on the Control/Flexibility axis. A radical innovation is facilitated by clear, strategic and less well-defined tactical objectives, thus requiring objectives that are simultaneously tight and loose. Along the horizontal axis, the themes, Company infrastructure, Growth/Development, External perspective, External confidence and Internal confidence are located at the External Focus and Differentiation end of this dimension. These themes relate to taking an external perspective and to taking a "do different" approach to radical innovation projects. The predominance of the themes at the top and right of the two axes aligns with the Adhocracy culture. However, one theme, Team composition does not align with either of the axes. This is because this theme is predominantly concerned with the composition of the team, their skills and experience. This theme is, therefore, not mapped onto the OCAI model. A representation of the alignment of the themes with the dimensions of the OCAI is shown in Figure 5-4.

Themes not mapped onto the OCAI map are:
- Team composition

Flexibility and Discretion
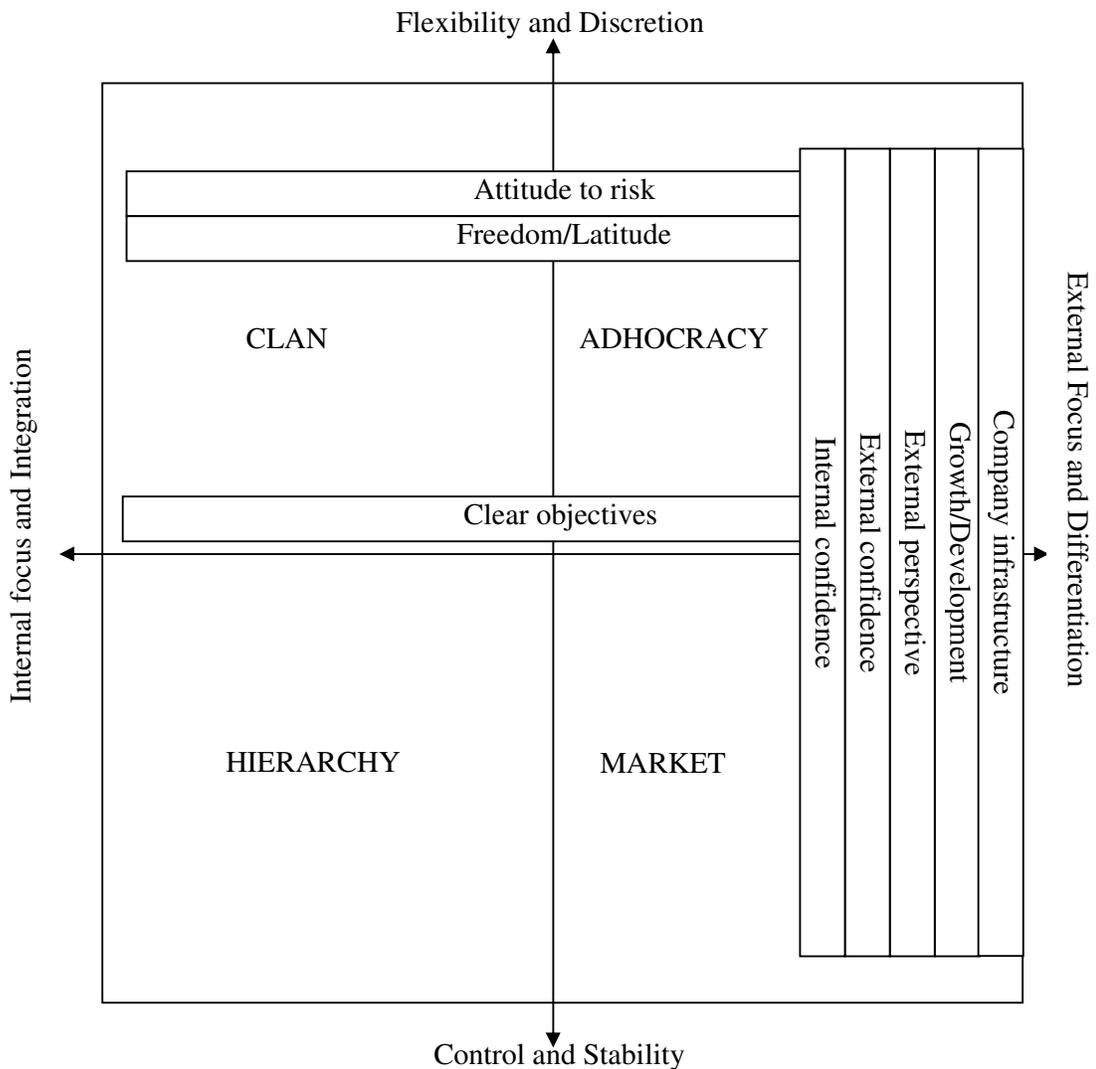
Figure 5-4 Relationship between nine themes and the OCAI dimensions

5.6 First use of the composite instrument

The composite instrument was discussed with the Development Team and a first assessment of the organizational culture and creative climate made. The OCAI questionnaire (Appendix C) was distributed along with a KEYS workbook to each team member. The presentation to the team included instructions on how to complete the questionnaires. The OCAI data were analysed by the researcher. The KEYS data were analysed by CCL after the completed workbooks had been returned to Greensboro, North Carolina.

5.7 Results from the composite instrument

The results from the first use of KEYS showed a very low climate for creativity. All the dimensions scored extremely low and in some cases, Supervisory Encouragement and Freedom, the Cerulean score was below the lowest previously recorded in the KEYS database. The KEYS scores are shown in Table 5-4 and the graphical representation is shown in Figure 5-5.

Table 5-4 KEYS scores from assessment of October 2004

KEYS dimension	Cerulean score	Highest in KEYS database	Lowest in KEYS database
Organizational Encouragement	28.8	84.2	25.3
Supervisory Encouragement	17.5	75.7	27.9
Work Group Supports	40.6	70.0	22.6
Freedom	20.9	71.7	26.4
Sufficient Resources	26.4	82.4	26.9
Challenging Work	34.1	75.8	22.1
Organizational Impediments	33.3	74.3	24.6
Workload Pressure	23.7	88.3	21.9
Creativity	35.4	75.9	29.3
Productivity	27.1	78.9	25.0

The scoring in the KEYS assessment is based on a scale from 0 to 100. The units are derived from the output from the individual KEYS questionnaires. The mid point of 50 represents a median score. Scores above 60 are considered to represent very high levels of creative climate and scores below 40 are considered to represent very low levels of creative climate.

Cerulean
October 2004

Score

90
80
70
60
50
40
30
20
10
0

Very High
High
Mid-range
Low
Very Low

Organizational
Encouragement

Supervisory
Encouragement

Work Group
Supports

Freedom

Sufficient
Resources

Challenging
Work

Organizational
Impediments

Workload
Pressure

Creativity

Productivity
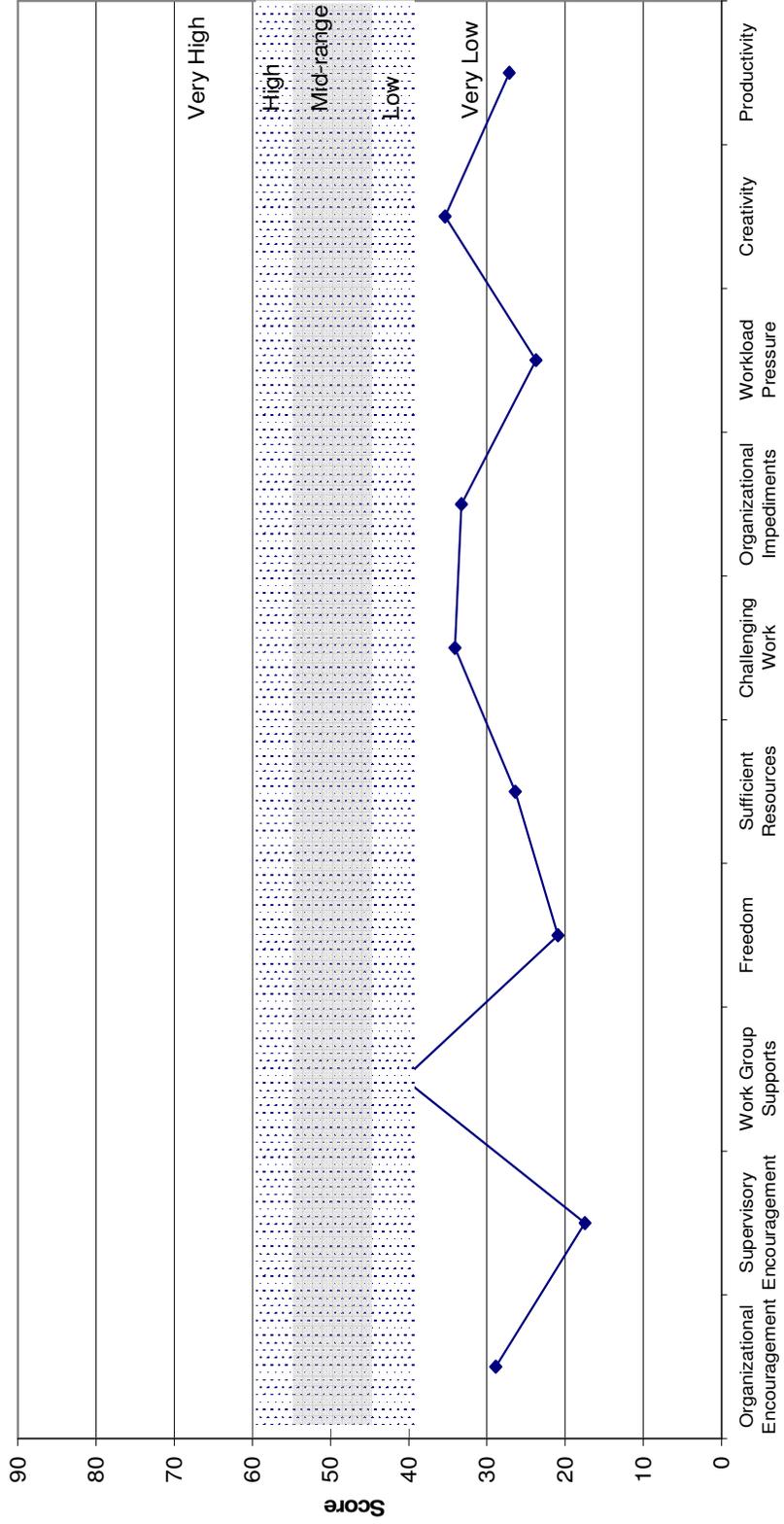
Figure 5-5 Results from first use of the KEYS assessment

The OCAI analysis for the Development Team indicated an organizational culture that was perceived to be highly oriented towards Market and Hierarchy cultures. This is in line with a "do better" culture. The perception of the team members for a preferred culture was for one that was highly scored in Clan and Adhocracy culture. The Adhocracy culture scored highest in the preferred culture. The OCAI scores are shown in Table 5-5, and the graphical representation of current and preferred organizational culture positions is shown in Figure 5-6.

Table 5-5 OCAI scores from assessment of October 2004

CURRENT POSITION	Score
CLAN	16.4
ADHOCRACY	14.9
MARKET	35.2
HIERARCHY	33.3

PREFERRED POSITION	Score
CLAN	27.5
ADHOCRACY	32.0
MARKET	20.9
HIERARCHY	19.9
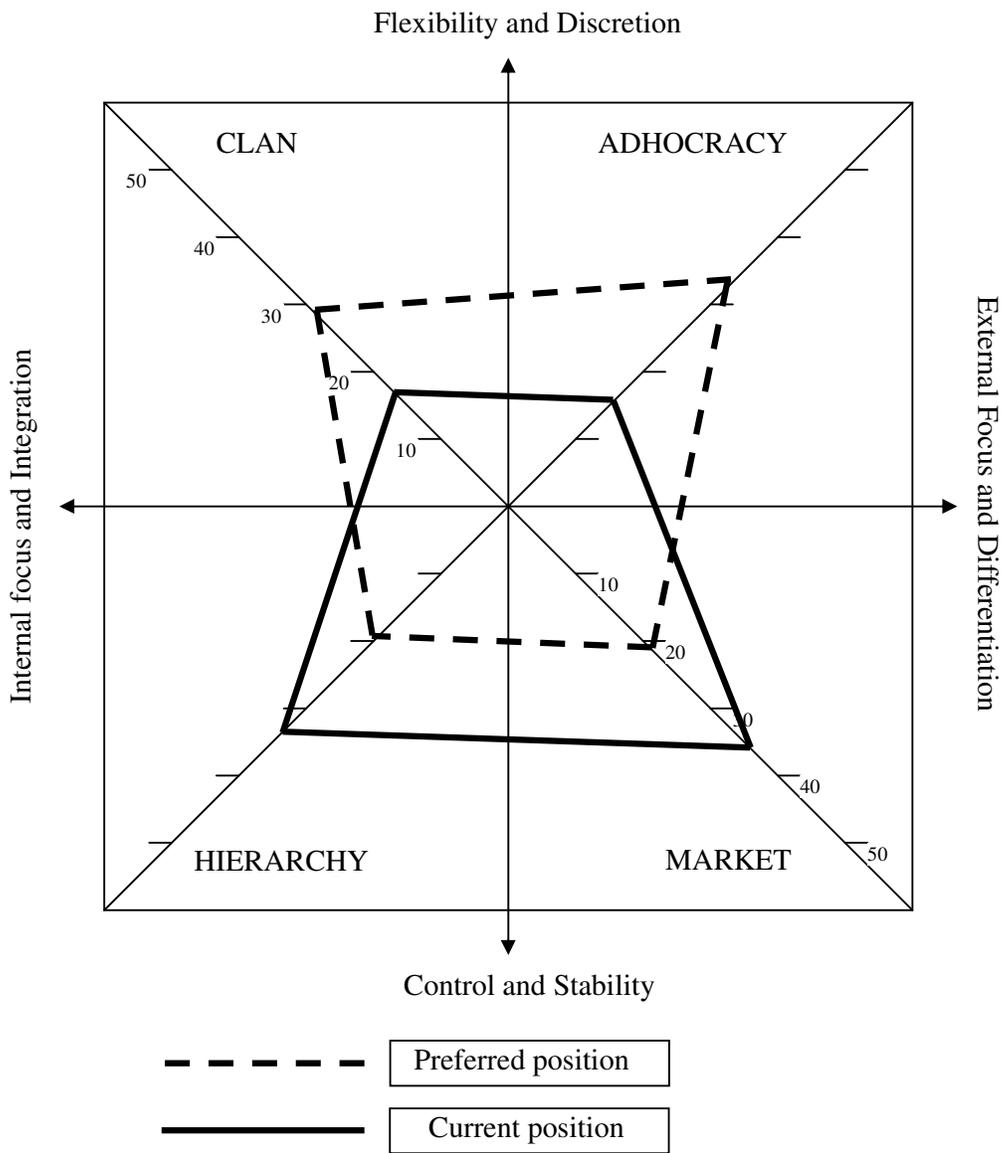
Figure 5-6 Results from first use of the OCAI assessment

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5.8 Self-assessment of proximity to a Type II radical innovation culture

The OCAI and KEYS results were discussed with the Development Team. This led to a joint review of the assessment results and their relevance to a radical innovation culture. In order to gauge the radical innovation culture more specifically, an assessment tool based on the radical innovation culture archetype described in Table 4-6 was participatively developed with the Development Team. Descriptions of what a radical innovation culture would "look like" and "feel like" were developed for each of the themes. A series of short statements relating to each of the nine themes were developed with the team members to describe an ideal radical innovation culture – the Type II position. These descriptions were grouped together to form nine theme-based descriptions of a radical innovation archetype. The statements for each theme indicated a state that would exist for the team if the ideal archetype, ie, Type II – a radical innovation culture, existed in the team. The team members assessed their perception of the radical innovation culture by gauging how close they perceived they were to each of the theme statements reflecting the ideal position of a Type II radical innovation culture. The statements used in the self-assessment for each theme are shown in Table 5-6.

Table 5-6 Ideal position for a Type II radical innovation culture.

Theme	Statements used to assess position against an ideal Type II position
Freedom/ Latitude	Exploration and discovery are part of the way things are done. Opportunity is provided to try new ideas. The team has a high degree of control over what steps it takes to achieve the objective
Attitude to risk	Taking risks is encouraged. Uncertainty is a part of the environment and discovery is accepted as being linked to taking risk.
Growth/ Development	There is a desire to grow and develop the ability and knowledge of the group. A hunger to know more and know why. The team is encouraged to gain new skills.
External confidence	People outside the team expect a "do differently" approach to new product development. People outside the team have confidence that the team will develop a radically different solution that will resolve the problem.
Internal confidence	The team is confident that it can find a radically new solution. Working with and respecting the individual talents of the other team members is a normal way of working. The team is comfortable with a questioning, and challenging of new ideas, and this is usually built upon to develop useable new ideas. The team is an autonomous unit that believes it can "do differently" to provide the radical solutions.
External perspective	Alternative perspectives and awareness of new technologies are constantly being sought by the team. These provide an array of possibilities that the team can call upon to resolve internal problems.
Clear objectives	Overall objectives are not specific but outline targets. These allow the team to make decisions about how to achieve these objectives. A degree of latitude in the set objectives is provided to the team.
Team composition	There is a mix of creative individuals in the team who have sufficient experience inside or outside the subject area such that they can apply lateral thinking to provide a radical solution. The team comprises different minded individuals who can work with some degree of uncertainty and conflict as part of the day-to-day activities. If disagreement happens because of this, then that is accepted.
Company infrastructure	A management style that encourages risk taking is prevalent. Rule following and conformance to procedures is not enforced and not considered to be necessary. Resources are neither abundant nor too tightly restricted. A "Champion" provides support for new product projects at a high level in the company.

Each individual score was added together and averaged to produce a group perspective of the Development Team's position against an ideal Type II radical innovation culture. The result is shown in Table 5-7.

Table 5-7 Innovation Culture self assessment scores

Theme	Average score
Freedom/Latitude	3.93
Attitude to risk	3.36
Growth/Development	4.93
External confidence	5.07
Internal confidence	5.00
External perspective	5.57
Clear objectives	4.64
Team composition	6.36
Company infrastructure	3.71

The object of this assessment was to identify the themes that were farthest away from the ideal position, and use these as a starting point for group discussion about possible interventions to change the innovation culture. By having statements about an ideal position, the team members would have a point of reference as a target for the result of the interventions. The results indicate that the team perceives itself as a little like a radical innovation team in respect of Team composition, whilst for the other themes the team perceives itself as generally unlike a radical innovation culture. The lowest scoring theme is Attitude to risk, with a score indicating the team felt that it was generally unlike a radical innovation culture. Also of interest in this assessment is the lower score for Company infrastructure. The team feels that the company support, management style and resource provision is not supporting radical innovation. This is in resonance with the low score in KEYS for Supervisory Support for Creativity. A graphical representation of this assessment is shown in Figure 5-7.
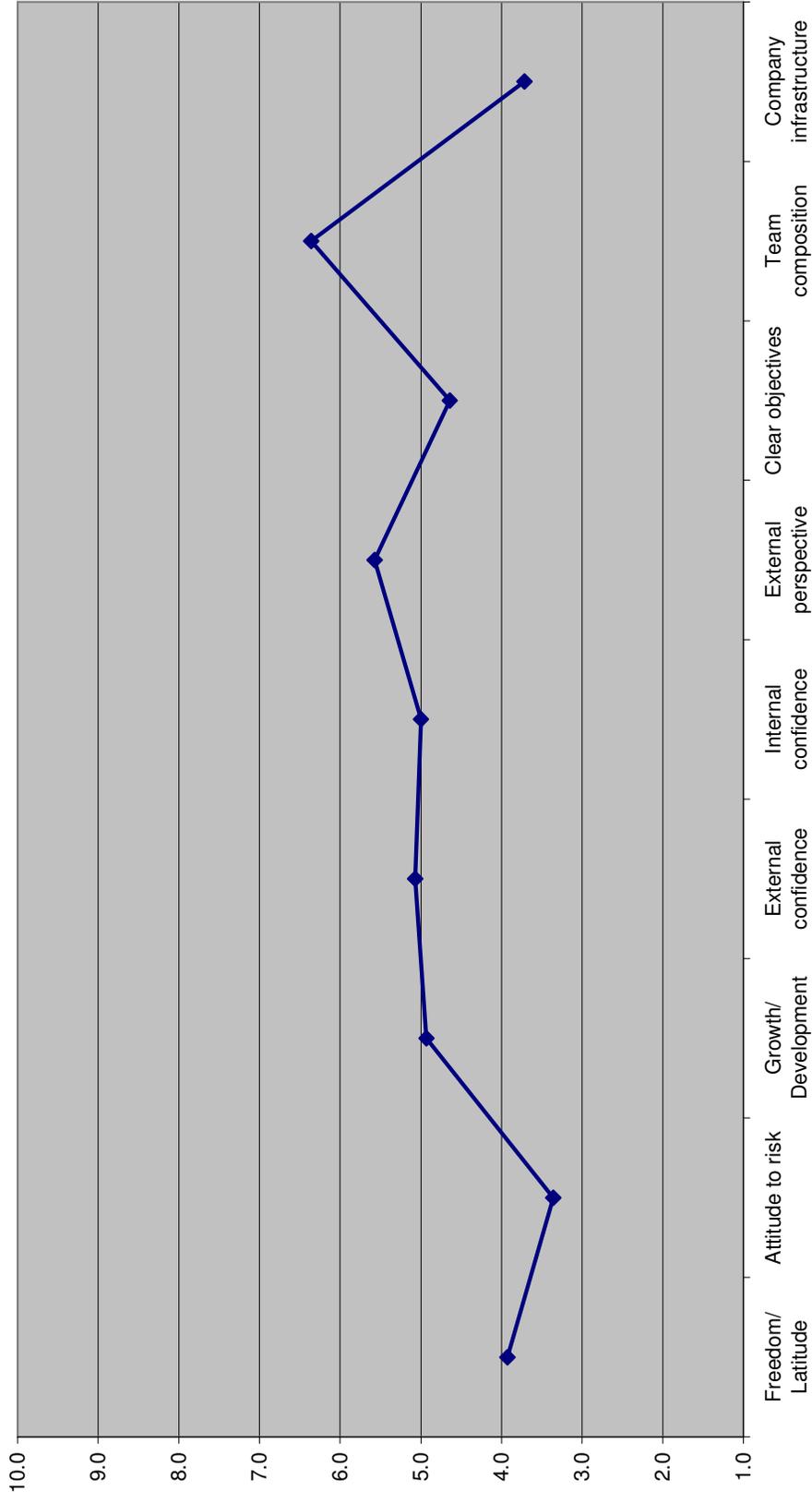
Figure 5-7 Results from innovation culture assessment

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5.9 Key points from Project Two

The OCAI assessed organizational culture, KEYS assessed creative climate and the innovation culture assessment can be considered to gauge the proximity of the team to a radical innovation enabling culture. The areas of relevance for the three assessments and their overlap are represented in Figure 5-8 using the model of innovation culture shown in Figure 3-4.
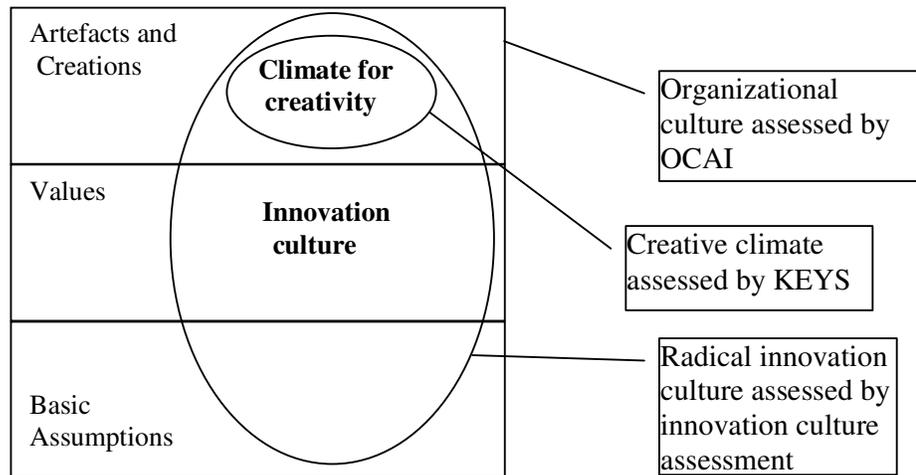
Figure 5-8 Relationship between assessments

The key points arising from Project Two can be summarized as:-

- KEYS and OCAI provided a composite assessment of the extant organizational culture and creative climate.
- Self-assessment by the Development Team of its perceived position against an ideal Type II, radical innovation culture indicated a similar position to that shown by OCAI and KEYS.
- Creativity is restricted by poor Supervisory Encouragement and restricted Freedom.
- The Development Team's self-assessment of its position with respect to a radical innovation culture was that the themes of Attitude to risk and Freedom/Latitude were particularly distant from the ideal position.
- The team perceived that the theme Company infrastructure, which includes the environment around the team, is not supportive to radical innovation.
- The team feels that their skill-set and experience, reflected in the theme Team composition, is more enabling for radical innovation than any of the other themes.

The output from this set of instruments indicated the extant position against an ideal type for a radical innovation culture. It also indicated areas where there were perceived inhibitors to developing a radical innovation culture. This provided a starting point for a participative evaluation of the assessments and developing a plan of integrated interventions to facilitate a radical innovation culture. The evaluation of suitable interventions to achieve this end and development of a plan suitable for the Cerulean Development Team formed the basis for Project Three.

6 Project Three
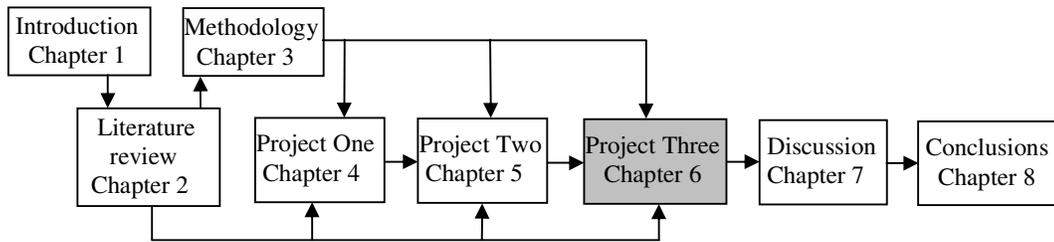
Figure 6-1 Research overview – Project Three

6.1 Introduction to Project Three

The third project in the research focused on identifying suitable interventions to facilitate a radical innovation culture. Participative review with the Development Team of the results of the assessments in Project Two in context of the ideal archetype of a radical innovation culture developed in Project One developed a series of possible interventions. A literature search identified interventions relevant to developing a radical innovation culture. Case and empirical examples of interventions that had been tried were evaluated. This provided examples of interventions used, how they were implemented and their perceived influence on changing the innovation culture. The empirical examples were sourced from case studies and from firms involved with DIF (Discontinuous Innovation Forum) activities (Bessant, Lamming, Noke and Phillips, 2005). Interventions in the context of this research refer to specific actions that have been or could be applied to a group with the objective of facilitating aspects of a radical innovation culture. Evaluation of these interventions permitted an "action plan" for Cerulean to be developed. A plan of linked interventions designed to develop aspects of a radical innovation culture forms the output for Project Three. The research plan for Project Three is represented in Figure 6-2.
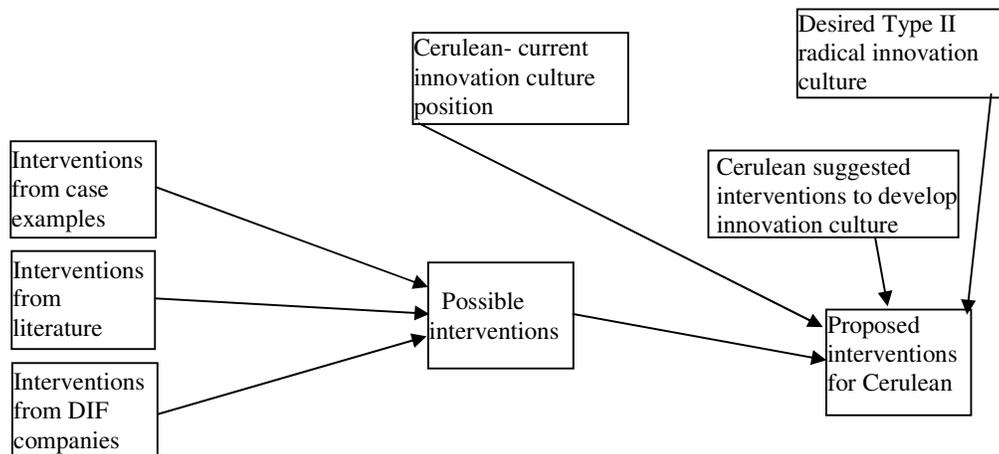
Figure 6-2 Research plan for Project Three

The context of Project Three in the overall research is shown in Appendix B.

6.2 Development Team suggested interventions

The Development Team engaged in a process to review the results from the three assessments described in Project Two, with the objective of making suggestions to facilitate a radical innovation culture. The OCAI culture profile indicated that movement along one dimension, towards more flexibility, discretion and freedom was the change required to move to a more radical innovation supporting culture – the Adhocracy (Cameron and Quinn, 1999). KEYS results (Amabile *et al*., 1996) indicated extremely low scoring on Supervisory Encouragement and Freedom, and low scoring on the other dimensions. The assessment against the ideal position for a radical innovation culture indicated generally low scores across all the themes. The lowest scoring themes were Attitude to risk, Company infrastructure and Freedom/Latitude. All three assessments indicated low scores for freedom and risk taking. The assessment results were used as the basis for exploring the issues associated with these scores and possible methods of improving them. Brainstorming was used to gather the Development Team's ideas related to developing a radical innovation culture. These ideas were discussed and refined in an iterative process to develop possible interventions that would facilitate aspects of a radical innovation culture. Where possible, each intervention was described in terms that specified an end point and a group of people responsible for undertaking the intervention. The output from the discussion was a list of six interventions. These were considered to be feasible for the team members and management, to be realistic in their intent and to be capable of developing a Type II radical innovation culture. The interventions suggested are shown in Table 6-1.

Table 6-1 Interventions suggested by Cerulean Development Team

	Intervention
1	Better time management, to allow slack, to allow some personal (radical) development projects to take place.
2	Development Team members be permitted and supported to undertake personal development projects that would be available for an "Ideas Market" session. This venue to be used as a forum to allow decisions to be made on what should be allowed to continue and what should be dropped amongst the personal (radical) development projects.
3	Resource allocation be made available to support these personal (radical) development projects.
4	Visits to external sources for ideas. Other companies, suppliers, customers, universities would provide sources of ideas for what is possible.
5	Exposure to the Sales team members and customers to better understand the potential issues facing customers, the industry and the company.
6	Management to work with the Development Team to facilitate these actions and to demonstrate trust in the team.

Following the development of these suggested interventions, interventions from literature and empirical examples of interventions used to facilitate a radical innovation culture were examined.

6.3 Interventions from the literature

The literature was examined for empirical examples of interventions made to improve radical innovation capability in firms using the criteria of an action and subsequent

outcome that was made to improve radical or discontinuous innovation capability. Examination of the literature discussed in Chapter 2 suggested a number of interventions. These are summarized in Table 6-2.

Table 6-2 Interventions from literature that facilitate radical innovation

	Intervention	Supporting literature
1	Resource provision to support experimentation	(Delbecq and Mills, 1985), (Christensen, 1997), (Judge *et al*., 1997), (Christensen and Overdorf, 2000), (Gundling, 2000)
2	Leadership for a radical innovation culture	(Buckler and Zien, 1996), (Schneider *et al*., 1996), (Tushman and O'Reilly III, 1996), (Judge *et al*., 1997), (Tushman and O'Reilly III, 1997), (Morison, 1988), (Rice *et al*., 1998), (Tushman and O'Reilly III, 1999), (Gundling, 2000), (Leifer *et al*., 2000), (Stringer, 2000), (Tripsas and Gavetti, 2000), (DeTienne and Koberg, 2002), (Abetti, 2003), (Christensen and Raynor, 2003)
3	Idea gathering and sharing process	(Christensen, 1997), (Norling and Statz, 1998), (Gundling, 2000), (Leifer *et al*., 2000), (Tidd *et al*., 2001), (Mikaelsson, 2002), (Elfing and Hulsink, 2003), (Hargadon, 2003), (O'Connor and McDermott, 2004), (von Stamm, 2004), (Amara and Landry, 2005)
4	Actions to encourage experimentation and learning	(Delbecq and Mills, 1985), (Bart, 1996), (Leonard-Barton, 1992b), (Chandy and Tellis, 1998), (Norling and Statz, 1998), (Cravens *et al*., 2002), (Mosey, 2005)
5	Team skills to promote "do different" behaviour	(Wolff, 1988), (Tushman and O'Reilly III, 1997), (Tushman and O'Reilly III, 1999), (Gundling, 2000), (Leifer *et al*., 2001; Simon *et al*., 2003), (Stevens and Burley, 2003), (Kelley *et al*., 2004), (O'Connor and McDermott, 2004)
6	Product champion for radical innovation projects	(Morison, 1988), (Veryzer, 1998), (Leifer *et al*., 2000), (Ettlie and Subramaniam, 2004), (Vincent, 2005)
7	Segregation of radical innovation activities from the routine	(Rich and Janos, 1994), (Bower and Christensen, 1995), (Rice *et al*., 1998), (Tushman and O'Reilly III, 1999), (Leifer *et al*., 2000), (Leifer *et al*., 2001), (Loutfy and Belkhir, 2001), (Malhotra *et al*., 2001), (O'Connor and Rice, 2001), (Benner and Tushman, 2003), (Macher and Richman, 2004), (O'Reilly III and Tushman, 2004).

The interventions that emerged from the literature indicated that leadership which encourages exploration and learning is important. To support this, the team should be developed and provided with adequate resources to facilitate this exploration. Segregation of radical activities and using a management champion are also noted as enabling interventions.

6.4 Examples of Type II radical innovation cultures

Greenwood and Hinings (1993) suggest that there are unlikely to be many organizations that are uniquely one archetype or another, but that they are more likely to display

characteristics of both. However, two examples of organizations that are predominantly Type II can be seen in Lockheed's Skunk Works and IDEO. They exist specifically to develop "do different" solutions for their customers. The characteristics of these organizations therefore tend towards a Type II radical innovation culture.

6.4.1 Skunk Works

A well known example of an organization set up to facilitate radical innovation is Lockheed's Skunk Works (Rich and Janos, 1994). Skunk Works is the unofficial name for Lockheed Martin's Advanced Development Projects Unit. This was the production unit responsible for a number of famous aircraft, including the U2, the SR71, and the F117. The history of the Skunk Works began in World War Two, when covert projects were located near Burbank airport (now Bob Hope Airport) in California. Kelly Johnson and his team developed the P80 in makeshift quarters in only 143 days. This aircraft was the US air force's first operational jet fighter. Kelly Johnson headed the Skunk Works until 1975, when Ben Rich took over leadership. In 1989, Lockheed reorganized its operations and relocated the Skunk Works to Palmdale, California, where it is still in operation today. Lockheed now considers the term "Skunk Works" to be a trademark of theirs, and has several registrations of it with the US Patent Office. The name came from a popular comic strip cartoon "Li'l Abner" by cartoonist Al Capp. In the cartoon, "Skonk Works" was a small factory whose business used skunks. (The exact nature of this enterprise was never explained). The Skonk Works was located far from other human habitation due to the terrible odour. In addition people who worked at the Skonk Works could only communicate with people of the outside world by yelling at them from a great distance while downwind. This name was deemed to be appropriate for the Lockheed development unit. The aspects of segregation, providing a "do different" focus and culture through innovation leadership and product champions are visible in this operation. The Skunk Works attitude was to attempt the impossible, and in so doing they created several radical new products for Lockheed. A culture of experimentation is encouraged by a management team who values its independence and isolation from the mainstream business activities. This creates confidence amongst the team members that encourages them to "attempt the impossible" in undertaking development projects. Rich and Janos define the heart of a Skunk Works operation as having extremely difficult but specific broad objectives and the freedom to take risks and fail.

6.4.2 IDEO

Another well known example of a radical innovation organization is IDEO, a 350-person design consultancy. It has offices in Palo Alto, San Francisco, Chicago, Boston, London, and Munich. Office-furniture maker Steelcase Inc. owns a majority stake in the firm, which operates as an independent unit. Its client list includes Hewlett-Packard, AT&T Wireless Services, Nestlé, Vodaphone, Samsung, NASA, and the BBC. IDEO began in 1991 as a merger between David Kelley Design, which created Apple Computer Inc.'s first mouse in 1982, and ID Two, which designed the first laptop computer in the same year. It has designed hundreds of products and won more design awards over the past decade than any other firm. IDEO is best known for designing user-friendly computers, PDAs, and other high-tech products such as the Palm V, Polaroid's I-Zone cameras and the Steelcase Leap Chair. It also designed the first no-squeeze, stand-up toothpaste tube for Proctor & Gamble's Crest and the Oral-B

toothbrushes. IDEO advises clients by teaching them about the consumer world through the eyes of anthropologists, graphic designers, engineers, and psychologists (Kelley and Littman, 2001).

This organization has the people skills and attitudes, systems and processes that facilitate a radical innovation culture. IDEO prospers by producing "do different" innovations, so this is a key focus for the organization. The behaviours and characteristics of this organization provide a clear indicator of a successful Type II innovation culture. The organization members in IDEO are no smarter, more rebellious or more courageous, than other organizations. They are simply better connected. These external connections provide an input of new ideas and knowledge into the group to facilitate innovation. Existing ideas and/or technologies are continuously re-evaluated to create something new. There are advantages in finding networks that connect different worlds. IDEO acts as a technology broker making it possible to build new connections between disparate organizations and groups (Hargadon and Sutton, 2000).

Hargadon and Sutton state that 'Culture has a profound effect on innovation via the value it places on tradition versus change, the stigma that is associated with ignorance and failure, the role of competition versus collaboration, and the value placed on invention versus using old ideas.' (2000: 153). The culture in IDEO supports the structure and the work practices within this organization by creating a shared sense of purpose and process. Individuals are encouraged to learn as much as they can about each new industry they enter because they share the value placed on learning about things that others might not have seen before. Thus they are willing to help others in the team, and are comfortable asking for help from others in the team. Asking for help is not seen as a sign of weakness. In IDEO, sharing problems and admitting failures is expected. However, failing alone attracts little sympathy.

6.5 Case examples

The database of the European Case Clearing House (ECCH) at Cranfield was searched for case studies that included interventions focused on improving radical or discontinuous innovation capability of the organization. Cases that included interventions relating to "innovation" and "new product development" were identified from the ECCH database. Four cases of a success were identified (BMW, Harley-Davidson, Mattel and 3M) and one of a failure (Hewlett-Packard). These cases discuss broader areas of business change than innovation or new product development. However, within the cases selected, there is an aspect of radical innovation, and interventions that were intended to improve the outcome of the radical innovation aspect of the project or could be considered to have improved the radical innovation capability based on literature findings, were identified. These cases were considered to be most relevant to this research in respect of the "do different" aspect of the innovation process and from the perspective that each case displayed one or more interventions focused on improving the product development capability of the organization. The key interventions are identified using the criteria defined above. There is overlap between the innovation projects that are incremental and those that are radical in some of the case studies. This is not always explicitly stated in each case. The analysis of the cases ignored any intervention unless it had an application to a "do different" type of project.

6.5.1 3M

3M (Gayatri, 2004) is an exemplar of innovation and innovation culture. It was ranked Number One in the Fortune list of most admired companies in the category "precision equipments" in 2004. From its origins as an abrasive manufacturer, it has developed a diverse range of products based on the innovative ideas of its employees. It is well known for is 15% rule, where employees are encouraged to devote 15% of their work time to developing novel ideas and their implementation. Employees who spent more than the stipulated time were never stopped from doing so. The allocated time was later increased to 25% and then to 30% in the early 1990s. Since its early years it has encouraged a culture of innovation. Despite this background, the 1990s saw the company performance decline. Profits fell and R&D stagnated. The company was not coming out with the new products at the pace it done previously. Many functions were duplicated and the cost structure was high.

A new CEO, W. James McNerney Jr., took the reins in 2001. He was the first outsider to lead the company and was unfamiliar with the 3M culture. McNerney, a veteran of GE, believed he could leverage the organizational and financial discipline to provide shorter times to market for new ideas, whilst protecting the corporate spirit for innovation. He laid off 5000 people in his first few weeks. He instigated cost savings in the business. He removed the 30% rule, whereby 30% of revenues were to come from products launched in the last four years. He considered that this rule was promoting haphazard ideas rather than promoting innovation. McNerney was concerned about the large number of products in the pipeline, in excess of 1500 on occasions. He believed quicker time to market was essential. He introduced a market oriented approach to new product innovations. Marketing functions were brought closer to research and manufacturing functions. He allocated more cash to promising ideas and dropped unprofitable ones. The programme was called 3M-Acceleration. This accelerated the research and implementation of new ideas with high probability of success. This allowed the R&D budget to be used more effectively and reduced unnecessary expenditure on projects that had no potential. Although a larger corporation, 3M was in a position where it had restricted resources and had to also focus on cost control and reduction. McNerney was taking an approach that a small firm would be forced to adopt due to its small size and resultant limit on resource availability. He expressed a desire to cut costs and restructure, but clearly indicated that he wanted to retain the innovation focus that had been the cornerstone of the company. The innovation aspect remained a top management priority. He also implemented a programme called Leadership Development to train employees to discuss problems and encourage them to contribute to providing solutions. This was based on a similar development programme at GE. Research and Development became more focused. Researchers, instead of accidentally stumbling on ideas, had a clear scope for their research and this was aligned with business needs. Early indications are that the strategy is benefiting 3M. Profits are improving and the innovation culture is retained.

6.5.2 BMW

The Munich based Bayerische Motoren Werke AG (BMW) (Radhika, 2003) started as an aero engine manufacturing company. Its roots can still be seen in the "spinning propeller" badge used on their products. It diversified into motorcycle and car manufacture and these became the core products of the business. In the 1950s the company came to the edge of bankruptcy and was rescued by Quandt, an industrial

financier. Quandt acquired a majority of shares and restructured the company to improve performance. During the 1970s and 1980s the company expanded globally. Although emerging as a major competitor to Volkswagen and Mercedes, BMW's performance began to suffer. During the 1990s BMW was criticized for having a model range where all the models looked alike. "One sausage three different lengths" was how it was described in the Press. In addition there were production and quality problems. The market was becoming more demanding, and this along with the problems faced by BMW made it imperative for the company to focus on product efficiencies, constantly generate new product/component ideas and launch a continuous stream of new and upgraded models. The company recognized that most of the new ideas generated were not getting the required attention in the innovation process. The company restructured its innovation routines to create a focused innovation process that would reduce time to market for new products and components to meet changing customer requirements. BMW used an external consultancy that confirmed that although many new ideas were in circulation, the innovation process failed in selecting the best ideas and in allocating appropriate resources. The consultants found more than 1200 innovations in progress at one time. There was also a lack of coordination between the different company divisions.

The restructuring plan was aimed at integrating the innovation process with the business plan, thus aligning the innovation activities with specific customer requirements. The new process focused on three major areas, unique selling propositions for each vehicle to be launched, breakthrough innovations and concept cars to convey brand image. The innovation process involved idea gathering from external technological sources in a database called Technis. In addition inputs from external sources, individuals, universities and other companies were sought and collated using a Virtual Innovation Agency (VIA) intranet system. The VIA generated more than 1000 ideas within one and a half years of its launch. Ideas were selected and prioritized through an Innovation Management stage. This weeded out weak ideas from the potentially successful, and prioritized the innovations. The company focused on specific areas of innovation. These included breakthrough innovations, premium branding environment and social responsibility and safety. Management resource was allocated to the innovation process and involvement of senior management took place at several stages, where selection, prioritization and resource allocation decisions were made. Top management leadership was demonstrated by the involvement of BMW board members in the Innovation Strategy Team. This group decided on the direction of innovations and the extent to which breakthrough innovations were pursued. The innovations selected to progress were guided by a steering committee. This group review progressed and facilitated cross-functional communication of ideas. This assisted with retaining a focus on company objectives rather than departmental objectives. There was a specific recognition of "breakthrough innovations" and management resource was allocated to projects of this type. Breakthrough innovations were categorized as such by a committee called the Innovation Field Committee. This group also prioritized the innovation project and allocated resources. The breakthrough projects were managed as part of the total innovation programme. Radical innovations therefore had their own categorization and were managed separately, but within the overall development programme. These innovations were reported to the main board much before the other innovation projects, as there was recognition that they involved potentially higher expenditures and strategic significance than the other projects. The

result of the adoption of the new system was that there were roughly 100 projects running at any one time, down from over 1200 prior to the adoption of the new system. The company has decreased time-to-market for new products by two-thirds and linked its revenues to the introduction of leading edge products.

6.5.3 Harley-Davidson

Harley-Davidson began operations in 1903 (Sarvani, 2004). The hallmark Harley V twin first emerged in 1909. Since then the basic concept has been developed to produce several generations of motorcycle products. In 1969 the company was acquired by American Machine and Foundry (AMF) and this began a period of attempting to increase sales but the push for output had the effect of reducing quality. Against a background of poor quality and falling sales AMF sold the business to thirteen members of the management team. From the brink of bankruptcy in the early 1980s, Harley-Davidson staged an improvement that led to an award for "Outstanding Corporate Innovator" in 2003. Harley-Davidson is committed to continuing product innovation. This philosophy, dating from the early days of the company in the early 1900s, had been abandoned during the 1970s, contributing to the critical state of the company by the early 1980s. From this point a turnaround programme improved the situation. Part of this turnaround was the change to the new product development process. To ensure survival, Harley focused on both product improvement and new product development. Harley's innovation philosophy was to use technology and engineering to support the processes that aimed at enhancing the overall customer experience. Several radical new technologies were developed to ensure that the market success of the trademark V-twin engine could be continued into the twenty-first century, meeting both the traditional customers' requirements and the increasingly stringent noise and emission legislation demands. The process, known as the Concurrent Product and Process Delivery Methodology (CPPDM) made recommendations for new products as well as improvements in existing products.

An idea gathering, evaluation and selection process was used. These stages are known as Swirl, Bins, and Cadence and Flow. Swirl is an idea discussion process where new ideas are discussed amongst the employees, competing for attention, time and legitimacy. The Swirl process comprised three phases, Zone of Consideration, Firewall and Acceptance. Initially, innovative and potential ideas circulated in a swirl of discussion among employees competing for attention, time and legitimacy. They then entered the Zone of Consideration when new ideas or changes were considered to be beneficial to enhancing the customer experience. These ideas then moved to the Firewall stage where political power of an idea and its ability to win supporters was tested. Next, the idea moved to the Acceptance stage after gaining enough support and overcoming any challenges. New concepts and ideas stayed in this Swirl until they evolved and expanded or contracted sufficiently that they had a group of strong proponents in the organization. This method facilitated assessment of the ideas' benefits to the organization and allowed ownership for the new ideas to be developed. The Bins stage allowed ideas exiting from the Swirl stage to be placed in one of several categories- Bins. Each category was associated with a level of risk and size of project. This facilitated portfolio management and life-cycle management. The next stage was Cadence and Flow. This stage scaled the project to fit the Bin and therefore resource allocation. Once this stage was complete the project was then launched as a development project. The success of Harley's innovation philosophy was in part

attributable to the fact that it used technology and engineering to support the process that aimed at enhancing customer experience.

6.5.4 Hewlett-Packard

Hewlett-Packard's Disk Memory Division wanted to develop a radical new rigid disk drive, codenamed the Kittyhawk (Christensen, 2003). This was a product that was envisioned for future market opportunities. Several possible design concepts were presented for the new drive. A decision was made to develop the smallest option for the drive- the 1.3 inch box. It was recognized as a risky venture, and it was felt that the main company could afford the cost of the risk. Management wanted the product development to be unconstrained by the traditional development process. To facilitate this, the Kittyhawk team were given autonomy to develop the drive, find new markets and cultivate a customer base.

Management looked for risk-takers for the new team. People who were not necessarily experienced in developing new architectures or cultivating emerging markets but were considered to be "can-do" people. The team members were carefully chosen. The team, from the outset, actively cultivated a culture that differentiated it from the Hewlett-Packard culture. All new team members were required to sign a creed ("*I am going to build a small, dumb, cheap disk drive*") before they were allowed to join the team. Those that refused were not allowed onto the team and returned to the Hewlett Packard mainstream areas. The team set tight goals relating to delivery time, sales growth and technology targets. Although aggressive, the targets were considered to be within reach. Management worked to create a sense of urgency in the team, promoting the view that the competition was close behind them.

Kittyhawk was introduced right on schedule. The design won new technology and new product awards for 1992. However, customer requirements grew beyond the initial specifications and despite plans for upgraded versions a customer (Hewlett-Packard's own Corvallis division) was lost to a competitor product. Other customers, in the form of PDA suppliers, found sales slow and several withdrew from the market. A customer product innovation (Microsoft operating system) had requirements beyond the planned specification for the upgraded product. This was offset against new unanticipated customers such as cash register machines and digital cameras. However this was a string of disappointments peppered with a few successes. The newness of the Kittyhawk product encouraged customers to think about what would be possible with this type of device and as a result their requirements began to become more specific. Unfortunately these demands could not be met by the developed product. In 1994 the company announced it would discontinue the Kittyhawk drives. The team recognized the commercial failure of the product, but were also pleased with the results of the project in bringing the product to market. Although the Hewlett-Packard case is considered to be a failure from a commercial perspective, the project team did deliver a "do different" project within the timescale specified. The changes in market requirements and evolution of customer expectations meant that the product had substantially reduced commercial opportunities. Despite the lack of success of Kittyhawk, no one was fired and several members of the team received promotion. The main problem the team members had was re-integrating into mainstream Hewlett Packard.

6.5.5 Mattel

Mattel is an industry leader in the design, manufacture and marketing of toys (Zacharias, 2004). It employs over 25,000 people worldwide. The company is based in California and has manufacturing operations in China, Indonesia, Italy, Malaysia and Thailand. It sells its products in 150 countries. One of its most well known products is the Barbie doll. From its launch in 1959, it has grown to be a market leader worldwide. In 2001 Barbie had a 90% market share for the fashion doll industry.

In the competitive world of toys, innovation is essential in remaining competitive. Mattel had responded to the ever changing trends in consumer behaviour by changing existing product lines and expanding into new markets through a series of acquisitions. Mattel wanted to create a new brand and needed a recurring product development process with emphasis on open idea sharing. Project Platypus was born from this desire. A platypus is a duck-billed mammal that lays eggs. It is native to Tasmania, semi-aquatic and is considered to be an uncommon mix of different animal characteristics. This represented the mix of cross-functional employees on the project team. It was an unconventional project team with the mission of developing "a new hit in a new market". It was described as a toy company "skunk works" that brought together a dozen people from various parts of the company, marketing, licensing, engineering for twelve week shifts. Project Platypus was basically about being able to think in an imaginative way and understand the sociology and psychology behind children's play patterns.

Initial response in the company was one of scepticism. The feeling was that employees would be unwilling to return to their jobs at the end of the project. The first Project Platypus delivered Ello, a girl's construction set. The team comprised designers, model makers, copywriters, child psychologists and other specialisms. The manager encouraged team members to stretch beyond their job, to apply skills they did not ordinarily use and even to discover new talents. Co-workers covered whilst employees were on the team on the basis that they would get their turn at a later date. A new environment was created, which was specifically different from the company's design centre. The intention was to provide a totally different environment for the team members in order to facilitate creativity. The layout of the work area encouraged idea exchange and out-of-the box thinking. The desks had wheels on to encourage spontaneous collaboration. Deadlines were not typical for a development project. They were given an outline that in twelve weeks they had to develop a new opportunity for Mattel that does not yet exist. They were required to conceive everything from the business plan to the product packaging at the end of the twelve weeks. A general outline target was provided but the specific details were left up to the team. External input was provided to stimulate ideas. Outside experts presented their ideas to the team. The team members were encouraged to visit external sites that were not directly relevant to the company or the project in order to encourage lateral thinking. Unrelated areas were studied in order to trigger new ideas. Sharing experiences was an integral part of the team culture. This acted as a glue to bind the team together. An idea wall (a 40 foot by 10 foot chalkboard) was used to suggest, expand and develop new ideas. This facilitated idea sharing, and a common ownership of the ideas. The project team acted out rituals to break down hierarchy and encourage participation amongst participants. There was a clear customer focus to the project in that the team members were encouraged to observe children playing with improvised toys. By the end of the project the team unveiled their first hybrid toy. This was Ello, a creative toy that

allowed girls to design and make characters, room accessories, jewellery, and houses amongst other things. It was intended to spark imagination and inspire creativity. Project Platypus generated such interest and enthusiasm from the Mattel employees that there was a waiting list to join the project team.

6.6 Analysis of the cases

6.6.1 Interventions suggested by case examples

The interventions that emerged from evaluation of case examples and which are relevant to the facilitation of radical innovation are:-

1. *Idea gathering process to amass new ideas*

In three of the cases there was a specific intervention aimed at gathering ideas and collating them. BMW used the Technis and VIA systems, Harley-Davidson used the Swirl process and Mattel, with a smaller project, used a 40 foot by 10 foot chalkboard to gather new ideas.

2. *Knowledge exchange process to share ideas*

The exchange of knowledge about the ideas gathered uses essentially the same mechanisms to promulgate those ideas. The Technis/VIA intranet systems used by BMW and the Swirl process used by Harley both achieve this at a macro level for all new ideas. At a micro level, Project Platypus' chalkboard and the team approach to discuss and develop ideas achieves the same result of sharing ideas.

3. *Use of external sources for ideas*

Two of the cases show a specific focus on looking outside the company for new ideas. BMW set up an intranet system to allow external input to their idea gathering process. They encourage input from external bodies and solicit input from external sources on their website:- 'Our task is to secure the long-term innovation and technology leadership of the BMW Group. To realise this goal, the BMW Group is permanently looking for unusual innovations on the subject "mobile future". We are not only interested in our own research and development departments, but also in the creative minds outside the BMW Group. We seek contact with small and medium-sized innovative companies. Your submission through the Virtual Innovation Agency is the platform for you to bring your achievement into the world of the BMW Group' (BMW, 2004). The Mattel project specifically took actions to encourage external input. This was done by asking people who worked outside the industry to provide talks to the team, by setting up visits to external sites that were considered to promote creative thinking and encouragement from top management to talk to people about areas that were not related to the project on hand.

4. *Allocation of resources is made to approved projects*

In 3M Acceleration and in BMW's Innovation process, there is specific provision of resources to projects that are considered breakthrough. In Mattel, the creation of the project and resources required are an allocation of resources to the radical innovation project. In these cases there is a visible acknowledgement and support through resourcing that the radical project has legitimacy and support from the organization.

5. *Idea selection and prioritization* process

Four of the five cases use a specific process to select and prioritize the new ideas. 3M adopted a system called 3M Acceleration that focused on identifying potential innovations that had commercial benefit and allocating resources in an attempt to speed them to market readiness. BMW use a formal system in their Innovation Management process, with senior management involvement, to select suitable projects. Harley use the Swirl and Bin phases of their process but allow the involvement of employees in the selection process. Mattel's approach in Project Platypus is the use of the chalkboard and team discussion to select a suitable project. In this method, as with the Harley process, the team is involved in making the decision. At 3M and BMW, a group of innovation managers along with senior management make the decision on project selection. These processes all identify potential projects that have some degree of commercial or customer benefit to the organization. 3M Acceleration, BMW's Technis and VIA, and Harley-Davidson's Swirl processes indicate an organization-wide emphasis on idea generation. These have top level support and are encouraged by management to facilitate ideas in the organization. For the Platypus and Kittyhawk projects, there were specific interventions focused on gathering ideas that may be of benefit to the project.

6. *Commercial focus for innovations*

There was a focus on a commercial or customer potential for the radical innovation. 3M specifically focused on only projects that had commercial potential. BMW's innovation strategy was aligned with the business plan, and therefore any breakthrough innovation project would be aligned with a commercial benefit. Harley's philosophy of enhancing the customer experience drives the innovation selection process. Only those ideas that meet this requirement pass through to the adoption phase of the innovation process. Mattel's project team had a very specific objective of a commercial application at the outset.

7. *Limit to the number of projects that are allowed to run*

For 3M and BMW, there was a deliberate intervention to reduce the number of projects running, from numbers in the thousand range to numbers in the hundred range in both cases. Mattel and Hewlett-Packard focused on a single radical project for the duration of the radical innovation process. In these cases there is a specific intervention that attempts to concentrate the attention of the organization and therefore resource provision onto fewer projects. This is achieved without curtailing idea generation.

8. *Team selection to promote "do different" capabilities*

For Hewlett-Packard and Mattel, there was a deliberate intervention to populate the radical innovation project team with people who were considered to be more capable of being effective in this type of project. For Hewlett-Packard a "can-do" attitude was desired. For Mattel, the deliberate selection of different types of people from different parts of the business was used.

9. *Creation of a sense of urgency or time pressure in the project*

For Hewlett-Packard and for Mattel, the team management created a sense of time pressure for the team. Although resources were made available for the team members, time was not an unlimited resource. In the Kittyhawk project, management deliberately

created the sense that the competition were just behind the Hewlett-Packard team in their progress, while in reality they were over a year behind. In Mattel's case a defined period of twelve weeks to produce the business plan and project proposal was used to generate the time pressure.

10. Innovation leadership from top management
In the case of 3M and BMW there is a clear support from top management for the innovation process. This includes the acknowledgement that some of the innovations will be "do different". 3M has and continues to have innovation as part of its culture. Innovation and 3M are synonymous. BMW has an innovation strategy approved at board level, with recognition that breakthrough innovations are unlike incremental innovations, and need to be managed and monitored separately, again with board level interest. For Hewlett-Packard and Mattel, the creation of a specific radical innovation project team is evidence of top management support for "do different" innovation.

11. Recognition of "radical" as different from incremental
BMW define their "do different" ideas as breakthrough innovations. Hewlett-Packard's Kittyhawk and Mattel's Platypus were explicitly stated to be a "do different" project that would create something new where there had been no product before. In this respect there is recognition that radical innovation is different to other innovation projects and as such needs to be managed differently.

6.6.2 Summary of case study interventions

The interventions suggested from the case studies indicate a focus on fewer project numbers, support from top management, and developing legitimacy of the project in the eyes of the organization- supported by formal approval and resource provision. Idea gathering and distillation into fewer workable ideas that can be handled by the organization allows a focus of limited resources on those ideas that bring benefit to the business. Too many ideas without having a commercial objective impede innovation inviting time wasting and conflict (Kanter, 2001). A mechanism for idea gathering and exchange facilitates idea development. BMW and Harley-Davidson have formalized idea gathering and evaluation systems. Facilitating external input, seeing other locations and listening to outsiders used to enhance creativity, provide additional input for new ideas and knowledge. BMW use the internet to facilitate external input (BMW, 2004). Idea gathering continues after innovation projects are selected in order to provide a nursery of ideas that can be taken and developed into commercially beneficial products. By creating the concept of a "different to the mainstream" product development, the radical innovation project is given legitimacy and status in the organization. At Mattel there was a waiting list to participate in these types of project teams. Even if the project failed, there was still a benefit to participation. At Hewlett-Packard, some of the Kittyhawk project members were promoted after the project was wound up. This approach reinforces the view that radical is different, that it is supported, that failure might be the outcome. This enhances legitimacy for the "do different" methods used in Type II innovation culture. Radical innovation is seen in these organizations as non-threatening and positively perceived. Throughout the cases there is a strong strand of top management support, either through initiation of changes to support a radical project, creation of a project team to develop a radical product or through active participation in the development of radical projects. This sends a clear message that radical is important to the company, and is reinforced when this is aligned with business strategy, indicating that the development of radical products is part of the overall business, ie, "way we do things round here" rather than a "bolt-on" that resolves an immediate problem for the organization. The interventions to facilitate radical innovation capability identified from the case study analysis are shown in tabular format in Table 6-3.

Table 6-3 Interventions identified from case examples

	Intervention	3M	BMW	Harley-Davidson	Hewlett-Packard	Mattel
1	Idea gathering process to amass new ideas		BMW Technis/VIA intranet system	Harley Swirl process		Platypus Chalkboard
2	Knowledge exchange process to share ideas		BMW Technis/VIA intranet system	Harley Swirl process		Platypus Chalkboard
3	Use of external sources for ideas		BMW Technis/VIA intranet system			Platypus management encouraging team to look outside and inviting external input
4	Allocation of resources to approved projects	3M Acceleration process	BMW Innovation Managers			Platypus team allocation of adequate resources
5	Idea selection and prioritization process	3M Acceleration process	BMW revised New Product Development process	Harley Swirl and Bin process		Platypus Chalkboard
6	Commercial focus for innovations	3M moving innovation closer to the customer	BMW's innovation strategy aligned with business strategy	Harley's philosophy of improving the customer experience		Platypus' specific target for a "new to the world" toy
7	Limit to the number of projects allowed to run	3M Acceleration process	BMW's revised New Product Development process		Kittyhawk target of one specific product	Platypus target of one specific product
8	Team selection to promote "do different" capabilities				Kittyhawk team selection requirements for a "can-do" team member	Platypus team requirements for a diverse multi-skilled team
9	Creation of a sense of urgency or time pressure in the project				Kittyhawk management indicating close proximity of competitors	Platypus time target of twelve weeks
10	Innovation leadership from top management	3M top management support for the 3M Acceleration process and retaining the 3M innovation philosophy	BMW top management involvement in the innovation strategy board		Hewlett-Packard support for the "do different" Kittyhawk project	Mattel support for the "do different" Platypus project
11	Recognition of "radical" as different from incremental		BMW define as "breakthrough"		Kittyhawk project to create a product where none had existed before	Platypus project to create a "new-to-world" toy

6.7 Discontinuous Innovation Forum companies

Cerulean is a member of the DIF- the Discontinuous Innovation Forum (Bessant *et al*., 2005). DIF is a group of companies sponsored by the Department of Trade and Industry, facilitated by The Oxis Partnership and Thames Valley Technology who wish to improve their discontinuous innovation capabilities (The Oxis Partnership, 2004). It is supported by the Universities of Bath and Cranfield. Four companies indicated that they would be willing to discuss the interventions that they had taken to facilitate discontinuous innovation. Each company was visited and a semi-structured interview with a company representative who was involved with discontinuous product development was conducted. The interview allowed the individual to talk generally about actions that had been taken, their impact, and lessons learned from these actions. The researcher avoided suggesting ideas about interventions by asking the individuals to "talk about interventions made to facilitate discontinuous or radical innovation in your organization". Questions were restricted to points of clarification wherever possible. The interviews were recorded and transcribed. Each transcription was analysed using NVivo to identify interventions that were used to facilitate radical innovation.

6.7.1 Analysis of DIF companies' interventions

Company A

Company A operates in the security printing industry. It produces cheques, identity cards, security labels and specialized paper products that require protection against counterfeiting. The company has a research and development department, comprising 28 people, that produces new products. Its turnover is around £200 million per year and it has been established for many years. The development function is charged with creating both incremental and radical product developments to keep the company competitive. Innovation was described as being at the heart of survival for the business by an R&D manager. The company operates a technology management process to manage product developments with a manual which defines what has to be done at each stage-gate and who acts as the gate keeper. The manual defines what sort of specific activities that would generally be expected to happen at each gate.

Projects that tend towards discontinuous innovation do not fit the stage gate process particularly well. The R&D manager stated that "the projects that are to do with new processes tend not to fit this model very comfortably and we've been thinking about how to run these in a sort of formal project management way for about 10 years, haven't as yet come up with a fully fledged version of the technology management process that really fits them, although we have attempted to shoehorn them into various different types of process". As a result the company has taken actions to improve its capability to manage radical innovation.

The company recognizes radical innovation as a separate activity. It provides segregation for the Development Team from day-to-day production and technical support activities. In addition where some experimentation is believed necessary to develop new levels of knowledge, this is facilitated by "ring-fencing" the personnel and resources required to facilitate this. A culture of experimentation is encouraged. This is not purely speculative research, but is focused on achieving a product development or enhancement that utilizes a radical aspect. Time and resources are allocated to pursue experimentation or radical developments. The number of projects running at any one time is restricted in order to balance supply of resource with project demand. The

company operates a system for gathering and sharing ideas. This is an SQL database that is available to all members of the Development Team. All ideas are recorded and shared using this mechanism. To assist idea generation the team members are also encouraged to revisit old ideas, in some cases from centuries ago, in order to re-evaluate their potential in the current market. This has the effect of generating further ideas for development. There is top management involvement though participation in review committees. Top management maintains an interest in what radical projects are running. There are imposed project deadlines with which the team members are required to comply. Although there is involvement by top management, the team is encouraged to be autonomous and take responsibility for its own management. It is allowed to balance its experimentation activities, radical projects and day-to-day activities for itself. This is aided by the high calibre of team members. Most team members are graduates. The mix of the team is craftsmen, engineers and scientists, most of whom are educated to doctoral level. Radical innovation is perceived as different from incremental, and although the company has not been able to shoehorn radical projects into its stage-gate development process, this has not prevented those projects from being successfully completed. Knowledge gathering and sharing is part of the way of working in the Development Team. This is perceived as the seed-corn for new product ideas. This knowledge and idea gathering is supported by encouragement to look outside the company, either through institutions such as universities or trade associations or through individual contacts. Individual networking outside the company is encouraged amongst the team members. The team is a group of people who have the capability to think of "do different" solutions as well as "do better" solutions, and who have a wide spread of technical knowledge and interests. There is a homogeneous mix of skills and attitudes. The team is deliberately maintained with this mix of capabilities. Radical innovation is rewarded through bonus schemes based on new product developments. This can sometimes create conflict with the overall bonus scheme based on "do better" activities that also operates within the team. The interventions identified from Company A are:

- Allocation of approved resources
- Commercial focus for innovations
- Creation of a sense of urgency
- Idea gathering process
- Idea selection and prioritization process
- Innovation leadership from the top management
- Knowledge exchange process
- Limit the number of projects running at any one time
- Radical recognized as different to incremental innovation
- Team selection for "do different" capabilities
- Use of external sources for ideas
- Allocation of slack time
- Autonomy for the Development Team
- Reward mechanism for radical innovation projects
- Evaluation of past ideas
- Segregation of radical activities

Company B
Company B is a leading UK supplier of temperature control, monitoring and refrigeration management services. It is a highly innovative company, winning many national awards for product innovation. It was formed in 1986 and is now based on two sites in the UK. It employs less than 50 people. The company works closely with its customers to develop new products and systems to improve the efficiency and performance of refrigeration, particularly in the commercial sector. It offers energy saving products with software tools for remote access and system analysis. These are supported by the services of their Monitoring Centre, which manages refrigeration alarms for over 420 stores around the clock. Commitment to innovation is demonstrated by the presence of a full-time Project Manager who is responsible for discontinuous product innovation projects. The Managing Director's support for discontinuous innovation is demonstrated by the hiring and provision of resources for a Project Manager whose remit includes radical new products. The company has a long history of discontinuous innovation and the Project Manager has been in this position for twelve years.

The company is small and as a result has limited resources to allocate to radical product development. Nevertheless, the presence of a full-time manager tasked with developing the radical innovation projects is a clear indication of the commitment to radical innovation. The manager operates almost autonomously and acts as a one man Development Team for the radical projects. There is a commercial focus to these projects, driven from external contact with industry bodies and a desire to develop new ideas for product applications to meet those commercial opportunities. This contact is maintained through active involvement of the Project Manager in the industry trade associations and institutions.

The Project Manager was recruited specifically to manage discontinuous development projects. He attempts to provide additional resource for these projects through grants and awards from government and industry bodies. The Managing Director supports this activity and participates in an informal knowledge exchange and idea generation process with the Project Manager. This is described as "sofa discussions" by the Project Manager. These discussions act as an idea selection and prioritization process. There is no formal idea gathering process but extensive use is made of external sources to identify potential ideas. External input of ideas is actively sought through trade bodies, other companies and universities. The company has undertaken three teaching company schemes in recent years that focused on a radical product innovation. The Project Manager is an active member of the trade associations and institutions. This external input facilitates knowledge gathering and also provides a range of commercial opportunities for exploitation through new products. Slack time is provided through the mechanism of a manager devoted to discontinuous innovation activities. When discussing the team characteristics of a radical innovation team, the Project Manager described a suitable team member as being "a controlled maverick". Retaining some degree of control is important as uncontrolled creativity can be destructive. This aspect can be seen in the example of Enron. The term *creative destruction* as suggested by Joseph Schumpeter (1961) can be applied to Enron's demise. This company encouraged employees to pursue new ideas and rewarded them when they succeeded. Funds were made available to support speculative activities. Whilst these policies were sound in advocating "do different", taken as a whole they created a system that ratcheted up pay and rewards for individuals to such an extent that

people were prepared to lie, steal and cheat rather than miss their growth targets. This ultimately destroyed the company (Buckland, Hatcher, and Birkinshaw, 2003).
The interventions identified from Company B are:

- Allocation of approved resources
- Commercial focus for innovations
- Idea gathering process
- Idea selection and prioritization process
- Innovation leadership from the top management
- Knowledge exchange process
- Radical recognized as different to incremental innovation
- Limit the number of projects running at any one time
- Team selection for "do different" capabilities
- Use of external sources for ideas
- Allocation of slack time
- Autonomy for the Development Team
- Segregation of radical activities

Company C
Company C designs and manufactures a range of instrumentation for use in the surface coatings industry. It is part of a UK based group. The group employs less than 50 people of which Company C employs around 15 people. The holding company is based in Oxford. There is also a sister company that sells electronic components in the UK. The company was established around 15 years ago. It is a technology company that aspires to increase its level of technological capability and therefore the research and development function is tasked with improving the technological capability of the new products. In a similar manner to Cerulean, company C has had a period of several years where there have been few new product launches. It wanted to improve this situation and undertook a series of actions to improve its development capability. Some of this development capability is focused on new to company and new to industry products, and thus encompasses radical innovation.

   Ideas tend to flow from the Chairman of the company or from contact with industry personnel. The Sales force ideas tend to be of a more incremental nature focused on improvements to the product or maybe cost reductions. The Chairman takes an active interest in product development in the company, regularly reviewing progress and ensuring adequate resources are provided for the projects. Although there is no formal idea gathering and selection processes, this activity is managed by the direct intervention of the Chairman in the development activities of the company. The Development Team is allowed a high degree of autonomy in how they manage the new product development projects. Resources are made available as required to support this method of working. There is a high degree of latitude provided to the Development Team in Company C. The Chairman also acts as a link with industry personnel, utilizing a personal network of contacts that allows the identification of potential product opportunities. The identification of product opportunities tends to be driven by the Chairman. There is therefore support for "do different" projects, speculative development and a clear innovation leadership demonstrated to the Development Team. Although segregation of radical innovation projects is not practised by Company C, this

was suggested by the R&D manager as being beneficial for this type of development. The interventions identified from Company C are:

- Allocation of approved resources
- Commercial focus for innovations
- Idea gathering process
- Innovation leadership from the top management
- Knowledge exchange process
- Radical recognized as different to incremental innovation
- Use of external sources for ideas
- Allocation of slack time
- Autonomy for the Development Team
- Segregation of radical activities (desired, but not part of an intervention)

Company D

Company D is a UK based organization that designs and manufactures medial devices. The company was formed in 1995 to research, develop, finance and commercialize neural computing technology developed at a university. The first product, an ambulatory monitor and event recorder for cardiac arrhythmia and morphology changes, was launched in 1999. This product received an award for innovation. The company has continued to develop products based on this technology. Although the company is relatively new, market changes have meant that the product has not sold in the anticipated numbers. The company is therefore evaluating alternative opportunities for its products and simultaneously seeking to bring innovative new products to the market. It is attempting to enhance its capability in discontinuous innovation. Close relations are maintained with several universities and with the medial community. The company operates in an industry that is highly regulated. These customers tend to be very slow in the adoption of new technology because the main customer in the UK is in a monopoly position, so there are no competitive pressures to innovate or adopt anything too radical. The company recognises radical innovation as different and there is strong leadership from the top management to adopt radical solutions to product problems. Employees are encouraged to offer several solutions to a problem rather than just one. This "do different" approach, described by the Technical Director as encouraging the employees to think more laterally, is reinforced by training focused at developing the technique and by recruitment of people who can provide solutions that are not "rule based". Idea exchange is facilitated by annual company two-to-three-day workshops where the employees go off site and discuss all issues relevant to the business. Mind mapping software is used to capture and connect the ideas. Whilst these workshops are not specifically focused on radical innovation projects, the nature of the company and its small size means that these projects are part of the issues discussed. This workshop facilitates knowledge sharing amongst the employees. The small size of the company and the fact that the employees work in one open plan office means that conversations are overheard and employees are aware of each other's problems. The culture in the company encourages the employees to join the discussion and offer their ideas on the problems being discussed. This further shares ideas and knowledge amongst the employees. This is similar to the way in which employees of IDEO, the design consultancy operates. Employees will overhear other conversations and join these discussions, offering their ideas and knowledge in an attempt to resolve the problem (Hargadon and Sutton, 2000). The interventions identified from Company D are:

- Commercial focus for innovations
- Idea gathering process
- Innovation leadership from the top management
- Knowledge exchange process
- Radical recognized as different to incremental innovation
- Team selection for "do different" capabilities
- Use of external sources for ideas

6.7.2 Potential interventions suggested by the DIF examples

The interventions identified from the DIF companies are similar to those identified from the case examples. Some of the eleven interventions identified from the case examples (Table 6-3), were identified amongst the DIF companies. Five additional interventions were identified from the DIF examples. These are; (1) allocation of slack time, (2) autonomy for the Development Team, (3) evaluation of past ideas, (4) reward mechanism for radical innovation projects and (5) segregation of radical activities. The additional five interventions are discussed below.

12. Allocation of slack time.

The allocation of time specifically for radical projects is well recognized in literature (Gundling, 2000). Company A allocates 10% of the Development Team members' time specifically for radical project work. In company C the allocation of slack time is an informal process, where the Development Team members are encouraged to take time to examine ideas, opportunities and technologies outside their day-to-day projects. The use of a dedicated manager for discontinuous innovation in Company B ensures that time is allocated to scanning the market for opportunities, other industries and external bodies for potential technologies and for experimentation to evaluate their application in pursuit of the potential opportunities. This time is beneficial in facilitating experimentation and knowledge gathering in pursuit of radical solutions. In addition, the acceptance of time being spent on radical project work helps legitimize radical innovation as part of the "the way things are done" in the organization.

13. Autonomy for the team

Some degree of self management for the team is evident in three of the DIF companies. Whether through the single manager in company B, the small team in company C or the Development Team in Company A, they all have a degree of control over their own work. This develops confidence that the team is trusted to manage its development projects, its experimentation, its idea gathering and selection activities without management interference. This demonstrates confidence in the team from top management and facilitates a sense of freedom within the team. This sense of freedom reinforces the perspective that the radical innovation activities are accepted by the organization, are beneficial to the organization and that the team is trusted to undertake those activities.

14. Evaluation of past ideas

In one of the DIF companies old ideas were re-evaluated at different stages to determine if they were relevant to any of the current innovation projects. This acts to maintain knowledge diffusion amongst the team and is similar to the re-evaluation of previous discarded ideas practised by the design consultancy IDEO (Sutton and Kelley, 1997;

Hargadon and Sutton, 2000). For radical innovation, knowledge reuse may facilitate a solution where incremental thinking does not allow a solution (Majchrzak, Cooper and Neece, 2004).

15. Reward mechanism for radical innovation projects
Rewarding radical innovation activity reinforces this behaviour. This is a mechanism applied in Company A to encourage radical innovation activity. In its larger development group the normal reward systems encourage "do better" activities. The company applies a bonus scheme specifically focused on radical innovation projects to encourage this type of activity. This acts to reinforce the "do different" behaviour as acceptable to the team and therefore part of the group culture.

16. *Segregation of radical activities.*
This is the long advocated "Skunk Works" approach to radical innovation (Rich and Janos, 1994). Having a segregated radical development area that operates apart from mainstream business activities is considered to facilitate radical innovation. Company A allocates separate areas and personnel to radical activities within the Development Team. The Development manager described this as "we take people away and put them into a ring fenced environment". This segregation provides protection from day-to-day activities and creates an environment "where they are not distracted by long-term projects with harsh milestones that have to be met". Although still part of and operating within the main Development Team, the team members working on a radical project are allocated separate space and relative segregation from the main part of the team. Company B, in having a separate manager who sits in his own area with his own resources, has in effect created a mini skunk works to facilitate radical innovation. Company C, although not undertaking an intervention to segregate this type of development activity, suggested that in hindsight this would have been beneficial to radical innovation activity. Recent research by O'Connor and Ayers (2005) indicates that total segregation may not be beneficial. Successful Development Team structures observed were connected to the mainstream business in some way and they suggest that "skunkworks" is not a widespread structure for innovation.

6.7.3 Summary of interventions identified in DIF companies
The DIF companies had taken action specifically to improve their discontinuous innovation capability, so the interventions identified are specifically linked to achieving this type of innovation activity. In all four cases there is again a clear innovation leadership dimension. Several interventions feature in all four DIF examples, (1) idea gathering process, (2) knowledge exchange process, (3) external sources for ideas, (10) innovation leadership and (11) recognition of "radical" as different. This indicates that gathering, storing and reviewing knowledge and ideas is a key feature and is strengthened by looking outside the company. Radical innovation is perceived in all four DIF examples as a different type of innovation to incremental. The active support and involvement of top management is also evident in all four DIF companies. This innovation leadership appears as support through creation of structures and processes to support radical innovation or as a direct involvement or interest from top management in the radical innovation projects. This in turn acts to provide legitimacy for radical innovation, where otherwise it can be seen as an illegitimate activity within the

organization (Dougherty and Heller, 1994). The occurrence of each intervention among the four DIF companies is shown in Table 6-4.

Table 6-4 Interventions identified from the DIF companies

	Intervention	Company			
		A	B	C	D
1	Idea gathering process to amass new ideas	X	X	X	X
2	Knowledge exchange process to share ideas	X	X	X	X
3	Use of external sources for ideas	X	X	X	X
4	Allocation of resources to approved projects	X	X	X	
5	Idea selection and prioritization process	X	X	X	
6	Commercial focus for innovations	X	X		X
7	Limit the number of projects allowed to run	X	X		
8	Team selection to promote "do different" capabilities	X	X		X
9	Creation of a sense of urgency or time pressure in the project	X			
10	Innovation leadership from top management	X	X	X	X
11	Recognition of "radical" as different from incremental	X	X	X	X
12	Allocation of slack time	X	X	X	
13	Autonomy for the team	X	X	X	
14	Evaluation of past ideas	X			
15	Reward mechanism for radical innovation projects	X			
16	Segregation of radical activities	X	X	*x*	
	X- Intervention tried by the company *x*- Intervention not tried, but suggested as being beneficial				

The sixteen interventions from the empirical examples (Table 6-4) are shown in relation to the interventions from literature (Table 6-2) and the interventions suggested by the Cerulean Development Team (Table 6-1) in Table 6-5.

Table 6-5 Relationship between identified interventions

	Intervention from empirical examples (Table 6-4)	Intervention from literature (Table 6-2)	Suggested intervention from Development Team (Table 6-1)
1	Idea gathering process to amass new ideas	Idea gathering and sharing process (3)	Visit external sources (4) Exposure to sales team (5)
2	Knowledge exchange process to share ideas	Idea gathering and sharing process (3)	Personal project/Ideas market (2)
3	Use of external sources for ideas	Idea gathering and sharing process (3)	Visit external sources (4)
4	Allocation of resources to approved projects	Resource provision (1) Segregation from the routine (7)	Resource allocation (3) Management to facilitate actions (6)
5	Idea selection and prioritization process		Personal project/Ideas market (2)
6	Commercial focus for innovations	Leadership for a radical innovation culture (2)	Exposure to sales team (5)
7	Limit the number of projects allowed to run	Leadership for a radical innovation culture (2) Resource provision (1)	Personal project/Ideas market (2)
8	Team selection to promote "do different" capabilities	Team members' skills and attributes (5)	
9	Creation of a sense of urgency or time pressure in the project	Leadership for a radical innovation culture (2)	
10	Innovation leadership from top management	Resource provision (1) Leadership for a radical innovation culture (2) Project champion (6)	Management to facilitate actions (6)
11	Recognition of "radical" as different from incremental	Leadership for a radical innovation culture (2) Actions to encourage experimentation (4) Segregation from the routine (7)	Personal project/Ideas market (2)
12	Allocation of slack time	Resource provision (1)	Allow slack time (1) Management to facilitate actions (6)
13	Autonomy for the team	Segregation from the routine (7)	
14	Evaluation of past ideas	Idea gathering and sharing process (3)	
15	Reward mechanism for radical innovation projects		
16	Segregation of radical activities	Actions to encourage experimentation (4) Segregation from the routine (7)	

The interventions suggested by the empirical examples cover a broader spectrum and are more detailed than those suggested by either literature or the Development Team. Table 6-5 indicates that the sixteen interventions overlap the interventions from literature and the Development Team. These sixteen interventions were used as the foundation for developing Cerulean specific interventions designed to create the conditions for a radical innovation culture. The desired effect and influence of the sixteen interventions in developing the desired aspects of a radical innovation culture are shown in Table 6-6.

Table 6-6 Intended outcomes and associated Type II culture characteristics

	Intervention	Desired effect	Type II characteristics being developed
1	Idea gathering process to amass new ideas	A process that facilitates the gathering and recording of ideas for future innovations. This gives emphasis to the concept that gathering new ideas is a necessary part of day-to-day business operations.	Freedom and latitude in thinking about potential product applications for new technologies and "do different" solutions for known problems.
2	Knowledge exchange process to share ideas	Diffuses the gathered ideas across the group involved with the innovation proves. Spreads the accumulated knowledge across all members of the team.	Growing and developing the knowledge of the group.
3	Use of external sources for ideas	Solicits input for ideas from sources external to the organization. It facilitates knowledge that is likely to benefit "do different" innovations.	Awareness of new and emerging technologies, of other industrial applications for existing technologies.
4	Allocation of resources to approved projects	The provision of resources to selected radical innovation projects. This provides the necessary time and funding, but also reinforces legitimacy of the radical innovation project alongside other incremental projects.	Provision of sufficient resources to facilitate the radical project. This also provides reinforcement for the importance of "do different" projects.
5	Idea selection and prioritization process	Selection of ideas for further development, killing unsuitable ideas and providing prioritization for the selected radical projects. Provides prominence and visibility for idea gathering within the organization. This encourages organization members to see idea generation as "the way things are done".	Aligning the radical project with organization needs, in order to maximize resource efficiency, but also to provide outline objectives for the Development Team members.
6	Commercial focus for innovations	Provides focus for the radical innovation giving it a commercial reason for existing. This supports the legitimacy of the radical innovation project.	Creating a rationale for taking a radical approach, and credibility for the radical project, thus reinforcing that such innovation projects are an acceptable part of the organization's activities.
7	Limit the number of projects allowed to run	Restriction mechanism to match resource availability with radical innovation projects. This facilitates slack required for radical innovation.	Ensuring the best chance of success for radical projects by matching available resources to projects that most benefit the business.
8	Team selection to promote "do different" capabilities	Building a team that has the "do different" capabilities needed for radical innovation. Actively selecting those people who are considered more suitable for radical innovation projects.	Team with a mix of creative individuals who have broad experience and are willing to evaluate and apply "do different" solutions. These individuals are happy to work with a degree of uncertainty about the outcome of the radical innovation projects.
9	Creation of a sense of urgency or time pressure in the project	Provides a pressure for the radical project. This contributes to the team being able to come up with a "do different" solution.	Ensuring that time resource is not perceived as unlimited. This creates a sense that there is a finite period of time to deliver a solution but even though the solution may be radical, unlimited time is not available to the team.

Table 6-6 Intended outcomes and associated Type II culture characteristics

	Intervention	Desired effect	Type II characteristics being developed
10	Innovation leadership from top management	A visible and clear support for radical innovation from top management. This reinforces the perspective that radical projects are legitimate and indeed are part of the company culture. This leadership also reinforces the team perspective that radical innovation with its associated failures is a legitimate way of working and an integral part of the organization.	Management style that encourages risk-taking in the Development Team. A Champion for radical innovation projects also provides a clear indication of the importance of "do different" projects to the business.
11	Recognition of "radical" as different from incremental	Radical innovation projects are seen as different from incremental innovation projects. This reinforces the perspective that radical projects are different, are treated differently but are just as necessary for the survival of the business.	Recognition that radical projects are different and are managed differently. Radical projects are perceived as important aspects of the organization's activities.
12	Allocation of slack time	Allows time to experiment as well as carry out day-to-day activities.	Creates a sense that experimentation is part of the way things are done in the team. Supports the perspective that the radical innovation is recognized, is important and is allocated its own resources. This encourages confidence in the team to undertake "do different" activities.
13	Autonomy for the team	Allows the team to manage their own day-to-day activities. They can control the time they spend on experimentation and idea gathering and discussion.	Develops confidence that the team are trusted to manage their development projects, their experimentation, their idea gathering and selection activities without management interference. This also demonstrates confidence in the team from top management. The autonomy facilitates a sense of freedom within the team.
14	Evaluation of past ideas	This allows past ideas to be re-evaluated for their suitability to be developed as a radical innovation. No idea is allowed to disappear but is kept "live" for continual re-evaluation as required.	Promotes sharing and renewing of knowledge within the group. It also allows past ideas from external sources to be evaluated for their suitability to be developed as a radical innovation.
15	Reward mechanism for radical innovation projects	An incentive scheme mechanism that rewards radical innovation activities.	Encourages behaviour that supports radical innovation. Provides direct encouragement for radical innovation activities and helps legitimize radical innovation within the company.
16	Segregation of radical activities	This segregates "do different" from "do better" activities. A physically separate working area with its own services that is used for radical activities, knowledge gathering, experimentation, evaluation of new ideas and development of radical projects.	Reinforces the perspective that radical innovation is recognized as a separate and equal activity in the business. This helps support the perspective that radical innovation is a legitimate activity within the business.

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6.8 Making the change

6.8.1 Intervention plan for Cerulean

The results of the assessments in Project Two provided an indication of areas of inadequacy with respect to a radical innovation culture. The suggested interventions from the Cerulean team were made within the context of this information. Two components are outside the influence of the team- Team selection to promote "do different" capabilities and Innovation leadership from top management. Of these two, the leadership appears to be the most critical. Companies that have been successful with radical innovation demonstrate clear leadership of, or involvement with, radical projects as part of the business strategy. This demonstrates strong commitment from the organization to this type of activity. This support and involvement provides a strong message that radical innovation and its associated practices, which are sometimes counter-productive to incremental activities, are legitimate, important to the business, valued by the company and are worth allocating resources to. In talking about the Lockheed Skunk Works, Ben Rich suggests that 'going "skunky" is a very practical way to take modest risks, provided that top management is willing to surrender oversight in exchange for a truly independent operation' (1994: 318). The success of the Skunk Works was facilitated by this hands-off approach from top management whilst at the same time displaying support for the operation. This development of radical as a legitimate activity, that is equal to other business activities, is an important feature of the planned interventions. Being cognizant of this issue, a plan of interventions was developed to foster aspects of a radical innovation culture in the Cerulean Development Team. The intervention plan was built on interventions identified from empirical examples. The shortcomings identified in the innovation culture assessment from Project Two provide guidance for the aspects of innovation culture that must be modified. These sixteen interventions are moderated by the desired Type II innovation culture characteristics, and by the specific position of the Cerulean innovation culture, to produce a series of proposed interventions suitable for nudging the innovation culture to be more supportive of radical innovation. This is shown diagrammatically in Figure 6-3.
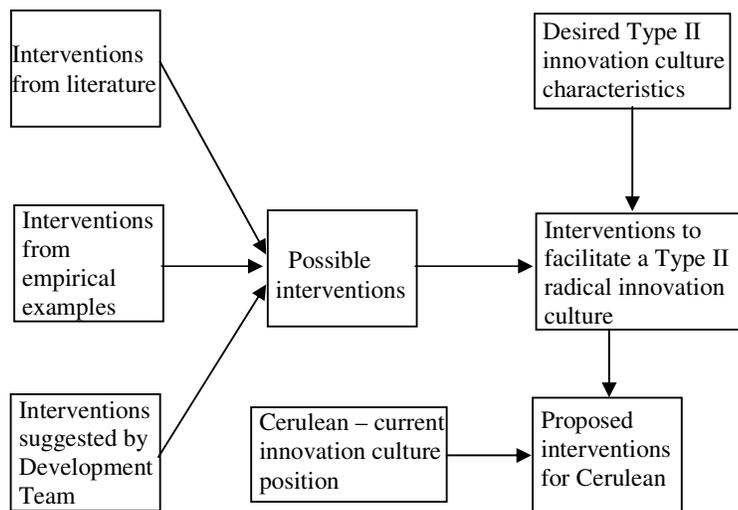
**Figure 6-3 Developing interventions suitable for Cerulean**

The planned interventions for Cerulean are sequential and focus on developing confidence to suggest, select and undertake a "do different" project which will have team ownership and commitment. This is likely to encourage behaviours that facilitate radical innovation. The seven inter-linked Cerulean specific interventions are shown in Table 6-7.

Table 6-7 Proposed interventions for Cerulean

	Proposed Intervention	No	Based on intervention from Table 6-6
1	Team membership strengthened to add in "do different" skills and attitude. This will mean additional training of existing team members and adding new team members to bring a "can-do" attitude to the team.	8 10	Team selection to promote "do different" capabilities Innovation leadership from top management
2	Develop an idea/knowledge gathering and sharing system. Firstly, use DIF Company A's system as a template. This is an SQL database accessible by all team members which was used to generate hard copies at regular intervals for the purpose of record keeping. This database would be accessible by all team members and regularly scanned to surface old ideas that may be relevant to new opportunities. Secondly, create an area where examples of technologies, products and interesting pieces of equipment can be stored and examined as necessary.	1 2 10 14	Idea gathering process to amass new ideas Knowledge exchange process to share ideas Innovation leadership from top management Evaluation of past ideas
3	Visit external bodies with a view to information gathering, ie, external industry bodies, suppliers, customers, and potential technology partners. This would be advocated to ensure that taking an external perspective was the normal method for the team. In addition, external input would be added by having outside people talk to the team.	3 10	Use of external sources for ideas Innovation leadership from top management
4	Implement idea gathering and experimentation as a process within the team as a specific activity, leading to potential product opportunities. Supported by the idea sharing system in intervention 2, implement a process where new ideas are encouraged, recorded and reviewed. This process would add a potential applicability dimension to the ideas to provide a commercial focus. This process would encourage the team members in evaluating ideas for themselves and in experimenting to determine what is feasible. The process would require slack time to be added to facilitate this.	10 12	Innovation leadership from top management Allocation of slack time
5	Request the team to identify new product ideas that are new to market and new to company. Provide a prize for the best one. This would lead on from intervention 4, in that it would encourage the team to take the ideas and suggest them as potential products or product applications. This process would be internal to the Development Team, and allow them to put forward the strongest ideas for products to the rest of the company in a "show and tell" session.	6 10 11 12 13 15	Commercial focus for innovations Innovation leadership from top management Recognition of "radical" as different from incremental Allocation of slack time Autonomy for the Development Team Reward mechanism for radical innovation projects
6	Provide a "show and tell" session on a quarterly basis for the Development Team to "showcase" their new ideas. The team members would be able to present their ideas for new product opportunities or product applications to the rest of the company. This would be a technical and commercial presentation. A bonus for the most original concept and the concept believed to have the most potential would be offered.	10 11 15	Innovation leadership from top management Recognition of "radical" as different from incremental Reward mechanism for radical innovation projects
7	Identify a "do different" project and allocate space, people and resources to it. Allow the team to manage the project but with top management to champion it. This would be a project that is perceived to be near impossible in timescale or in technological application, and would act as a focus for resource allocation and top management support. Segregation or separation of this project team would reinforce the "radicalness" of the project to the rest of the Development Team and the company. Regardless of the outcome, the results would be evaluated for future potential and the contribution of the team recognized and rewarded.	4 5 7 9 11 13 16	Allocation of resources to approved projects Idea selection and prioritization process Limit the number of projects allowed to run Creation of a sense of urgency or time pressure in the project Recognition of "radical" as different from incremental Autonomy for the Development Team Segregation of radical activities

The plan comprises the following seven interventions as a sequence of steps:-

1. Team membership

Team membership is modified to add in "do different" skills and attitude. This intervention seeks to add individuals to the team who have a "can-do" attitude, who have a high level of training or skills and who are willing to think of "do different" solutions to problems. Selection of such individuals will necessitate some form of assessment of their attitude and skills levels. Innovative or adaptive behaviour can be assessed using the Kirton Adaptation Innovation (KAI) measure (1976; 1989; 2003). Attitude and psychological profile could be assessed by using Myers Briggs Type Indicator (MBTI) psychometric evaluations (Stevens and Burley, 2003). Skills can be assessed by using specific skill assessment techniques or by past performance and delivering results by using these skills. This intervention seeks to add people to the Development Team, rather than develop the ability of the existing team. Adding people with higher degrees and post degree experience is likely to improve the skill levels in the team. The desired artefacts from this intervention are presence of skilled individuals in the team. The values being developed are a desire to question and challenge existing beliefs, to re-frame problems and re-use knowledge from external sources to solve those problems. The extant Cerulean team shows significant risk aversion, and is comprised of individuals with long service. Many of them have no degree level qualification. Adding in the "do different" attitudes of new team members is likely to begin to change the attitude of the team members to risk taking and thinking of "do different" solutions.

2. Idea/knowledge gathering and sharing system

This can be achieved through two different interventions. Firstly, creating and operating a system that traps ideas and facilitates sharing across all team members. This system would be based on a database, possibly an SQL database, and be used to log ideas and facts about new technologies. This intervention is at the artefact level, in that it provides a system and process to use the system, thus acting as a tool to gather and share new ideas and facts. The system on its own will not provide radical breakthroughs, but it can act to support the values of the team members in making these breakthroughs. A hard copy print would be made at regular intervals for record purposes. The ideas would be reviewed on a regular basis to identify those that might be worth developing. Secondly, the creation of an ideas area for the team. This is a physical space where ideas can be put forward in physical form, refined, critiqued, where new technology can be examined, and interesting pieces of equipment can be evaluated and retained for future inspection. It would act in the same way as the first intervention, the database, but in this case it would retain physical objects rather than ideas or knowledge. Having a display area for team members to add or critique ideas related to the physical objects would act in conjunction with the knowledge based system. This intervention would provide some of the framework to support the "do different" behaviours.

3. External input

This intervention would encourage and facilitate input from external sources. These are sources outside the company which may also be outside the tobacco or tube packing industry. The team members would be encouraged to visit external sources for ideas and new knowledge. This information would be recorded in the system described in Intervention 2. The external sources would include exhibitions of technology, trade fairs, university contacts, Discontinuous Innovation Forum group and other companies who offer access to new technologies. In addition, external speakers, "experts" in their own area, would be asked to present their ideas and views to the team at regular intervals to support the external input. The contact with universities would be a suitable initial source for these external speakers. This intervention is designed to develop a sense that going outside for ideas is part of the way things are done.

4. Idea gathering as a process

The objective of this intervention is to develop the first three interventions into a process whereby idea gathering and development is perceived to be part of the routine of the group. A weekly brainstorming session to evaluate possible new products or select a solution to a particular problem is proposed to initiate this. This session would be held each Wednesday at 2pm, in order to provide regularity and embed the process into the behaviour of the group. This session would be facilitated by different people each week. The output would be fed back into the idea gathering system described in Intervention 2. This would also be a suitable venue to invite people external to the company to attend. This external input would add new ideas to the group knowledge. It is proposed that each session selects a particular focus that is relevant to the business, and allows the session to generate multiple ideas for resolving the issue. The generation of these ideas would be enhanced by the external knowledge gained as part of Intervention 3.

5. New product areas to be identified

This intervention takes the ideas and knowledge generated from interventions 2, 3 and 4. The proposal for this intervention is to ask the team to create a list of potential new product areas. These product areas should be described in sufficient detail to allow the team to select one and then develop a product that fits into the new product area. The product areas should be new to the company and new to the industry, or for a different industry. The objective of this intervention is to encourage the team to develop possible opportunities for product development that moves the team into the radical innovation area. The specification for the product groups should be sufficiently clear to indicate that an iteration of an existing product would not be suitable, but sufficiently open-ended to allow the creativity of the team to provide a series of potential new areas for product development. The task would be defined as identifying a new product area, potential product applications, benefits to the business, estimated costs and selling process along with the associated outline plan for development. Depending on the constitution of the team following Intervention 1, it may be more appropriate to allocate this task to a number of teams created from the whole Development Team, rather than to each Development Team member. This intervention builds on the preceding interventions to produce a number of possible development routes for the company.

6. Show and tell presentation

This intervention takes the new product opportunities created in Intervention 5 and, with input from the commercial and operations areas of the business, selects one suitable for developing into a new product for the business. The proposal is for a group evaluation of the product opportunities. Each idea would be presented by the individual or team responsible for its creation. These proposals would be evaluated at a session where other members of the company had the opportunity to test the thinking and feedback their view of the probability of the product proposal being of benefit to the company. It may be appropriate to run such a session internally with the Development Team, prior to opening the ideas up to the company at large. This venue would be used to discuss the relative merits and drawbacks of each of the product proposals. This intervention would provide a showcase for the creative output of the Development Team and this would provide a degree of confidence in the team being able to think of "do different" solutions. This would, in turn, strengthen the confidence of the team.

7. "Do different" project

This is the final stage in this series of interventions. It builds on the preceding steps and uses one of the product opportunities from Intervention 6 as the basis of a radical innovation project. This project would be initiated on the basis that it may, or may not, become a production product, but that the development of the product would still take place. The selection of a "do different" project would have a degree of ownership by the team as it would flow from their involvement in the preceding interventions. The project would be given to a

team drawn from the Development Team members with a clear overall goal, but without a high degree of specification being provided. As the product opportunity will have evolved from the work of the team this would be a different scenario from providing a full specification for a new product. This ownership of the project would be important to reinforce the willingness to undertake the development of such a "do different" project. A segregated area should be provided if possible, to create the perception that the project is "different". Resource allocation would be provided as per other development projects, as it would be a legitimate product development. A bonus for completion of project deliverables would be offered to the project team. These deliverables should reflect that the project may or may not deliver a viable product, but nevertheless would contribute to the knowledge of the team. This step would again build the confidence of the team and those outside the team, indicating that "do different" in product development was an acceptable, and indeed expected, behaviour for the Development Team.

6.8.2 Making the change

In the literature and case examples, there is a clear requirement to have strong top management support for radical innovation, through personal involvement, and recognising and encouraging radical innovation. The Cerulean Development Team expressed concern about top management support for radical innovation during the interview stages of Project One. In addition the scores on KEYS indicate poor management support for creativity. Past experience of the team, in succeeding by making incremental improvements, has provided a degree of resistance to doing things differently. The past behaviours that resulted in success are still perceived as the way things should be done. It is not surprising then that this group of people would want to be guided by management, would want to take steps that improve on what they have currently got and would be wary of moving away from the pattern of behaviour that they know, and are comfortable with, to undertake a series of interventions that require a different way of behaving. The suggested interventions for facilitating aspects of a Type II, radical innovation supporting culture in Cerulean will depend heavily on top management support and input. A key part of this support is the creation of a vision for the Development Team. This acts as a model of the desired position for development at the end of the transformation. Based on studies of several organizations that underwent change programmes, from the top ten most effective components of initiative for change, the first two were, a common vision to guide efforts and an effective champion to continually drive the change (Carter *et al*., 2001). French and Bell (1999) find that leadership style, mission and strategy are required to change in order to create enduring change. Recent research has emphasized the importance of vision and mission in initiating and sustaining culture change as major features of interventions required to transform an organization (French, Bell Jr., and Zawacki, 2005). The final step in the plan of the team managing their own radical innovation project would provide a focus for the Development Team in participating in these seven intervention steps. This focal point would provide the guidance for the team's efforts.

The use of interventions in itself is unlikely to develop a Type II radical innovation culture. There are many different interventions suggested from literature, case examples and the DIF companies. These have common themes that indicate which aspects of innovation culture they would influence. The creation of the desired culture is more likely to be achieved by considering an appropriate group of interventions acting to modify the behaviour of the team members, and then reinforcing that behaviour such that it becomes embedded in the underlying values of the group (Schein, 1991). The interventions would be applied in an action research form of application, evaluation of the intervention, diagnosing the issues that are relevant and planning the next intervention based on this diagnosis (Coghlan and

Brannick, 2001). This cycle would then be repeated until the values become embedded. This method is shown in Figure 6-4.
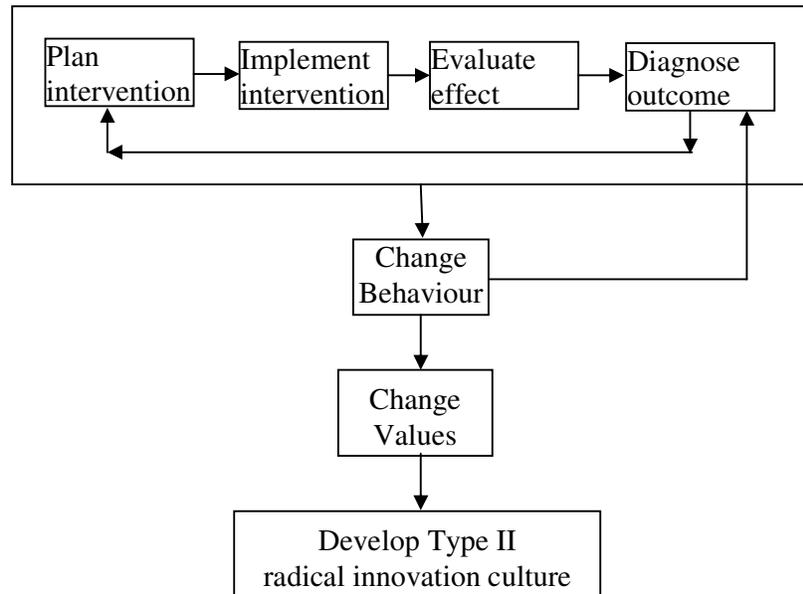
Figure 6-4 Developing culture through changing values by making interventions

The cycle of taking action, evaluating outcomes, diagnosing the results and planning further actions facilitates participative evaluation and reflection. This influences the behaviour of the team members, involves them in the planning and diagnosing process, and requires them to participate in the evaluation as well as the intervention.

6.8.3 *Facilitation of Type II radical innovation culture in Cerulean*

The seven interventions form a holistic approach to facilitating a radical Type II innovation culture. They operate sequentially and culminate in the team managing their own radical innovation project. The proposed interventions, their desired effect at the artefacts and values levels of Schein's model and the desired behaviours of a Type II radical innovation culture associated with each intervention are summarized in Table 6-8.

Table 6-8 Interventions and their desired effect in terms of Schein's model

	Intervention	**Artefact**	**Value**	**Type II behaviour**
1	Team membership	Higher degree qualified team members. Team members who are willing to question and challenge.	Confidence to think of untried solutions.	Questioning from team members. Willingness to offer untried solutions to problems, to seek out new knowledge, to experiment with new technologies or methods.
2	Idea/knowledge gathering and sharing system	Ideas gathering system. Physical area for interesting objects.	Gathering and evaluating new ideas, thoughts, and physical objects.	Provides the framework for collecting and reviewing ideas, technology and new knowledge.
3	External input	Visits to external sources. Invited external speakers.	Looking outside the company is a normal way to gather ideas and information.	Taking an external perspective to develop new knowledge and ideas for future use. Developing outside networks amongst different external organizations. Seeking out external contacts to facilitate this knowledge and idea gathering.
4	Idea gathering as a process	Brainstorming session each Wednesday.	Idea generation is a part of the normal behaviour of the group.	Collecting, and reviewing new ideas technologies and methods. Used in conjunction with the idea/knowledge gathering system to review these against current problems at different times.
5	New product areas to be identified	Project to develop new product areas for the business.	Creative activity is encouraged, even though much of this activity may never be taken forward.	Identification of potential product opportunities based on acquired knowledge and current problems. Being creative in thinking of new applications of known knowledge and ideas.
6	Show and tell presentation	A group meeting where product ideas are presented, discussed and critiqued.	Acceptance of "do different" solutions. Confidence in the team by others in the company. Confidence of the team in their own ability to provide "do different" solutions.	Confidence to present new ideas, and to discuss and critique those ideas. Being open with other team members and adding individual viewpoints to further develop possible solutions. Restlessness about wanting to seek out "do different" solutions.
7	"Do different" project	Undertaking a radical product development project, that may or may not lead to production.	Acceptance of "do different" behaviour. Developing previously untried solutions is an acceptable behaviour and is to be encouraged. Speculative development work is acceptable and is encouraged.	Running a radical innovation project with minimal supervision. Allocation of time and resource to radical projects. Radical projects are part of the day-to-day activity of the Development Team.

The suggested interventions act together to develop a willingness to take risk and to experiment. This will foster a "do different" approach to problem solving. The innovation leadership component of the radical innovation culture is approached by having the top management in Cerulean participate in a radical innovation project, thus reinforcing the perspective that radical innovation is important to the company. Interventions 2 and 4 act together to create a system for idea and knowledge gathering and sharing, and to encourage the Development Team to utilize the system for this purpose. The provision of a "show and tell" venue for new ideas will act to encourage boundary pushing, but with a commercial focus. The culmination of the interventions is the selection and development of a radical innovation project. The suggested intervention plan for presentation to the Development Team is shown in Appendix E.

Regardless of the outcome, risk taking, experimentation and gaining knowledge through this intervention should be encouraged and recognized. Providing a bonus for team members reinforces this behaviour. This will act to provide an example of the behaviour required to facilitate radical innovation in the organization. This behaviour will be embedded in the values of the group as it is rewarded and approved of by top management. These suggested interventions are mapped against the original nine themes in Table 6-9. This is shown graphically in the form of a Decision Explorer map in Figure 6-5. The interventions are numbered from 1 to 7 and the themes are numbered from 101 to 109 in order to differentiate them in the map. The arrows in this figure indicate influence of an intervention on a theme rather than any precise causality.

Table 6-9 Interventions and desired culture related to the nine themes

Theme	Suggested intervention for Cerulean (from Table 6-8)
Freedom/ Latitude	Implement idea gathering and experimentation as a process within the team (4) Team to identify product ideas that are new to the market and company (5) Identify a "do different" project and allow the team to manage it (7)
Attitude to Risk	Team membership strengthened to add in "do different" skills and attitude (1) Team to identify product ideas that are new to the market and company (5) Identify a "do different" project and allow the team to manage it (7)
Growth/ Development	Develop an idea/knowledge gathering and sharing system (2) Visit external bodies with a view to information gathering (3) Provide a "show and tell" session to "showcase" their new ideas (6)
External confidence	Team to identify product ideas that are new to the market and company (5) Provide a "show and tell" session to "showcase" their new ideas (6) Identify a "do different" project, allocate space, people and resources to it and allow the team to manage the project but with top management to champion it (7)
Internal confidence	Visit external bodies with a view to information gathering (3) Implement idea gathering and experimentation as a process within the team (4) Team to identify product ideas that are new to the market and company (5) Provide a "show and tell" session to "showcase" their new ideas (6) Identify a "do different" project and allow the team to manage it (7)
External perspective	Visit external bodies with a view to information gathering (3)
Clear objectives	Identify a "do different" project and allocate space, people and resources to it (7)
Team Constitution	Team membership strengthened to add in "do different" skills and attitude (1)
Company infrastructure	Develop an idea/knowledge gathering and sharing system (2) Implement idea gathering and experimentation as a process within the team (4) Provide a "show and tell" session to "showcase" their new ideas (6) Identify a "do different" project and support with top management champion (7)
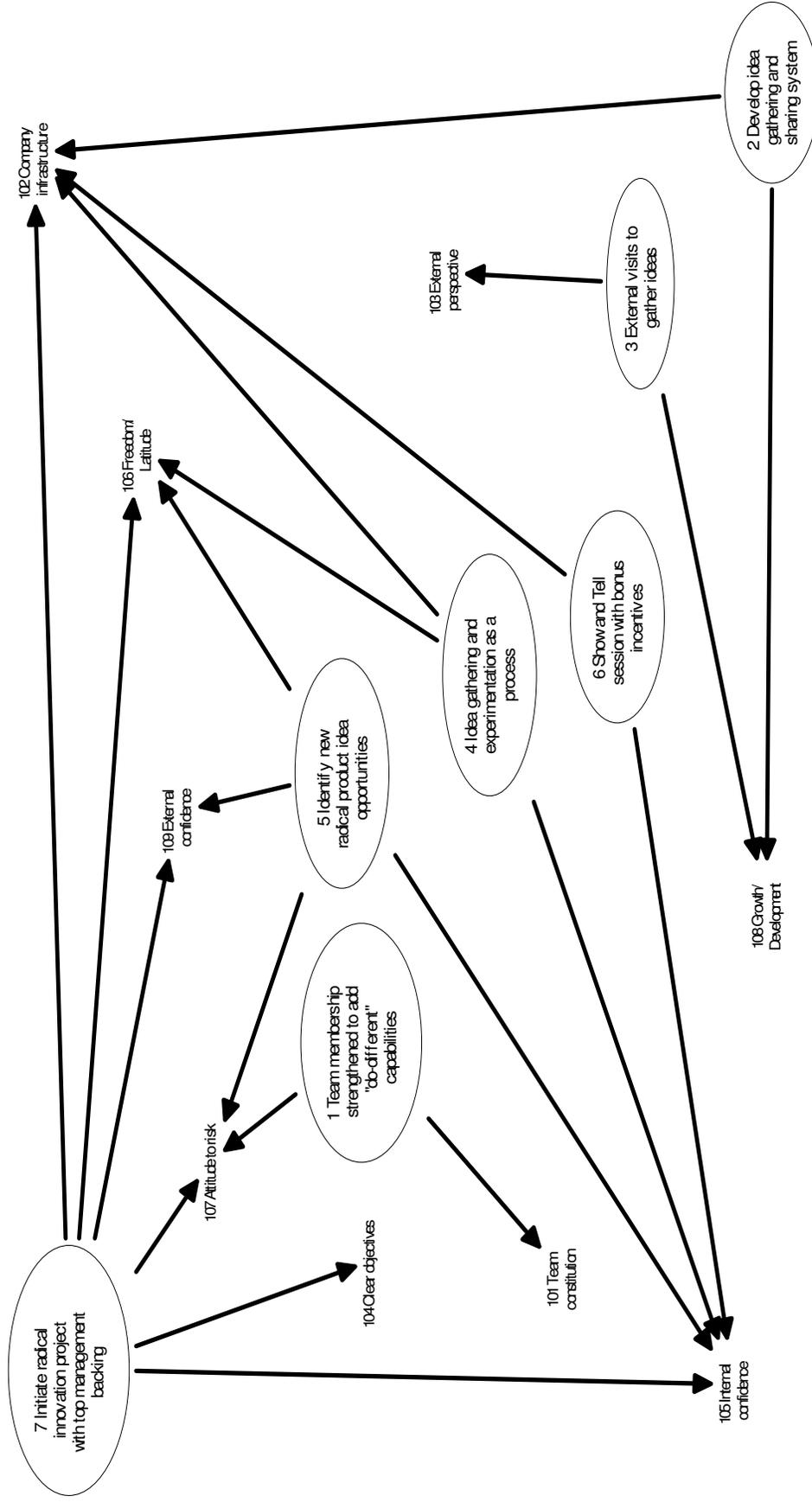
Figure 6-5 Map of the proposed interventions' influence on the nine themes

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Once implementation has commenced, participation should be maintained. Regular workshops to review progress, evaluate outcomes and re-plan follow-on steps would facilitate this. The involvement of the Development Team in making the change is a key factor in developing the desired innovation culture. The use of the assessment tools developed in Project Two would allow a gauging of presence and intensity of climate, culture and position against an "ideal" radical innovation culture at different stages during the implementation process. The regular review workshops would serve to maintain participation and ownership, whilst at the same time act as an additional gauge of progress towards the desired culture. To facilitate this, desired aspects of the artefacts and values in Schein's model are suggested as a benchmark to determine success or failure at various stages during the intervention process. These aspects are described in terms of the original nine themes in Table 6-10, along with typical success and failure indicators for each theme.

Table 6-10 Indicators of success and failure expressed in terms of the nine themes

	Theme	Level in Schein's model	Aspects of a radical innovation culture	Success indicators	Failure indicators
1	Company Infrastructure	Artefact	A management style that encourages risk taking. Bureaucracy or autocracy are not present. Some restriction in resources is evident – Goldilocks principle – not too little and not too much. A product champion to provide support at a high level is available.	Resources are made available. Projects have a product champion. Top management allow a greater degree of autonomy than for incremental projects. There is a system to store ideas and knowledge. There is a space allocated for keeping new or interesting objects or products. The weekly brainstorming meeting happens regularly and is well attended.	Management pressure is such that there is insufficient time to pursue radical projects. There is no idea knowledge storing system. There are no new or unusual objects or products kept by the Development Team. There is a high degree of project control and direction from top management. There is no weekly brainstorming session.
2	Team Constitution	Artefact	The team has a mix of creative individuals who have sufficient experience inside or outside the subject area such that they can apply lateral thinking to provide a radical solution. The team comprises different minded individuals who can work with some degree of uncertainty and conflict as part of the day-to-day activities.	There is a heterogeneous mix of team members – original Development Team members alongside new team members. Several of the new team members have higher degrees, different skill-sets and clearly have a "can-do" attitude.	There are no new team members. All team members have the same approach to problem solving – based on incremental improvement. There are no team members with higher degrees. There is no discussion or argument about ideas and solutions amongst team members. There remains a desire to follow instructions from top management.
3	External Perspective	Artefact	Examination and evaluation of technologies, processes, methods and product applications from outside the company and outside the industry. Networking of individual personal contacts is encouraged and supported. These ideas and knowledge are recorded and shared with the rest of the Development Team.	There are frequent visits to outside sources of information. External speakers regularly visit and talk to the team. There is discussion about what has been seen outside the company. There are many new contacts, both at a personal level and a group level. There is frequent communication with outside groups.	There are no external contacts and no visits other than those necessary to achieve the incremental development projects. There are no external visitors providing input to the team. Team members do not have a network of personal contacts outside the immediate industry.

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Table 6-10 Indicators of success and failure expressed in terms of the nine themes

	Theme	Level in Schein's model	Aspects of a radical innovation culture	Success indicators	Failure indicators
4	External Confidence	Value	Confidence and belief in the team's ability to "do differently" in pursuit of radical solutions. Groups outside the company and especially top management talk openly and positively about the Development Team's ability to deliver radical products.	The company employees outside the Development Team talk amongst themselves and with the Development Team members about radical innovation projects. There is an interest and pride from people outside the team about the team's progress in creating radical new products.	The Development Team is considered to remain incapable of radical innovation. Radical innovation projects are initiated by collaboration with outside agencies. There are no product development plans that include audacious projects as part of the Development Team's workload.
5	Clear Objectives	Artefact	Objectives that are not specific and clearly defined are the norm for "do different" projects. These are perceived as allowing a greater degree of latitude in developing solutions than more incremental projects. For "do different" solutions the presence of a less well defined specification is seen as an opportunity to develop a new solution to a problem.	Radical projects are characterized by specifications that are not complete and detailed. The product specification or requirements sometimes seem impossible to achieve. Some product requirements are outside the previous areas of experience of the company. There is an acceptance that this indicates the project is more radical in nature.	Product requirements are comprehensive and leave little if any room for judgement from the team members. The products tend to be incremental versions of what has gone before. The team members seek clarification and further explanation of aspects of the new product requirements until there is no requirement to apply any creativity to the development project. The specification is a very constrained outline for each new product.
6	Freedom/ Latitude	Value	Exploration and discovery are part of the way things are done. The Development Team controls the "do different" projects to a greater extent than incremental projects. The team is encouraged to make full use of the freedom and latitude within a project by top management.	The team takes responsibility for the radical projects to a greater degree than incremental projects. There is a clear absence of task management and top management control in radical projects. These projects are perceived to be "owned" by the Development Team.	The team requires project task management to complete discrete tasks on the project plan. The tasks are allocated as team members become available after completing the previous task. Top management controls the development projects and their technological direction.

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Table 6-10 Indicators of success and failure expressed in terms of the nine themes

	Theme	Level in Schein's model	Aspects of a radical innovation culture	Success indicators	Failure indicators
7	Attitude to Risk	Value	Taking risks is encouraged. Uncertainty is a part of the environment and discovery is accepted as being linked to taking risk. Failure is seen as an opportunity to learn. Failure in radical innovation projects is perceived to be as beneficial as successful outcomes, although not immediately delivering a solution to a problem.	Failures are perceived as inevitable outcomes prior to a successful radical project development and are not punished but used as learning opportunities. There is a willingness to try out different things and to experiment with previously untried solutions to problems. There are several "unofficial" experiments running in the Development area to test out ideas. Blame is not apportioned when a failure occurs. There is a process to distil learning points from failures.	There is a tendency to look for someone to blame when things go wrong. Actions are taken to reduce risk and ensure only successful outcomes are achieved on projects, to the extent that if a project looks as if it might not work, it is abandoned. Product solutions have a clear link to previously tried solutions. There are communications, such as email, used to prove that the team member was following an instruction or completing an allocated task when a failure occurs.
8	Internal Confidence	Value	Confidence among the team members that they can find a radical solution. Each team member works with other team members and respects the individual talents of others. Questioning, challenging but also supporting and nurturing other team members is day-to-day behaviour. There is confidence amongst the team members to try something new, knowing it may not work.	There is open debate within the team about new ideas and concepts. Team members have confidence to put forward their "do different" ideas. Other team members build on these ideas to develop potential solutions. The team are happy to take on a seemingly impossible or an audacious new product requirement. The weekly brainstorming meeting regularly generates many new ideas.	The team is wary about trying anything new. Product solutions have a clear link to previously applied solutions. There is little or no discussion, debate or argument about application of different technologies or untried methods. Difficult projects are resisted by team members. There is a tendency to define reasons why something cannot work rather than taking a "how to make it work" approach. A "can-do" attitude is missing.
9	Growth/Development	Value	Desire to grow and develop the ability and knowledge of the team members. A "restlessness" about wanting to discover new methods, technologies, ideas and concepts. A feeling of achievement when new skills or knowledge are gained by team members. A hunger to know more and know why.	Radical projects are seen as opportunities to use this freedom and latitude to push the boundaries. The team members continually seek out new ways of gaining new knowledge, or learning about new technologies and applications. The system for storing knowledge and ideas is populated and regularly used to generate further solutions.	There is no interest in discovering new ideas, technologies or input from new sources. The team members show no interest in learning new skills, finding reasons to avoid doing so. The system for storing ideas and knowledge is unused or underutilized.

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Top management ownership and involvement is critical to the success of the proposed interventions. This must be visibly demonstrated to the Development Team throughout the intervention process. Provision of adequate resources, provision of space and time to enact the interventions, and demonstration of an interest in progress of the interventions and resulting successes and failures will support this. Top management must take care not to assume control of the interventions. The responsibility for implementing interventions 2 to 7 lies with the Development Team. Top management must facilitate, encourage, take an interest, but at all stages it must allow the Development Team to retain control and ownership of these interventions. This sets the vision for radical product development in Cerulean, the perception that experimentation, learning and discovery are valued and are part of the "way things are done now" in the Cerulean Development Team.

6.9 Key points from Project Three

The key points arising from Project Three can be summarized as:-

- Interventions to facilitate a radical innovation culture focus on encouraging team members to experiment and seek out new knowledge.
- Copying interventions is unlikely to be effective. They need to be implemented with participation from team members and recognise the history and extant position of the team.
- The use of the ideal Type II radical innovation culture provides a goal for the interventions and provides a tangible focus for team members.
- Transition between the two archetypes can be facilitated by adopting Schein's model of organizational culture. This provides a framework for interventions focused on changing values and underlying beliefs by encouraging adoption of the desired behaviours.
- Leadership is a key component of developing a radical innovation culture. The leadership to facilitate this requires balancing of good business practices with the practices to facilitate radical innovation.
- Support from top management is a key aspect to developing a radical innovation culture. This gives legitimacy to what could otherwise be considered as practices that are counter-productive to good business operations.
- A radical innovation culture embraces risk. Management's task is to manage this risk-taking and balance the risk against the potential benefit.
- Top management must work continuously at maintaining the perception that failure is not necessarily to be avoided. Failure should be "fast and often" to provide learning for the team.
- Interventions to develop a radical innovation culture encourage learning through exploration.
- A radical innovation culture embedded in a normal business environment is not easily achieved.
- A planned set of linked interventions to facilitate a radical innovation culture specifically for the Cerulean Development Team was developed.

7 Discussion
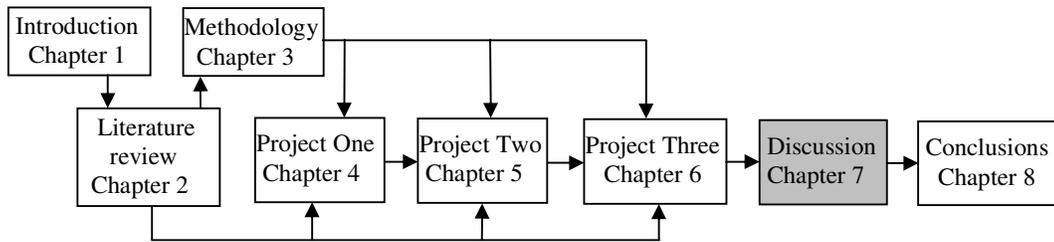
Figure 7-1 Research overview – Discussion

The extant literature discusses the diagnosis of innovation cultures and makes observations on what interventions may be beneficial to facilitate radical innovation. Eisenhardt, in Hargadon's book "How Breakthroughs Happen" (2003), suggests that in developing an innovative organization, there is a tendency to focus on the "where to go", ie, a particular position or strategy, and pay scant attention to the "how to get there". The landscape of a radical innovation culture is not well understood and so the steps to get there are not clearly visible. This research addresses the planning activities associated with this journey.

7.1 Developing the interventions

Radical innovation is rooted in risk (Utterback, 1994; Song and Montoya-Weiss, 1998) and a firm that embraces radical innovation must also be prepared to embrace risk. The Cerulean Development Team show an aversion to risk taking. An organizational culture that encourages risk taking is counter-productive to good business practice- where risks are avoided or minimized. In this environment failure is to be avoided. The routines and systems that work well for normal business operation become inhibitors when applied to radical innovation development (Christensen, 1997; Sutton, 2001; Farson and Keyes, 2002). Established players have a learned behaviour which they have developed that includes those ideas, techniques and habits which are passed on by one generation to another. The routines become institutionalized. The culture that facilitated past success based on "doing better" can become the culture that inhibits frame breaking behaviour needed for radical innovation. Maintaining this "do different" capability requires top management support and leadership that allows these practices to co-exist with the normal good business processes. Developing and sustaining this kind of ambidexterity requires continuing management support. In a radical innovation culture, failure is a learning step and the objective is to fail quickly and move on, learning from the failure. The radical innovation culture is one that encourages learning, from these failures but also from external sources. The "do different" step forward very often comes from linking two previously unlinked ideas to produce a radical innovation. Therefore a radical innovation culture encourages boundary crossing in the pursuit of new knowledge. Successful organizations manage this new knowledge using a process, and in some cases review it at regular intervals, to ensure that it is not forgotten. The radical innovation culture encourages learning, from both experimentation and exploration. It is a culture that has a hunger for new concepts, new technologies and new ideas. These are fuel for the flow of radical innovations.

Using Greenwood and Hinings (1993) archetypes as a basis for representing the innovation supporting culture allows the development of two archetypes. Type I represents an incremental innovation supporting culture. Type II represents an innovation culture that supports radical innovation. The holistic approach that the use of archetypes facilitates allows the comparison and contrast of the two types. There is some commonality, but there are also clear differences in the culture aspects that operate to facilitate each type of innovation. The archetypes are considered to be ideal types. It is unlikely that any organization would exhibit the characteristics of one type exclusively. However the use of the ideal facilitates the "end point" towards which any change process or activities should be directed in order to enable the desired characteristics for radical (or incremental) innovation. The assessments made of the Development Team culture provide a datum point for gauging progress towards a radical innovation culture and also indicate the areas where interventions are required to develop this radical innovation culture. The results show that freedom of operation and willingness to take risk are perceived as being low. The Development Team also feel that management support for "do different" activities is low. In evaluating interventions to develop a radical innovation culture, the interventions pooled from the empirical examples indicated a need to provide strong support and leadership to facilitate a radical innovation culture. This provides a legitimacy for what could be considered as counter-productive practices like experimentation and seeking out different ideas in the business context. Idea gathering and management of the amassed knowledge is another aspect in these examples. The plan developed for the Cerulean Development Team takes these examples and develops a series of inter-linked interventions designed to develop a radical innovation culture. The plan builds on the previous participation of the Development Team and the planned interventions are intended to be highly participative. The focus is on developing some "do different" aspects of a radical innovation culture that have legitimacy within the company, and then selecting and running a "do different" project. This would have high visibility within the company and encourage the Development Team members in behaviours that are new to them and which facilitate a radical innovation culture.

7.2 Making the change

Interventions adopted by other organizations that attempted to generate a "do different" capability show what has worked and what has not. It is not beneficial to simply copy these interventions in order to generate a Type II innovation culture. Adoption of Type II innovation culture ways of working can be encouraged through Organization Development (French, Bell Jr., and Zawacki, 1989) types of interventions. Using Schein's model of culture as a guide, interventions that influence the behaviours and can lead to adoption of values and underlying beliefs, the "way things are done" can be changed to behaviours that are in line with a Type II innovation culture.

The use of an archetype facilitates the "end point" towards which activities should be directed in order to enable the desired characteristics for radical (or incremental) innovation. Transition between archetypes is facilitated by using Schein's model. Change can be distinguished between incremental change, frame breaking change and quantum change. The dynamics of the process are different from incremental to large scale change, which involves movement from one archetype to another (Greenwood and Hinings, 1993). A series of interventions to facilitate change rather than a diffusion from one archetype to another is suggested as a method of moving towards a radical

intervention culture. If these interventions are perceived as actions taken at the artefact and value level in Schein's model of culture, then transition between archetypes is possible by embedding new values and underlying assumptions through implementation of artefact examples for the group. As the value relating to the artefact created by the intervention is developed, it in turn leads to a behaviour and as that behaviour begins to solve the problem which prompted it, the value is gradually transformed into an underlying assumption about how things really are. As the assumption is increasingly taken for granted, it drops out of awareness, thus creating a shift in the organizational culture. This shift facilitates the transition towards Type II radical innovation culture.

Throughout the cases examined, there is a clear thread of top management support, either through initiation of changes to support a radical project, creation of a project team to develop a radical product or through active participation in the development of radical projects. This sends a clear message that radical is important to the company, and reinforced when this is aligned with business strategy, indicating that the development of radical products is part of the overall business the "way we do things round here" rather than a "bolt-on" that resolves an immediate problem for the organization. Having the "do different" innovation aspect of product development aligned with or even integral to the business strategy reinforces company commitment to radical innovation and provides a clear message that it is essential for the business. A focus on fewer rather than more projects, with support from top management, adds legitimacy to the projects in the eyes of the organization. To create the belief that failure is a learning opportunity rather than something to be avoided at all costs, means appearing to accept a different standard for this group to the other areas of the business. This ambiguity, that contributes to the organization's ambidexterity, can be seen in many of the "ways of doing things" – the culture of a radical innovation organization. The support, encouragement and involvement of top managers in the radical innovation process and activities sends a clear signal that radical innovation is part of the "way we do things round here". Top management can interweave radical innovation into the business strategy such that it becomes an integral part of the day-to-day activities of the business. This can only be achieved if there is visible support and encouragement for the Type II behaviours that in many cases are counter-productive to normal day-to-day business activities. These counter-culture behaviours can be given legitimacy and credibility by the actions and behaviour of the top management team. By reinforcing Type II behaviours at the highest level, by acknowledging that the two behaviours, Type I and Type II, co-exist within the single organization, albeit perhaps physically segregated in some cases, the development of a radical innovation culture can be facilitated. Creation of a Type II innovation culture capability in the Cerulean Development Team could be perceived as developing a separate, but integrated, innovation culture within the existing Cerulean organizational culture. This radical innovation culture would be counter-intuitive to good business practice, yet be encouraged to co-exist with the existing culture. It cannot exist on its own as it needs links to the rest of the organization for its continued existence, yet it cannot be completely integrated into the existing culture as it acts to challenge and de-stabilize the "do better" approach of the organization. It is a symbiotic relationship where two separate organizational cultures, one embedded in the other, co-exist to their mutual benefit.

Moving to a radical innovation culture requires entering into a psychological space with unknowns and uncertainties. In this situation, providing psychological security is

extremely difficult (Francis *et al.*, 2003). It is in this environment that passion and an unfettered desire to achieve a desired position can be supported by adding people with this attitude and with the experience to know what this position is like (Kirton, 1984). The characteristics sought for new recruits include being able to think tangentially and to approach tasks from unsuspected angles. This is described by Kirton as discovering problems and discovering the avenues of solution. These new recruits act as a catalyst to the established group and provide the dynamics to bring about change within the group. Characteristics such as irreverence of consensual views, creating dissonance, challenging rules, having little respect for past custom and not needing consensus to maintain certitude in face of opposition are all beneficial in facilitating the culture change. This type of recruitment corresponds to the first intervention, whereby the team skills and attitudes are developed to embrace this step into new territory. Taking time to communicate the changes, why they are happening and involving the employees in a participative style of making the change provides a degree of psychological security for these employees during the change process (West, 2002). Innovation is given a high priority as part of the strategy and radical innovation is held up as an equally important part of this.

7.3 Structural arrangements for a radical innovation culture

A radical innovation culture is a collection of underlying beliefs, values and visible artefacts (Schein, 1984). To develop and sustain such a culture there must be processes and frameworks that allow the appropriate behaviours to take place and encourage their use. The structural arrangements suitable for this type of "do different" innovation are not clear and easily replicable. They interweave with the behaviours, and as the behaviours to facilitate radical innovation are not clear and consistent, ie, constantly evolving to respond to continuous learning and experimentation, the structural framework must also constantly evolve. A structure to support radical innovation must allow flexibility for the team members. Allocation of tasks, formal roles and responsibilities are anathema to this type of innovation. Rather, a flexible structure that shifts itself to suit the situation is required. This is clearly seen in the example of IDEO (Kelley and Littman, 2001). Here, the structure is loose, the working arrangements are temporary and constantly change, reporting lines are blurred and the focus is on delivering a solution for the customer. Any such structures should develop and evolve as the needs of the group change. Where processes are of benefit is in development of creative thinking. Processes that encourage experimentation, that facilitate learning are appropriate. Processes are designed to provide control over employees' actions and behaviours. With a radical innovation culture, control can be damaging. The words of Lockheed's Kelly Johnson are relevant here; 'if a Skunk Works really operates right, control is exactly what they don't get' (Rich and Janos, 1994: 288).

8 Conclusions
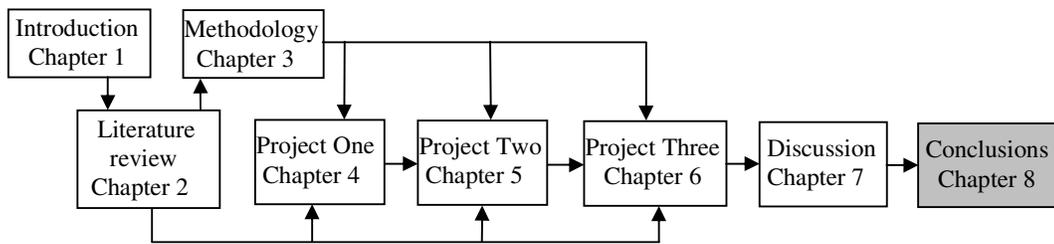
Figure 8-1 Research overview – Conclusions

8.1 Summary of key findings

Project One developed a model of innovation culture as two ideal types at opposite ends of a continuum. This was based on nine themes which represented aspects of innovation culture that related to radical innovation. The model of the radical innovation culture defines what this is like, in artefact and value terms (Schein, 1984). Project Two provided triangulation of the grounded research findings from Project One, and in addition, provided an assessment of the extant position of the Development Team's innovation culture in facilitating radical innovation. This provided a starting point for developing a plan of interventions suitable for moving the organizational culture to be more supportive of radical innovation. Project Three suggested a series of interventions that were suitable for Cerulean, in that they related to previous participative work with the team members and in that they had a precedent in other organizations in terms of developing aspects of a radical innovation culture. A key aspect of the interventions is the role of senior management. This leadership from the top of the company is essential to ensure resources and support for radical innovation are made available, but more importantly, it legitimizes a way of working and style of management that is in dissonance with good-practice methods. This is because the culture that facilitates radical innovation in itself must be open, questioning, challenging and unaccepting of the status quo and past successful methods and processes. Loosening control and encouraging learning through experimentation are necessary for facilitating this type of innovation culture.

8.2 Radical innovation culture

The nine themes represent aspects of Cerulean's innovation culture that enable or inhibit radical innovation. Using archetypes as a basis for representing the holistic perspective of an innovation supporting culture allows the development of two ideal types. The use of an ideal type facilitates the "end point" towards which any change process or activities should be directed in order to enable the desired characteristics for radical innovation. The framework based on Greenwood and Hinings' archetypes and Schein's model acts as a guide for managing and monitoring the transition between innovation cultures at various levels of analysis. Through planned interventions enacted in a participatory manner changing the underlying assumptions and values, behaviour changes can be embedded in the organization as "the new way we do things around here", thus leading to the desired radical innovation culture. Examination of empirical examples indicated several appropriate interventions that could facilitate radical

innovation. Throughout the cases examined, there is a clear thread of top management support, either through the initiation of changes to support a radical project, creation of a project team to develop a radical product or through active participation in the development of radical projects. This sends a clear message that radical is important to the company, and is reinforced when this is aligned with business strategy, indicating that the development of radical products is part of the overall business, the "way we do things round here" rather than an instant solution that resolves an immediate problem for the organization. Having the "do different" innovation aspect of product development aligned with or even integral to the business strategy reinforces the company commitment to radical innovation and provides a clear message that it is essential for the business. This will mean appearing to accept a different standard to the other areas of the business. This ambiguity, that contributes to the organization's ambidexterity, can be seen in many of the "ways of doing things" – the culture of a radical innovation organization.

8.3 Interventions to develop radical innovation culture

The OCAI (Cameron and Quinn, 1999) and KEYS (Amabile *et al*., 1996; Amabile, 1998; Amabile and Gryskiewicz, 1989) assessments along with the innovation assessment instrument based on the nine themes provided an estimate of the team's perception of the innovation culture in comparison to an ideal position- the Type II archetype. The results showed that freedom of operation and willingness to take risk is perceived as being low. The use of an archetype facilitates the "end point" towards which any change process or activities should be directed in order to enable the desired characteristics for radical (or incremental) innovation.

The sequence of interventions suggested is designed to facilitate aspects of a Type II radical innovation culture. The ideal type as defined in the innovation model provides the desired position – the aspects of a radical innovation culture the interventions are designed to facilitate. The interventions themselves are less important than the underlying beliefs and values being developed and embedded. It is these underlying beliefs and values that propagate the desired behaviours associated with a radical innovation culture.

The interventions require a significant input from top management, in providing resources, time and the infrastructure for the team. The involvement of top management is an important intervention in its own right, as evident in the literature, empirical and DIF company examples. The leadership shown by managers at the top of the organization have a major effect on the development of a radical innovation culture (Tripsas and Gavetti, 2000; Kaplan, Murray and Henderson, 2003). This is not surprising as leadership is a significant influence in changing organizational culture (Carter *et al*., 2001; Ekvall, 1996; Schneider *et al*., 1996).

Transition between archetypes is facilitated by using Schein's model. Change can be distinguished between incremental change, frame breaking change and quantum change. The dynamics of the process are different from incremental to large scale change, which involves movement from one archetype to another (Greenwood and Hinings, 1993). A series of interventions to facilitate change rather than a diffusion from one archetype to another is suggested as a method of moving towards a radical intervention culture.

8.4 Contribution

The literature is vocal on the issue of radical innovation and on diagnosing enablers and inhibitors. However, it remains largely silent on management actions to develop a radical innovation culture. There is a tension between exploitation – incremental innovation, and exploration – radical innovation, in terms of the management of the innovation activity. There is less known about what the cultural conditions for facilitating radical innovation are and about how to develop this type of culture. This research examines aspects of innovation culture that facilitate radical innovation, and suggests interventions suitable for developing such an innovation culture. Literature tends to focus on innovation in general or on incremental innovation and where radical innovation is the subject of the research this tends to be in larger firms. This research makes a contribution to designing a change programme to facilitate aspects of a radical innovation culture for a mature SME.

8.4.1 Practitioner contribution

For *practitioners*, the research findings can be used to help understand aspects of organizational culture that facilitate radical innovation. The nine themes influencing radical innovation have a degree of generalizability outside the specific context of Cerulean. These themes represent aspects of organizational culture that influence radical product development. The framework of ideal types forms a starting template for evaluating other organizations' radical innovation cultures. The composite instrument developed indicates the propensity for radical innovation in a small mature company, and may find application in other organizations where radical innovation is no longer prevalent. Although the research will be contextual to Cerulean, there are features that may be relevant to other SMEs struggling with a lack of innovative capability. As Parker states (2000: 222), 'all organizational cultures are unique, yet at the same time they share similar features'. Developing a radical innovation capability is of interest to a growing number of firms. The interventions suggested as part of the research are designed to develop a radical innovation culture. These interventions are based on empirical examples and address the reduction of the gap between the extant and ideal position of the innovation culture. For practitioners the contribution is therefore in what a radical innovation culture "looks like" and "how to get there" (Hargadon, 2003). Ambidexterity is a concept that is often used in describing the operation of radical innovation concurrently with incremental innovation (O'Reilly III and Tushman, 2004; Stringer, 2000; Tushman and O'Reilly III, 1996; Tushman and O'Reilly III, 1999). The two innovation types sometimes require different conditions and management (Markides, 2004). On occasions, what facilitates one may inhibit the other. This research makes a contribution to the area of innovation management, in designing a plan of interventions to create a radical innovation culture within a larger incremental culture.

   Finally in the field of innovation management, the research suggests that as the innovation process is contingent, innovation in the innovation process ensures it remains effective as the internal and external factors change.

8.4.2 Academic contribution

For *academics*, the research contributes to knowledge concerning aspects of organizational culture that facilitate radical innovation. This knowledge is trans-

disciplinary and adds to the domains of innovation management, organizational culture and organizational creativity.

This research adopts an experimental, "probe and learn" approach to organizational development to stimulate an innovation culture for radical product development in a medium sized mature engineering firm, which is part of a larger multi-national corporation. The researcher has deployed a grounded participative methodology, within a "live" new product development (NPD) team to surface key aspects of a radical innovation culture. The research can be considered to be a live experimental approach to organizational development. This "probe and learn" approach adds to the theoretical knowledge of organizational development for transformational change. The stage of the work discussed in this thesis represents the diagnostic phase. The next stage would be to undertake the interventions in the same experimental *"probe and learn"* manner.

As the research is participative, it is well placed in its potential for developing theory that will be relevant to practice (Huxham and Vangen, 2003). This participative approach to developing knowledge of the members' perceptions of a radical innovation culture and on creating a radical innovation capability from an insider perspective contributes to mode 2 knowledge production (Gibbons, Limoges, Nowotny, Schwartzman, Scott, and Trow, 1994; Tranfield and Starkey, 1998; MacLean, MacIntosh and Grant, 2002; Tranfield, 2002) in the domains of Innovation Management and Organizational Culture.

8.4.3 Researcher as a practitioner

This research includes an insider action research content. This inevitably had an influence on the response of participants to interviews, workshop sessions and discussions about the research activities. The methodology adopted used triangulation in the form of established assessment tools and a journal kept by the researcher as a method of validating what had been developed in the participative work with the team. This brand of insider participative action research is less usual. The methodological approach to this research required the experiential involvement of the researcher, the absence of *a priori* analytical categories and an intent to understand a particular situation (Evered and Louis, 1981). The researcher was also a senior manager and the inquiry was not "seen from the outside", but rather "seen from within". The triangulation of the findings developed from a grounded methodology through observations and assessments adds to the validity of the innovation model developed. The approach adopted would have applicability in other situations in which the researcher in the role of practitioner has similar opportunity to influence the responses from the research subjects. There is therefore a contribution to methodology for this form of action research. The areas of contribution are summarized in

Table 8-1.

Table 8-1 Domains of contribution and extent of contribution of the research

	What has been confirmed?	**What has been developed?**	**What has been found which is brand new?**
Theoretical Knowledge	Culture and climate for creativity. Top management influence on developing a radical innovation culture.	Framework to understand radical innovation culture. Interventions suitable to develop a radical innovation culture in one small mature company.	A probe and learn approach to organizational development for transformational change.
Empirical evidence	Aspects of organizational culture that influence radical product development.	Themes developed through participative inquiry. Themes that influence radical innovation.	Development of an instrument to allow self assessment to gauge a team's position against an ideal Type II radical innovation culture.
Methodological approaches	Content analysis. Action research. Participative research. Use of KEYS and OCAI. Triangulation using different methods.	Gauge for presence and intensity of a radical innovation culture. Combined use of KEYS and OCAI to gauge aspects of innovation culture.	Unusual participative research by a senior manager in the business. This is a one company, high influence situation where the researcher is also a practitioner.
Knowledge of practice	Interventions suitable for facilitating a radical product development.	Strategic plan to develop a radical innovation culture in a small mature company.	The innovation process is contingent. *Innovation* in the innovation process ensures effectiveness of change.

8.5 Review of the research questions

Section 1.3 outlines the research questions associated with this exploratory study. In this section the questions will be reviewed in the context of the investigation that has been conducted. The main research question was supplemented by four sub-questions that comprise the different stages of the research activity. A summary response to the research question is outlined in Table 8-2 and to the sub-questions in Table 8-3.

Table 8-2 Research questions and review informed from the research

Research question	Review
"*What aspects of organizational culture facilitate radical product innovation and how can change be planned to leverage potential improvement?*"	The aspects identified are in the form of the nine themes. Modelling these as archetypes of innovation culture provides a clear indication of the aspects of organizational culture that influence radical innovation. The development of a plan of interventions for Cerulean informs the second part of the question. These interventions are developed by reference to empirical examples with the ideal position for a radical innovation culture as the desired end-point.

Table 8-3 Sub-questions and review informed from the research

Sub question	Review
What are the known organizational culture enablers and inhibitors to radical innovation in mature small to medium sized design and manufacturing firms?	The enablers and inhibitors for a radical innovation culture are informed through the literature review. This examines the enablers and inhibitors of a radical innovation culture from both theoretical and empirical perspectives. These enablers and inhibitors form the basis of the aspects of an ideal radical innovation culture developed for the archetypes model.
What are the perceptions of Cerulean employees and their extant position on the company's culture for encouraging radical innovation?	The employees' perceptions are informed by the nine themes influencing radical innovation. These themes were developed in a participative method with the team. They represent their perceptions, not as a first snapshot, but as a refined and considered position of the aspects of organizational culture influencing radical innovation.
What is the gap between the Cerulean current organizational culture and the desired future state for radical innovation?	The use of the archetypes model provides the desired ideal position. The gauging of the team's perception of the current position against this ideal is informed by the use of the innovation culture assessment.
What change be effectively planned to encourage a culture that will develop a radical innovation capability at Cerulean?	A change programme in the form of a series of interventions is proposed. These interventions are based on literature, empirical examples and DIF companies' experiences. The interventions are developed with the ideal position for a radical innovation culture as an objective. This ideal position outlines aspects of such a culture. The interventions are designed to shift the underlying values and beliefs, closer to a desired position, through the application of suitable artefacts.

8.6 Limitations of the study and further research

8.6.1 Limitations in Project One

The themes that have emerged from this stage of the research refer to that part of the organizational culture that relates to radical innovation. They do not and are not intended to represent a complete picture of the organizational culture of the Cerulean company. The themes do not exist as stand alone entities, but co-exist as representations of the innovation enabling or inhibiting culture in the Cerulean Development Team. The data gathered relate to radical innovation, rather than innovation in general, and cannot be considered exhaustive. A decision was taken to stop any further refining of the themes after four workshops. Whilst there may have been the opportunity to further refine the themes, the dynamic perspective of the organizational culture suggests that dwelling on refining data developed through a grounded methodology is less useful the later it is done. The organizational culture is continuously evolving, as the artefacts, values and underlying beliefs influence each other. The nature of this research was very participative and the very fact of beginning to talk about radical innovation and engage the Development Team in a process of discussing and refining its perspective of this culture means that its initial views had developed from the early stages of the research. As time progressed this involvement itself had an influence on its values and underlying beliefs, thus changing the innovation culture. Too much time spent on introspection was likely to yield a view that is significantly outdated and therefore less valid. The opportunity in this research was therefore to develop a reflection and refining process that retained an up-to-date perspective of the team's innovation culture. The objective of this was making sense from the data (Langley, 1999), and this was achieved to allow the research to progress to the next stage. Further refining after a period of reflection may have added more insights.

   The innovation culture archetypes were constructed in the light of existing theory and literature. They also reflected the perceptions of the Development Team. Although their results are not clear cut, Greenwood and Hinings (1993) are confident that organizations do tend to operate with structures and systems that approximate archetypes. There is also evidence that organizations tend to move towards archetype coherence. Passage between archetypes (organizational change) is less common than archetype stability (organizational inertia), and they argue that 'archetypes are probably institutionally specific' (1993: 1057). Therefore generalizability beyond Cerulean of these forms of archetype may be limited. Development of organization specific archetypes would however be facilitated by following the same participative approach as in this research.

8.6.2 Limitations in Project Two

The assessments provide a perspective of the Development Team at three levels. However, although the OCAI and KEYS have external validity, the radical innovation culture self-assessment based on the nine themes has internal validity. This assessment instrument was not intended to provide a rigorously reliable and externally valid measure of the innovation culture. The objective was to obtain an estimate of the team's perception of the innovation culture in comparison to an ideal position – the Type II archetype. This was an attempt to gauge more directly than was possible with KEYS and OCAI, the presence and intensity of the themes relating to radical innovation

culture. However, there is no direct link from the OCAI and KEYS to the innovation culture assessment. This assessment tool was derived by participative development based on the themes surfaced in Project One. As this assessment tool is designed specifically for the research within Cerulean, it is considered adequate for repeated use on the same organization group as an assessment for the effectiveness of the planned interventions. Further work would be required if this assessment tool were to be used outside the confines of this Executive Doctorate research.

For culture and climate assessment, it was considered impractical to evaluate all available instruments and then develop a suitable assessment tool. Therefore, only more common assessment tools were considered. The tools considered were required to be widely used, academically robust, validated and reliable. In addition, it was considered preferable if the tool did not require specialist training or assessors in order to be utilized. This, therefore, restricted the pool of assessments evaluated. The nature of action research, involving the members of the team in making the change, was also considered when selecting instruments. The assessment tool developed as part of this research was required to be suitable for use and understanding by the members of the Development Team. This was considered necessary in order to preserve the ownership and participation that had been developed during the course of Project One. Further research may indicate a broader pool from which a suitable composite instrument could be developed. Recent literature suggests another instrument, part of an innovation audit, that may be relevant to gauging the radical propensity of the innovation culture (Goffin and Mitchell, 2005).

8.6.3 Limitations in Project Three

The interventions identified from literature and empirical examples were evaluated from the perspective of being relevant to changing the Cerulean Development Team innovation culture. The interventions suggested are contingent to this research, although their foundation is in innovation management in general.

The interventions examined cannot be considered as exhaustive. Those identified potentially create aspects of the desired radical innovation culture. They act together to have an effect on the innovation culture of the group, but cannot be considered to act independently of each other. Leonard-Barton suggests that when an organization is examined to identify the reason for its innovation capability, if a part is 'pulled out to be examined, it comes out vinelike, trailing roots back to deeply held values and widely observed management practices' (1992b: 25). It is the interconnectedness that makes such systems difficult to imitate and fragile but effective. There are likely to be other interventions that also act to develop the desired culture. The outcome of applying the Cerulean set of interventions to another organization would be dependent upon the existing position of the innovation culture. The suggested interventions may have some applicability in other mature SME organizations, but it would be pertinent to gauge the issues that are inhibiting radical innovation culture in these organizations before suggesting suitable remedies. However, some of the research described in this report may be of benefit to similar organizations struggling with a lack of radical innovation capability. Where there are clear similarities, similar interventions applied in a participatory manner may result in closer proximity to a Type II innovation culture. Further research would be required to test the extent to which the proposed interventions have widespread applicability.

The interventions identified from literature and case examples were evaluated from the perspective of being relevant to changing the Cerulean Development Team innovation culture. The interventions suggested are therefore contingent to this example, although their foundation is in the innovation management in general..

8.6.4 Further research

The main opportunity for further research is in observing the impact of the planned interventions implemented over time on the development of a radical innovation culture. This would provide an opportunity for participative research in which the researcher as practitioner plays a central role in developing a radical innovation culture.

The composite instrument has potential to be further developed as an instrument to assess radical innovation culture. KEYS and OCAI are creative climate and organizational culture assessments, and OCAI refers to a specific culture type (Adhocracy) that closely matches many aspects of a radical innovation culture.

Two opportunities for further research are in evaluating interventions suitable for a broader range of organizations and in developing interventions specifically focused on creating a particular type of belief. This form of research is likely to be more academic in nature and the practitioner setting of this research precluded taking such an approach. The ultimate outcome for Cerulean is not the suggested list of interventions from the Executive Doctorate research, but in the creation of a radical innovation culture that facilitates a stream of radically new products.

Although the research is based on a single organization, this allows a deeper evaluation of the aspects influencing radical innovation. The research strategy focuses on understanding the dynamics present within a single setting. To build theory from case studies it is necessary to overlap the data analysis with data collection. A study of this type produces large volumes of rich data. The forced comparisons create new categories and concepts (Eisenhardt, 1989). Overlapping this study with similar studies in other mature small organizations would add a broader range of data and allow more comparisons to be drawn.

8.7 Personal reflection on the research

This research has been a fascinating journey; extremely demanding yet also satisfying. It has awakened an interest in management research which is likely to evolve through my future career aspirations. Whilst in the beginning, embarking on the Executive Doctorate was a well considered course of action, my research developed in many unexpected ways. The academic learning is woven throughout this thesis. I will reflect here on my personal and professional development.

I have undoubtedly changed during the course of this research. The ability to think critically, to evaluate and to write crisp incisive papers is considered to be a developmental aspect for an individual undertaking doctoral research! I may have developed a little skill in this aspect, yet it is in being more critical of myself, of my assumptions and of my conclusions, that I have become more aware. I find myself reflecting more about events around me, whether professional or social, and rather than accepting the proffered explanation for an event, I now consider the validity of any explanation and its robustness. I have become more receptive to alternative perspectives to any given situation and alert to contradictory explanations. I have learned that each perspective can have validity and yet can also be related to other perspectives. The co-existence of multiple viewpoints, plurality and paradoxes are all a natural and necessary part of organizational life and survival.

I have also ventured into many different domains of research during the Executive Doctorate programme. Some of these ventures overlapped with my own research, and some were driven by curiosity about a particular issue. At times, it was difficult to resist the temptation to pursue a new area of interest and remain focused on the doctoral research area. Some of these areas will undoubtedly be revisited in the future.

My company has also benefited from my doctoral research through my own personal and professional development. Some of the actions taken to improve company performance in my role as Managing Director are based on ideas discovered or developed during this Executive Doctorate research process. This is, in one way, recompense for the lack of total focus on my "day" job whilst undertaking the research.

REFERENCES

Abetti, P.A. (2003), 'Over-managing and Under-managing Radical Technological Innovations: Lessons from USA, Japan and Europe', in *IEMC 03 Proceedings. Managing Technologically Driven Organizations: "The Human Side of Innovation and Change"*, Albany, NY, IEEE, pp. 542-545.

Ahmed, P.K. (1998), 'Culture and climate for innovation', *European Journal of Innovation Management*, Vol. 11, No. 1, pp. 30-43.

Ahuja, G. and Lampert, C.M. (2001), 'Entrepreneurship in the Large Corporation: a Longitudinal Study of How Established Firms Create Breakthrough Inventions', *Strategic Management Journal*, Vol. 22, No. 6-7, June-July, pp. 521-543.

Akgün, A.E., Lynn, G.S. and Byrne, J.C. (2006), 'Antecedents and Consequences of Unlearning in New Product Development Teams', *Journal of Product Innovation Management*, Vol. 23, No. 1, January, pp. 73-88.

Al-Beraidi, A. and Rickards, T. (2003), 'Creative team climate in an international accounting office: an exploratory study in Saudi Arabia', *Managerial Auditing Journal*, Vol. 18, No. 1/2, pp. 7-18.

Ali, A. (1994), 'Pioneering Versus Incremental Innovation: Review and Research Propositions', *Journal of Product Innovation Management*, Vol. 11, No. 1, January, pp. 46-61.

Alvesson, M. (2002), *Understanding Organizational Culture*, Sage, London.

Amabile, T., Burnside, R.M. and Gryskiewicz, S.S. (1999), *User's Manual for KEYS Assessing the Climate for Creativity*, Center for Creative Leadership, Greensboro NC.

Amabile, T., Conti, R., Coon, H., Lazenby, J. and Herron, M. (1996), 'Assessing the work environment for creativity', *Academy of Management Journal*, Vol. 39, No. 5, October, pp. 1154-1184.

Amabile, T.M. (1988a), 'From Individual Creativity to Organizational Innovation', in Gronhaug, K. and Kaufmann, G. (Editors), *Innovation: A Cross-Disciplinary Perspective*, Norwegian University Press, Oslo, pp. 139-166.

Amabile, T.M. (1988b), 'A Model of Creativity and Innovation in Organizations', in Straw, B.M. and Cummings, L.L. *Research in Organizational Behavior: An Annual Series of Analytical Essays and Critical Reviews*, JAI Press, Greenwich, CT, pp. 123-167.

Amabile, T.M. (1997), 'Motivating Creativity in Organizations: On Doing What You Love and Loving What You Do', *California Management Review*, Vol. 40, No. 1, Fall, pp. 39-58.

Amabile, T.M. (1998), 'How to Kill Creativity', *Harvard Business Review*, Vol. 76, No. 5, September/October, pp. 76-87.

Amabile, T.M. and Gryskiewicz, N.D. (1989), 'The Creative Environment Scales: Work Environment Inventory', *Creativity Research Journal*, Vol. 2, pp. 231-253.

Amabile, T.M., Hadley, C.N. and Kramer, S.J. (2002), 'Creativity under the gun', *Harvard Business Review*, Vol. 80, No. 8, August, pp. 52-61.

Amara, N. and Landry, R. (2005), 'Sources of information as determinants of novelty of innovation in manufacturing firms: evidence from the 1999 statistics Canada innovation survey', *Technovation*, Vol. 25, No. 3, March, pp. 245-259.

Amis, J., Slack, T. and Hinings, C.R. (2004), 'The Pace, Sequence and Linearity of Radical Change', *Academy of Management Journal*, Vol. 47, No. 1, February, pp. 15-39.

Anderson, N.R. and West, M.A. (1998), 'Measuring climate for work group innovation: development and validation of the team climate inventory', *Journal of Organizational Behaviour*, Vol. 19, No. 3, May, pp. 235-258.

Anderson, P. and Tushman, M.L. (1990), 'Technological Discontinuities and Dominant Designs: A Cyclical Model of Technological Change', *Administrative Science Quarterly*, Vol. 35, No. 4, December, pp. 604-633.

Andriopoulos, C. (2001), 'Determinants of organisational creativity: a literature review', *Management Decision*, Vol. 39, No. 10, pp. 834-840.

Andriopoulos, C. and Gotsi, M. (2002), 'Lessons from a creative culture', *Design Management Journal*, Vol. 13, No. 2, Spring, pp. 57-63.

Angle, H.L. (1989), 'Psychology and Organizational Innovation', in Van de Ven, A.H., Angle, H.L. and Poole, M.S. (Editors), *Research on the Management of Innovation*, Harper and Row (Ballinger Division), New York, pp. 135-170.

Arad, S., Hanson, M.A. and Schneider, R.J. (1997), 'A Framework for the Study of Relationships Between Organizational Characteristics and Organizational Innovation', *Journal of Creative Behavior*, Vol. 31, No. 1, First Quarter, pp. 42-58.

Argyris, C. (1960), *Understanding Organizational Behaviour*, Dorsey Press, Homewood, Ill.

Argyris, C., Putnam, R. and McLain Smith, D. (1985), *Action Science*, Jossey Bass, San Francisco.

Argyris, C. and Schön, D.A. (1996), *Organizational Learning II. Theory, Method, and Practice*, Addison-Wesley, USA.

Ashkanasy, N.M., Wilderom, C.P.M. and Peterson, M.F. (Editors) (2000), *Handbook of Organizational Culture and Climate*, Sage, Thousand Oaks, CA.

Baranano, A.M., Bommer, M. and Jalajas, D.J. (2005), 'Sources of innovation for high-tech SMEs; a comparison of USA, Canada, and Portugal', *International Journal of Technology Management*, Vol. 30, No. 1/2, pp. 205-219.

Barley, S.R. (1991), 'Semiotics and the Study of Occupational and Organizational Culture', in Frost, P.J., Moore, L.F., Louis, M.R., Lundberg, C.C. and Martin, J. (Editors), *Reframing Organizational Culture*, Sage, USA, pp. 39-57.

Barney, J.B. (1986), 'Organizational Culture: Can it Be a Source of Sustained Competitive Advantage', *Academy of Management Review*, Vol. 11, No. 3, July, pp. 656-665.

Bart, C.K. (1996), 'The impact of mission on firm innovativeness', *International Journal of Technology Management*, Vol. 11, No. 3/4, pp. 479-493.

Bate, P. (1994), *Strategies for Cultural Change*, Butterworth-Heinemann, Oxford.

Beckhard, R. (1989), 'What is Organization Development?', in French, W.L., Bell Jr., C.H. and Zawacki, R.A. (Editors), *Organization Development. Theory, Practice, and Research*, BPI Irwin, Ill, pp. 33-36.

Beer, M. and Walton, A.E. (1989), 'Organization Change and Development', in French, W.L., Bell Jr., C.H. and Zawacki, R.A. (Editors), *Organization Development. Theory, Practice, and Research*, BPI Irwin, Ill, pp. 58-78.

Benner, M.J. and Tushman, M.L. (2003), 'Exploitation, Exploration, and Process Management: The Productivity Dilemma Revisited', *Academy of Management Review*, Vol. 28, No. 2, April, pp. 238-256.

Bessant, J., Lamming, R., Noke, H. and Phillips, W. (2005), 'Managing innovation beyond the steady state', *Technovation*, Vol. 25, No. 12, December, pp. 1366-1376.

Bessant, J. (2003), *High Involvement Innovation*, John Wiley, Chichester.

Bessant, J., Birkinshaw, J. and Delbridge, R. (2004), 'Theories of Creation', *People Management*, Vol. 10, No. 3, 12 February, pp. 28-31.

Bessant, J. and Caffyn, S. (1997), 'High involvement innovation through continuous improvement', *International Journal of Technology Management*, Vol. 14, No. 1, pp. 7-28.

Bessant, J. and Francis, D. (1997), 'Implementing the new product development process', *Technovation*, Vol. 17, No. 4, April, pp. 189-197.

Bharadwaj, S. and Menon, A. (2000), 'Making Innovation Happen in Organizations: Individual Creativity Mechanisms, Organizational Creativity Mechanisms or Both?', *Journal of Product Innovation Management*, Vol. 17, No. 6, November, pp. 424-434.

Bhaskar, R. (1978), *A Realist Theory of Science* (Second edition), The Harvester Press, Sussex.

Bierly, P.E.I. and Spender, J. (1995), 'Culture and high reliability organizations: The case of the nuclear submarine', *Journal of Management*, Vol. 21, No. 4, pp. 639-656.

Birkinshaw, J. and Gibson, C. (2004), 'Building Ambidexterity Into an Organization', *Sloan Management Review*, Vol. 45, No. 4, Summer, pp. 47-55.

Blaikie, N. (2000), *Designing Social Research*, Polity Press/Blackwell, USA.

BMW (2004), *BMW Group: Virtual Innovation Agency*, available at: http://www.bmwgroup.com/e/nav/index.html?http://www.bmwgroup.com/e/0_0_www_bmwgroup_com/4_forschung/4_1_menschen_netze/4_1_4_innovative_people/7_4_15_kosch.shtml (accessed 4 April 2005).

Boer, H. and Gertsen, F. (2003), 'From continuous improvement to continuous innovation: a (retro)(per)spective', *International Journal of Technology Management*, Vol. 26, No. 8, pp. 805-827.

Bommer, M. and Jalajas, D. (2002), 'The innovation work environment of high-tech SMEs in the USA and Canada', *R&D Management*, Vol. 32, No. 5, November, pp. 379-386.

Bommer, M. and Jalajas, D.S. (2004), 'Innovation Sources of Large and Small Technology-Based Firms', *IEEE Transactions on Engineering Management*, Vol. 51, No. 1, February, pp. 13-18.

Bouwen, R. and Fry, R. (1991), 'An Agenda for Managing Organizational Innovation and Development in the 1990s', in Lambrecht, M. (Editor), *Corporate Revival: Managing into the Nineties*, Catholic University Press, Leuven, Belgium, pp. 153-172.

Bower, J.L. and Christensen, C.M. (1995), 'Disruptive Technologies: Catching the Wave', *Harvard Business Review*, Vol. 73, No. 1, January/February, pp. 43-53.

Brady, D. (2005), 'The Immelt Revolution', *Business Week* , Vol. 3926, 28 March,

Breton, E.J. and Gold, R.J. (1987), 'Cultivating Innovation', *Research Management*, Vol. 30, No. 5, September-October, pp. 9-12.

Bruce, M. and Bessant, J. (2002), 'What is Design?', in Bruce, M. and Bessant, J. (Editors), *Design in Business* , Pearson Education, Harlow, Essex, pp. 18-35.

Bryman, A. (1992), *Charisma and Leadership in Organizations*, Sage, London.

Buckland, W., Hatcher, A. and Birkinshaw, J. (2003), *Inventuring*, McGraw-Hill Professional, London.

Buckler, S.A. and Zien, K.A. (1996), 'The Spirituality of Innovation: Learning from Stories', *Journal of Product Innovation Management*, Vol. 13, No. 5, September, pp. 391-405.

Buhler, P.M. (2002), 'The manager's role in building an innovative organization', *Supervision*, Vol. 63, No. 8, August, pp. 20-22.

Bundy, W.M. (2002), *Innovation, Creativity, and Discovery in Modern Organizations*, Quorum Books, Westport CT.

Burnes, B. (2004), 'Kurt Lewin and the Planned Approach to Change: A Re-appraisal', *Journal of Management Studies*, Vol. 41, No. 6, September, pp. 977-1002.

Burns, T. and Stalker, G.M. (1966), *The Management of Innovation*, Social Science Paperbacks, London.

Callahan, J. and Lasry, E. (2004), 'The importance of customer input in the development of very new products', *R&D Management*, Vol. 34, No. 2, March, pp. 107-120.

Cameron, K.S. and Freeman, S.J. (1991), 'Cultural Congruence, Strength , and Type', in Woodman, R.W. and Pasmore, W.A. (Editors), *Research in Organizational Change and Development*, JAI Press, Greenwich, CT, pp. 23-58.

Cameron, K.S. and Quinn, R.E. (1999), *Diagnosing and Changing Organizational Culture*, Addison-Wesley, USA.

Carter, L., Giber, D. and Goldsmith, M. (Editors) (2001), *Best Practices in Organization Development and Change*, Jossey-Bass, San Francisco.

Chandler, G.N., Keller, C. and Lyon, D.W. (2000), 'Unravelling the Determinants and Consequences of an Innovation-Supportive Organizational Culture', *Entrepreneurship Theory and Practice*, Vol. 25, No. 1, Fall, pp. 59-76.

Chandy, R.K. and Tellis, G.J. (1998), 'Organizing for Radical Product Innovation: The Overlooked Role of Willingness to Cannibalize', *Journal of Marketing Research*, Vol. 35, No. 4, November, pp. 474-487.

Chandy, R.K. and Tellis, G.J. (2000), 'The Incumbent's Curse? Incumbency, size, and Radical Product Innovation', *Journal of Marketing*, Vol. 64, July, pp. 1-17.

Chatman, J.A. and Cha, S.E. (2003), 'Leading by Leveraging Culture', *California Management Review*, Vol. 45, No. 4, Summer, pp. 20-34.

Chatman, J.A. and Jehn, K.A. (1994), 'Assessing the relationship between industry characteristics and organizational culture: How different can you be?', *Academy of Management Journal*, Vol. 37, No. 3, June, pp. 522-553.

Checkland, P. and Holwell, S. (1998), 'Action Research: Its Nature and Validity', *Systemic Practice and Action Research*, Vol. 11, No. 1, February, pp. 9-21.

Christensen, C.M. (1997), *The Innovator's Dilemma*, Harvard Business School Press, USA.

Christensen, C.M. (2003), *Hewlett-Packard: The Flight of the Kittyhawk*, Report no. 9-697-060. (Distributed by The European Case Clearing House, England and USA), Harvard Business School Publishing, Boston.

Christensen, C.M. and Overdorf, M. (2000), 'Meeting the Challenge of Disruptive Change', *Harvard Business Review*, Vol. 78, No. 2, March/April, pp. 66-76.

Christensen, C.M. and Raynor, M.E. (2003), *The Innovator's Solution*, Harvard Business School Press, Boston MA.

Clapp, R.G. and Kirton, M.J. (1994), 'The Relationship between Cognitive Style and Psychological Climate', *Studia Psychologica*, Vol. 36, No. 2, pp. 129-134.

Claver, E., Llopis, D.G. and Molina, H. (1998), 'Organizational culture for innovation and new technological behavior', *Journal of High Technology Management Research*, Vol. 9, No. 1, Spring, pp. 55-68.

Clegg, C., Unsworth, K., Epitropaki, O. and Parker, G. (2002), 'Implicating trust in the innovation process', *Journal of Occupational and Organizational Psychology*, Vol. 75, December, pp. 409-422.

Coghlan, D. and Brannick, T. (2001), *Doing Action Research in Your Own Organization*, Sage, London.

Coghlan, D. (2001), 'Insider Action Research Projects: Implications for Practising Managers', *Management Learning*, Vol. 32, No. 1, pp. 49-60.

Coghlan, D. (2002), 'Putting "Research" Back into OD and Action Research', *Organizational Development Journal*, Vol. 20, No. 1, Spring, pp. 62-65.

Cohen, W.M. and Levinthal, D.A. (1990), 'Absorptive Capacity: A New Perspective on Learning and Innovation', *Administrative Science Quarterly*, Vol. 35, No. 1, pp. 128-152.

Collins, J.C. and Porras, J.I. (1996), 'Building Your Company's Vision', *Harvard Business Review*, Vol. 74, No. 5, September/October, pp. 65-77.

Collins, J. (2001), *Good to Great*, Random House, London.

Cooper, R.G. (1999), 'From experience: The invisible success factors in product innovation', *Journal of Product Innovation Management*, Vol. 16, No. 2, March, pp. 115-133.

Cooper, R.G. and Kleinschmidt, E.J. (1990), *New Products: The Key Factors in Success*, American Marketing Association, USA.

Cravens, D.W., Piercy, N.F. and Low, G.S. (2002), 'The innovation challenges of proactive cannibalisation and discontinuous technology', *European Business Review*, Vol. 14, No. 4, pp. 257-267.

Cummings, A. and Oldham, G.R. (1997), 'Enhancing Creativity: Managing Work Contexts for the High Potential Employee', *California Management Review*, Vol. 40, No. 1, Fall, pp. 22-38.

Dahlin, K.B. and Behrens, D.M. (2005), 'When is an invention really radical? Defining and measuring technological radicalness', *Research Policy*, Vol. 34, No. 5, June, pp. 717-737.

Day, G.S. and Schoemaker, J.H. (2004), 'Driving Through the Fog: Managing at the Edge', *Long Range Planning*, Vol. 37, No. 2, April, pp. 127-142.

de Brentani, U. and Kleinschmidt, E.J. (2004), 'Corporate Culture and Commitment: Impact on Performance of International New Product Development Programs', *Journal of Product Innovation Management*, Vol. 21, No. 5, September, pp. 309-333.

de Guerre, D.W. (2002), 'Doing Action Research in One's Own Organization: An Ongoing Conversation Over Time', *Systemic Practice and Action Research*, Vol. 15, No. 4, August, pp. 331-349.

Deal, T.E. and Kennedy, A.A. (1982), *Corporate Cultures: The Rites and Rituals of Corporate Life*, Addison-Wesley, USA.

Delbecq, A.L. and Mills, P.K. (1985), 'Managerial Practices that Enhance Innovation', *Organizational Dynamics*, Vol. 14, No. 1, Summer, pp. 24-34.

Denison, D.R. and Spreitzer, G.M. (1991), 'Organizational culture and organizational development: a competing values approach', in Woodman, R.W. and Pasmore, W.A. (Editors), *Research in Organizational Change and Development*, JAI Press, Greenwich, CT, pp. 1-21.

Denison, D.R. (1996), 'What is the difference between organizational culture and organizational climate? A native's point of view on a decade of paradigm wars', *Academy of Management Review*, Vol. 21, No. 3, July, pp. 619-654.

DeSalvo, T. (1999), 'Unleash the Creativity in Your Organization', *HR Magazine*, Vol. 44, No. 6, June, pp. 154-164.

DeTienne, D.R. and Koberg, C.S. (2002), 'The Impact of Environmental and Organizational Factors on Discontinuous Innovation Within High-Technology Industries', *IEEE Transactions on Engineering Management*, Vol. 49, No. 4, November, pp. 352-364.

Dewar, R.D. and Dutton, J.E. (1986), 'The adoption of radical and incremental innovations: An empirical analysis', *Management Science*, Vol. 32, No. 11, November, pp. 1422-1433.

Dickens, L. and Watkins, K. (1999), 'Action Research: Rethinking Lewin', *Management Learning*, Vol. 30, No. 2, June, pp. 127-140.

Dornblaster, B.M., Lin, T. and Van de Ven, A.H. (1989), 'Innovation Outcomes, Learning, and Action Loops', in Van de Ven, A.H., Angle, H.L. and Poole, M.S. (Editors), *Research on the Management of Innovation*, Harper and Row (Ballinger Division), New York, pp. 193-217.

Dougherty, D. and Hardy, C. (1996), 'Sustained product innovation in large, mature organizations: overcoming innovation-to-organization problems', *Academy of Management Journal*, Vol. 39, No. 5, October, pp. 1120-1153.

Dougherty, D. and Heller, T. (1994), 'The Illegitimacy of Successful Product Innovation in Established Firms', *Organization Science*, Vol. 5, No. 2, May, pp. 200-218.

Drennan, D. (1992), *Transforming Company Culture*, McGraw-Hill, Maidenhead, England.

DTI (2003), *DTI Economics Paper No 7: Competing in the Global Economy - The Innovation Challenge*, UK Department of Trade and Industry, London.

Dyer Jr., W.G. (2005), 'Organization Development in the entrepreneurial Firm', in French, W.L., Bell Jr., C.H. and Zawacki, R.A. (Editors), *Organization Development and Transformation. Managing Effective Change*, McGraw-Hill/Irwin, New York, pp. 386-400.

Easterby-Smith, M., Thorpe, R. and Lowe, A. (2002), *Management Research: An Introduction*, Sage, London.

Eden, C. (1988), 'Cognitive mapping', *European Journal of Operational Research*, Vol. 36, No. 1, July, pp. 1-13.

Eden, C. and Huxham, C. (1996), 'Action Research for Management Research', *British Journal of Management*, Vol. 7, No. 1, March, pp. 75-86.

Edwards, T., Delbridge, R. and Munday, M. (2005), 'Understanding innovation in small and medium-sized enterprises: a process manifest', *Technovation*, Vol. 25, No. 10, October, pp. 1119-1127.

Eisenhardt, K.M. (1989), 'Building Theories from Case Study Research', *Academy of Management Review*, Vol. 14, No. 4, October, pp. 532-550.

Eisenhardt, K.M. and Martin, J.A. (2000), 'Dynamic Capabilities: What are They?', *Strategic Management Journal*, Vol. 21, No. 10-11, October-November, pp. 1105-1121.

Ekvall, G. (1983), *Climate, structure and innovativeness of organizations: a theoretical framework and an experiment*, Report no. 1, Faradet-The Swedish Council for Management and Work Life Issues, Stockholm, Sweden.

Ekvall, G., Arvonen, J. and Waldenstrom-Linblad, I. (1983), *Creative organizational climate: construction and validation of a measuring instrument*, Report no. 2, Faradet-The Swedish Council for Management and Work Life Issues, Stockholm, Sweden.

Ekvall, G. (1991), 'The organizational culture of idea-management: a creative climate for the management of ideas', in Henry, J. and Walker, D. (Editors), *Managing Innovation*, Sage, London, pp. 73-79.

Ekvall, G. (1996), 'Organizational Climate for Creativity and Innovation', *European Journal of Work and Organizational Psychology*, Vol. 5, No. 1, pp. 105-123.

Elden, M. and Chisholm, R.F. (1993), 'Emerging Varieties of Action Research: Introduction to the Special Issue', *Human Relations*, Vol. 46, No. 2, February, pp. 121-141.

Elfing, T. and Hulsink, W. (2003), 'Networks in Entrepreneurship: the Case of High-technology Firms', *Small Business Economics*, Vol. 21, No. 4, December, pp. 409-422.

Elsmore, P. (2001), *Organisational Culture: Organisational Change?*, Gower Publishing, Aldershot, Hants.

Ettlie, J.E. (2000), *Managing Technological Innovation*, John Wiley & Sons, New York.

Ettlie, J.E., Bridges, W.P. and O'Keefe, R.D. (1984), 'Organization strategy and structural differences for radical versus incremental innovation', *Management Science*, Vol. 30, No. 6, June, pp. 682-695.

Ettlie, J.E. and Subramaniam, M. (2004), 'Changing strategies and Tactics for New Product Development', *Journal of Product Innovation Management*, Vol. 21, No. 2, March, pp. 95-109.

Evered, R. and Louis, M.R. (1981), 'Alternative Perspectives in the Organizational Sciences: "Inquiry from the Inside" And "Inquiry from the Outside"', *Academy of Management Review*, Vol. 6, No. 3, July, pp. 385-395.

Farson, R. and Keyes, R. (2002), 'The failure-tolerant leader', *Harvard Business Review*, Vol. 80, No. 8, August, pp. 64-71.

Feldman, M.S. and Pentland, B.T. (2003), 'Reconceptualizing Organizational Routines as a Source of Flexibility and Change', *Administrative Science Quarterly*, Vol. 48, No. 1, March, pp. 94-118.

Fiol, M.C. (1991), 'Managing Culture as a Competitive Resource: An Identity-Based View of Sustainable Competitive Advantage', *Journal of Management*, Vol. 17, No. 1, March, pp. 191-211.

Fitzgerald, T.H. (1988), 'Can Change in Organizational Culture Really Be Managed?', *Organizational Dynamics*, Vol. 17, No. 2, Autumn, pp. 5-15.

Fleury, A. and Fleury, M.T. (2003), 'Competitive strategies and core competencies: perspectives for the internationalisation of industry in Brazil', *Integrated Manufacturing Systems*, Vol. 14, No. 1, pp. 16-25.

Florida, R. and Goodnight, J. (2005), 'Managing for Creativity', *Harvard Business Review*, Vol. 83, No. 7, July/August, pp. 124-131.

Fontana, A. and Frey, J.H. (1998), 'Interviewing The Art of Science', in Denzin, N.K. and Lincoln, Y.S. (Editors), *Collecting and Interpreting Qualitative Materials*, Sage, Thousand Oaks, CA, pp. 47-78.

Foster, M. (1972), 'An Introduction to the Theory and Practice of Action Research in Work Organizations', *Human Relations*, Vol. 25, No. 6, June, pp. 529-556.

Foster, R. and Kaplan, S. (2002), *Creative Destruction*, Harvard University Press, Cambridge, MA.

Francis, D., Bessant, J. and Hobday, M. (2003), 'Managing radical organizational transformation', *Management Decision*, Vol. 41, No. 1/2, pp. 18-31.

Francis, D. (2002), 'Strategy and design', in Bruce, M. and Bessant, J. (Editors), *Design in Business. Strategic Innovation Through Design*, Pearson Education, Harlow, Essex, pp. 61-75.

Freel, M.S. (2000), 'Barriers to Product Innovation in Small Manufacturing Firms', *International Small Business Studies Journal*, Vol. 18, No. 2, January to March, pp. 60-80.

Freel, M.S. (2005), 'Patterns of innovation and skills in small firms', *Technovation*, Vol. 25, No. 2, February, pp. 13-134.

French, W.L. and Bell Jr., C.H. (1999), *Organization Development. Behavioral Science Interventions for Organization Improvement* (Sixth edition), Prentice Hall, NJ.

French, W.L., Bell Jr., C.H. and Zawacki, R.A. (1989), *Organization Development. Theory, Practice, and Research* (Third edition), BPI Irwin, Ill.

French, W.L., Bell Jr., C.H. and Zawacki, R.A. (2005), *Organization Development and Transformation. Managing Effective Change* (Sixth edition), McGraw Hill/Irwin, New York.

Frohman, A.L. (1998), 'Building a Culture for Innovation', *Research Technology Management*, Vol. 41, No. 2, March/April, pp. 9-12.

Galpin, T.J. and Herndon, M. (2000), *The Complete Guide to Mergers and Acquisitions*, Jossey-Bass, San Francisco.

Garvin, D.A. (2000), *Learning in Action*, Harvard Business School Press, Boston, MA.

Gayatri, D. (2004), *Innovating 3M's Innovations*, Report no. 304-357-1. (Distributed by The European Case Clearing House, England and USA), ICFAI Business School Case Development Centre, Hyderabad.

Gebhardt, C. (2005), 'The Impact of Managerial Rationality on the Organizational Paradigm. Role Models in the Management of Innovation', *Technology Analysis and Strategic Management*, Vol. 17, No. 1, March, pp. 21-34.

Getz, I. and Robinson, A.G. (2003), 'Innovate or Die: Is that a Fact?', *Creativity and Innovation Management*, Vol. 12, No. 3, September, pp. 130-136.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. and Trow, M. (1994), *The New Production of Knowledge*, Sage, London.

Glaser, B.G. and Strauss, A.L. (1967), *The Discovery of Grounded Theory*, Aldine Publishing, Hawthorne, NY.

Gleick, J. (1988), *Chaos: Making a New Science*, Penguin, New York.

Glynn, M.A. (1996), 'Innovative genius: A framework for relating individual and organizational intelligences to innovation', *Academy of Management Review*, Vol. 21, No. 4, October, pp. 1081-1111.

Goffee, R. and Jones, G. (1998), *The Character of a Corporation*, HarperCollins Business, London.

Goffin, K. and Mitchell, R. (2005), *Innovation Management. Strategy and Implementation Using the Pentathlon Framework*, Palgrave Macmillan, Basingstoke, Hampshire, UK.

Goldstein, J. (1994), *The Unshackled Organization*, Productivity Press, Portland, OR.

Govindarajan, V. and Kopalle, P.K. (2006), 'The Usefulness of Measuring Disruptiveness of Innovations Ex Post in Making Ex Ante Predictions', *Journal of Product Innovation Management*, Vol. 23, No. 1, January, pp. 12-18.

Greenwood, D.J. and Levin, M. (1998), *Introduction to Action Research*, Sage, Thousand Oaks, CA.

Greenwood, R. and Hinings, C.R. (1988), 'Organization Design Types, Tracks and the Dynamics of Strategic Change', *Organization Studies*, Vol. 9, No. 3, pp. 293-316.

Greenwood, R. and Hinings, C.R. (1993), 'Understanding Strategic Change: The Contribution of Archetypes', *Academy of Management Journal*, Vol. 36, No. 5, October, pp. 1052-1081.

Greiner, L.E. (1998), 'Evolution and Revolution as Organizations Grow', *Harvard Business Review*, Vol. 76, No. 3, May/June, pp. 55-67.

Gresov, C. (1984), 'Designing Organizations to Innovate and Implement: Using Two dilemmas to Create a Solution', *Columbia Journal of World Business*, Vol. 19, No. 4, Winter, pp. 63-67.

Gryskiewicz, S.S. (1999), *Positive Turbulence*, Jossey Bass, San Francisco.

Guba, E.G. and Lincoln, Y.S. (1998), 'Competing Paradigms in Qualitative Research', in Denzin, N.K. and Lincoln, Y.S. (Editors), *The Landscape of Qualitative Research Theories and Issues*, Sage, Thousand Oaks, CA, pp. 195-220.

Gudmundson, D., Tower, C.B. and Harman, E.A. (2003), 'Innovation in Small Businesses: Culture and Ownership Structure Do Matter', *Journal of Developmental Entrepreneurship*, Vol. 8, No. 1, April, pp. 1-17.

Gummesson, E. (2000), *Qualitative Method in Management Research* (Second edition), Sage, Thousand Oaks, CA.

Gundling, E. (2000), *The 3M way to Innovation*, Kodansha International, Tokyo.

Hadler, D.A. and Tushman, M.L. (1980), 'A Model for Diagnosing Organizational Behavior', *Organizational Dynamics*, Vol. 9, No. 2, Autumn, pp. 35-51.

Hage, J. (1980), *Theories of Organizations*, John Wiley & Sons, New York.

Hall, E.T. (1976), *Beyond Culture*, Doubleday, New York.

Hamel, G. and Prahalad, C.K. (1989), 'Strategic Intent', *Harvard Business Review*, Vol. 67, No. 3, May/June, pp. 63-76.

Handy, C.B. (1985), *Understanding Organizations* (Third edition), Penguin Books, London.

Harborne, P. and Johne, A. (2003), 'Creating a project climate for successful product innovation', *European Journal of Innovation Management*, Vol. 6, No. 2, pp. 118-132.

Hargadon, A. (2003), *How Breakthroughs Happen. The Surprising Truth About How Companies Innovate*, Harvard Business School Press, Boston, MA.

Hargadon, A. and Sutton, R.I. (2000), 'Building an Innovation Factory', *Harvard Business Review*, Vol. 78, No. 3, May/June, pp. 157-166.

Harrison, R. and Stokes, H. (1992), *Diagnosing Organizational culture*, Pfeiffer, San Diego, CA.

Hatch, M.J. (1993), 'The Dynamics of Organizational Culture', *Academy of Management Review*, Vol. 18, No. 4, pp. 657-693.

Hauser, M. (1998), 'Organizational culture and innovativeness of firms - an integrative view', *International Journal of Technology Management*, Vol. 16, No. 1/2/3, pp. 239-253.

Heilmeir, G.H. (2000), 'Enabling innovation the "no excuses" way', *Research Technology Management*, Vol. 43, No. 3, May/June, pp. 26.

Heine, C. (2001), 'Is your company innovative?', *Machine Design*, Vol. 73, No. 14, 26 July, pp. 84-88.

Hickman, C. and Raia, C. (2002), 'Incubating Innovation', *Journal of Business Strategy*, Vol. 23, No. 3, May/June, pp. 14-18.

Hill, C.W.L. and Rothaermel, F.T. (2003), 'The performance of incumbent firms in the face of radical technological innovation', *Academy of Management Review*, Vol. 28, No. 2, April, pp. 257-274.

Hofstede, G. (1991), *Cultures and Organizations: Software of the mind*, McGraw Hill, Maidenhead, England.

Hofstede, G. (1997), 'Organizational culture', in Warner, M. (Editor), *Concise International Encyclopaedia of Business and Management*, International Thompson Business Press, London, pp. 540-558.

Hofstede, G., Neuijen, B., Ohayv, D.D. and Sanders, G. (1990), 'Measuring Organizational Cultures: A Qualitative and Quantitative Study across Twenty Cases', *Administrative Science Quarterly*, Vol. 35, No. 2, June, pp. 286-316.

Huizenga, E. (2000), *Innovation Management How Front runners Stay Ahead*, Universitaire pers Maastricht, Maastricht.

Humble, J. and Jones, G. (1989), 'Creating a Climate for Innovation', *Long Range Planning*, Vol. 22, No. 4, August, pp. 46-51.

Humphreys, P., McAdam, R. and Leckey, J. (2005), 'Longitudinal evaluation of innovation implementation in SMEs', *European Journal of Innovation Management*, Vol. 8, No. 3, pp. 283-304.

Huxham, C. and Vangen, S. (2003), 'Researching Organizational Practice Through Action Research: Case Studies and Design Choices', *Organizational Research Methods*, Vol. 6, No. 3, July, pp. 383-403.

Irani, Z. and Sharp, J.M. (1997), 'Integrating continuous improvement and innovation into a corporate culture: a case study', *Technovation*, Vol. 17, No. 4, April, pp. 199-206.

Isaksen, S.G. and Kaufmann, G. (1990), 'Adaptors and Innovators: Different Perceptions of the Psychological Climate for Creativity', *Studia Psychologica*, Vol. 32, No. 3, pp. 129-141.

Isaksen, S.G., Lauer, K.J. and Ekvall, G. (1999), 'Situational Outlook Questionnaire: A Measure of the Climate for Creativity and Change', *Psychological Reports*, Vol. 85, October, pp. 665-674.

Jassawalla, A.R. and Sashittal, H.C. (2002), 'Cultures that support product-innovation processes', *Academy of Management Executive*, Vol. 16, pp. 42-54.

Jelinek, M. and Schoonhoven, C.B. (1991), 'Strong culture and its consequences', in Henry, J. and Walker, D. (Editors), *Managing Innovation*, Sage, London, pp. 80-88.

Jick, T.D. (1995), 'Accelerating Change for Competitive Advantage', *Organizational Dynamics*, Vol. 24, No. 1, Summer, pp. 77-82.

Johne, A. and Snelson, P. (1988a), 'Auditing product innovation activities in manufacturing firms', *R&D Management*, Vol. 18, No. 3, pp. 227-233.

Johne, F.A. and Snelson, P.A. (1988b), 'Success Factors in Product Innovation: A Selective Review of the Literature', *Journal of Product Innovation Management*, Vol. 5, No. 2, June, pp. 114-128.

Johnson, G. (1992), 'Managing strategic change - strategy, culture and action', *Long Range Planning*, Vol. 25, No. 1, February, pp. 28-36.

Judge, W.Q., Fryxell, G.E. and Dooley, R.S. (1997), 'The New Task of R&D Management: Creating Goal Directed Communities for Innovation', *California Management Review*, Vol. 39, No. 3, Spring, pp. 72-85.

Kanter, R.M. (1985), *The Change Masters*, Unwin Paperbacks, London.

Kanter, R.M. (2001), *Evolve!*, Harvard Business School Press, Boston MA.

Kanter, R.M. (1988), 'When a Thousand Flowers Bloom: Structural, Collective, and Social Conditions for Innovation in Organization', in Straw, B.M. and Cummings, L.L. (Editors), *Research in Organizational Behavior: An Annual Series of Analytical Essays and Critical Reviews*, JAI Press, Greenwich, CT, pp. 169-211.

Kaplan, N. (1960), 'Some Organizational Factors Affecting Creativity', *IEEE Transactions on Engineering Management*, Vol. 7, No. 1, March, pp. 24-30.

Kaplan, S., Murray, F. and Henderson, R. (2003), 'Discontinuities and senior management: assessing the role of recognition in pharmaceutical firm response to biotechnology', *Industrial and Corporate Change*, Vol. 12, No. 2, April, pp. 203-233.

Kaplan, S.M. (1999), 'Discontinuous innovation and the growth paradox', *Strategy and Leadership*, Vol. 27, No. 2, March/April, pp. 16-21.

Katila, R. and Shane, S. (2005), 'When does lack of resources make new firms innovative?', *Academy of Management Journal*, Vol. 48, No. 5, October, pp. 814-829.

Kelley, D., Neck, H.M., O'Connor, G.C. and Paulson, A. (2004), 'Developing Radical Innovation Capabilities: Opposing Forces from the Corporate Entrepreneurship and Organizational Systems', *Frontiers of Entrepreneurship Research 2002*, pp. 558-568.

Kelley, T. and Littman, J. (2001), *The Art of Innovation. Lessons in Creativity from IDEO, America's Leading Design Firm* (First edition), Doubleday, New York.

Kirton, M.J. (1984), 'Adaptors and Innovators - Why New Initiatives Get Blocked', *Long Range Planning*, Vol. 17, No. 2, April, pp. 137-143.

Kirton, M.J. (1989), 'A Theory of Cognitive Style', in Kirton, M.J. (Editor), *Adaptors and Innovators* , Routledge, London, pp. 1-36.

Kirton, M.J. (2003), *Adaption-Innovation*, Routledge, Hove, East Sussex.

Kirton, M. (1976), 'Adaptors and Innovators: A Description and Measure', *Journal of Applied Psychology*, Vol. 61, No. 5, pp. 622-629.

Kotter, J.P. (1995), 'Leading Change: Why Transformation Efforts Fail', *Harvard Business Review*, Vol. 73, No. 2, March/April, pp. 59-67.

Kovach, R. (2000), 'Creating an environment that fosters innovation', *The British Journal of Administrative Management*, Vol. 22, September/October, pp. 26-27.

Kuratko, D.F. and Hodgetts, R.M. (2001), *Entrepreneurship: A Contemporary Approach* (Fifth edition), South-Western, Mason, OH.

Langley, A. (1999), 'Strategies for theorizing from process data', *Academy of Management Review*, Vol. 24, No. 4, October, pp. 691-710.

Leavy, B. (2005), 'A leader's guide to creating an innovation culture', *Strategy and Leadership*, Vol. 33, No. 4, pp. 38-45.

Lee, M. and Na, D. (1994), 'Determinants of Technical Success in Product Development When Innovative Radicalness is Considered', *Journal of Product Innovation Management*, Vol. 11, No. 1, January, pp. 62-68.

Leifer, R., McDermott, C.M., O'Connor, G.C., Peters, L.S., Rice, M.P. and Veyzer, R.W. (2000), *Radical Innovation How Mature Companies Can Outsmart Upstarts*, Harvard Business School Press, Boston, MA.

Leifer, R., O'Connor, G.C. and Rice, M. (2001), 'Implementing radical innovation in mature firms: The role of hubs', *Academy of Management Executive*, Vol. 15, No. 3, August, pp. 102-113.

Leonard-Barton, D. (1992a), 'Core Capabilities and Core Rigidities: a Paradox in Managing New Product Development', *Strategic Management Journal*, Vol. 13, No. 8, Summer, pp. 111-125.

Leonard-Barton, D. (1992b), 'The Factory as a Learning Laboratory', *Sloan Management Review*, Vol. 34, No. 1, Fall, pp. 23-38.

Leonard-Barton, D. (1995), *Wellsprings of Knowledge*, Harvard Business School Press, Boston MA.

Lewin, K. (1947), 'Group Decision and Social Change', in Maccoby, E.E., Newcombe T. and Hartley, E. (Editors), *Readings in Social Psychology*, Holt, Rinehart and Winston, New York, pp. 330-344.

Lewin, K. (1946), 'Action Research and Minority Problems', *Journal of Social Issues*, Vol. 2, pp. 34-46.

Litwin, G.H. and Stringer, R.A. (1968), *Motivation and Organizational Climate*, Harvard University, Boston.

Loutfy, R. and Belkhir, L. (2001), 'Managing Innovation at Xerox', *Research Technology Management*, Vol. 44, No. 4, July/August, pp. 15-24.

Lundberg, C.C. (1985), 'On the Feasibility of Cultural Intervention in Organizations', in Frost, P.J., Moore, L.F., Louis, M.R., Lundberg, C.C. and Martin, J. (Editors), *Organizational Culture*, Sage, Beverly Hills, CA, pp. 169-185.

Macher, J.T. and Richman, B.D. (2004), 'Organizational Responses to Discontinuous Innovation: A Case Study Approach', *International Journal of Innovation Management*, Vol. 8, No. 1, March, pp. 87-114.

Machiavelli, N. (Translation by Bull, G.) (1961), *The Prince*, Penguin, London.

MacLean, D., MacIntosh, R. and Grant, S. (2002), 'Mode 2 Management Research', *British Journal of Management*, Vol. 13, No. 3, December, pp. 189-207.

Majchrzak, A., Cooper, L.P. and Neece, O.E. (2004), 'Knowledge Reuse for Innovation', *Management Science*, Vol. 50, No. 2, February, pp. 174-188.

Malhotra, A., Majchrzak, A., Carman, R. and Lott, V. (2001), 'Radical Innovation Without Collocation: A Case Study at Boeing-Rocketdyne', *MIS Quarterly*, Vol. 25, No. 2, June, pp. 229-249.

March, J.G. (1996), 'Continuity and Change in Theories of Organizational Action', *Administrative Science Quarterly*, Vol. 41, No. 2, June, pp. 278-287.

Markides, C. (2004), 'Rethinking Innovation', *Leader to Leader*, Vol. 2004, No. 34, Fall, pp. 35-42.

Marquis, D.G. (1988), 'The Anatomy of Successful Innovation', in Tushman, M.L. and Moore, W.L. (Editors), *Readings in the Management of Innovation*, Ballinger Publishing, USA, pp. 79-87.

Martin, J. (2002), *Organizational Culture Mapping the Terrain*, Sage, Thousand Oaks, CA.

Martins, E.C. and Terblanche, F. (2003), 'Building organisational culture that stimulates creativity and innovation', *European Journal of Innovation Management*, Vol. 6, No. 1, pp. 64-74.

Mascitelli, R. (2000), 'From Experience: Harnessing Tacit Knowledge to Achieve Breakthrough Innovation', *Journal of Product Innovation Management*, Vol. 17, No. 3, May, pp. 179-193.

Mathisen, G.E. and Einarsen, S. (2004), 'A Review of Instruments Assessing Creative and Innovative Environments Within Organizations', *Creativity Research Journal*, Vol. 16, No. 1, pp. 119-140.

McDermott, C. and Handfield, R. (1996), 'Does the Parallel Approach Make Sense in the Development of Discontinuous Innovations?', in *Proceedings of the International Conference on Engineering and Technology Management* IEEE, pp. 370-374.

McDermott, C. and Handfield, R. (2000), 'Concurrent development and strategic outsourcing: do the rules change in breakthrough innovation?', *Journal of High Technology Management Research*, Vol. 11, No. 1, Spring, pp. 35-57.

McDermott, C.M. (1999), 'Managing radical product development in large manufacturing firms: a longitudinal study', *Journal of Operations Management*, Vol. 17, No. 6, November, pp. 631-644.

McDermott, C.M. and O'Connor, G.C. (2002), 'Managing radical innovation: an overview of emergent strategy issues', *Journal of Product Innovation Management*, Vol. 19, No. 6, November, pp. 424-438.

McDonough III, E.F. and Leifer, R.P. (1996), 'Effective Control of New Product Projects: The Interaction of Organization Culture and Project Leadership', *Journal of Product Innovation Management*, Vol. 3, No. 3, September, pp. 149-157.

McFadzean, E. (2000), 'Techniques to enhance creative thinking', *Team Performance Management: An International Journal*, Vol. 6, No. 3/4, pp. 62-72.

McGourty, J., Tarshis, L.A. and Dominick, P. (1996), 'Managing Innovation: Lessons from World Class Organizations', *International Journal of Technology Management*, Vol. 11, No. 3/4, pp. 354-368.

Mento, A.J., Jones, R.M. and Dirndorfer, W. (2002), 'A change management process: Grounded in both theory and practice', *Journal of Change Management*, Vol. 3, No. 1, August, pp. 45-59.

Mikaelsson, J. (2002), 'Managing change in product development organization: learning from Volvo Car Corporation', *Leadership and Organization Development Journal*, Vol. 23, No. 6, pp. 301-313.

Miller, D. and Friesen, P.H. (1984), *Organizations: a quantum view*, Prentice Hall, Englewood Cliffs, NJ.

Mintzberg, H. (1979), *The Structure of Organizations*, Prentice-Hall, Englewood Cliffs, NJ.

Morgan, G. (1997), *Images of Organization*, Sage, USA.

Morison, E. (1988), 'Gunfire at Sea: A Case Study of Innovation', in Tushman, M.L. and Moore, W.L. (Editors), *Readings in the Management of Innovation*, Ballinger Publishing, USA, pp. 165-178.

Morrison, E.W. and Milliken, F.J. (2000), 'Organizational Silence: A barrier to change and development in a pluralistic world', *Academy of Management Review*, Vol. 25, No. 4, October, pp. 706-725.

Mosey, S. (2005), 'Understanding new-to-market product development in SMEs', *International Journal of Operations & Production Management*, Vol. 25, No. 2, pp. 114-130.

Nadler, D.A. and Tushman, M.L. (1980), 'A Model for Diagnosing Organizational Behavior', *Organizational Dynamics*, Vol. 9, No. 2, Autumn, pp. 35-51.

Nemeth, C.J. (1997), 'Managing Innovation: When Less Is More', *California Management Review*, Vol. 40, No. 1, Fall, pp. 59-74.

Nijhof, A., Krabbendam, K. and Looise, J.C. (2002), 'Innovation through exemptions: building upon the existing creativity of employees', *Technovation*, Vol. 22, No. 11, November, pp. 675-683.

Nijssen, E.J., Hillebrand, B. and Vermeulen, P.A.M. (2005), 'Unraveling willingness to cannibalize: a closer look at the barrier to radical innovation', *Technovation*, Vol. 25, No. 12, December, pp. 1400-1409.

Nohria, N. and Gulati, R. (1996), 'Is Slack Good or Bad for Innovation?', *Academy of Management Journal*, Vol. 39, No. 5, October, pp. 1245-1264.

Nonaka, I. and Takeuchi, H. (1995), *The Knowledge Creating Company*, Oxford University Press, New York.

Nord, W.R. and Tucker, S. (1987), *Implementing Routine and Radical Innovations*, D.C. Heath and Company, Lexington, MA.

Norling, P.M. and Statz, R.J. (1998), 'How Discontinuous Innovation Really Happens', *Research Technology Management*, Vol. 41, No. 3, May/June, pp. 41-44.

Oakey, R., Rothwell, R. and Cooper, S. (1988), *Management of Innovation in High Technology Small Firms*, Pinter, London.

Ogbonna, E. and Harris, L.C. (2000), 'Leadership style, organizational culture and performance: empirical evidence from UK companies', *International Journal of Human Resource Management*, Vol. 11, No. 4, August, pp. 766-788.

Oliver, N. (2002), 'An organizational perspective', in Bruce, M. and Bessant, J. (Editors), *Design in Business Strategic Innovation Through Design*, Pearson Education, Harlow, Essex, pp. 139-165.

Ong, C.-H., Wan, D. and Chng, S.-H. (2003), 'Factors affecting indivual (sic) innovation: an examination within a Japanese subsidiary in Singapore', *Technovation*, Vol. 23, No. 7, July, pp. 617-631.

Ottoson, S. (2003), 'Participation action research - A key to improved knowledge of management', *Technovation*, Vol. 23, No. 2, February, pp. 87-94.

Ouchi, W.G. (1981), *Theory Z*, Addison-Wesley, USA.

O'Connor, G.C. and Ayers, A.D. (2005), 'Building a Radical Innovation Competency', *Research Technology Management*, Vol. 48, No. 1, Jan/Feb, pp. 23-31.

O'Connor, G.C. and McDermott, C.M. (2004), 'The human side of radical innovation', *Journal of Engineering and Technology Management*, Vol. 2, No. 1-2, March-June, pp. 11-30.

O'Connor, G.C. and Rice, M.P. (2001), 'Opportunity Recognition and Breakthrough Innovation in Large Established Firms', *California Management Review*, Vol. 43, No. 2, Winter, pp. 95-116.

O'Connor, G.C. and Veryzer, R.W. (2001), 'The nature of market visioning for technology-based radical innovation', *Journal of Product Innovation Management*, Vol. 18, No. 4, July, pp. 231-246.

O'Reilly III, C.A. and Tushman, M.L. (2004), 'The Ambidextrous Organization', *Harvard Business Review*, Vol. 82, No. 4, April, pp. 74-81.

Paap, J. and Katz, R. (2004), 'Anticipating Disruptive Innovation', *Research Technology Management* , Vol. 47, No. 5, September/October, pp. 13-22.

Parker, M. (2000), *Organizational Culture and Identity*, Sage, London.

Partington, D. (2000), 'Building Grounded Theories of Management Action', *British Journal of Management*, Vol. 11, No. 2, June, pp. 91-102.

Partington, D. (2002), 'Grounded Theory', in Partington, D. (Editor), *Essential Skills for Management Research*, Sage, London, pp. 136-157.

Payne, R. and Pheysey, D. (1971), 'G. C. Stern's organizational climate index: a reconceptualization and application to business organizations', *Organizational Behavior and Human Performance*, Vol. 6, pp. 77-98.

Perel, M. (2002), 'Corporate courage: Breaking the barrier to innovation', *Research Technology Management*, Vol. 45, No. 3, May/June, pp. 9-17.

Peters, M. and Robinson, V. (1984), 'The Origins and status of Action Research', *Journal of Applied Behavioural Science*, Vol. 20, No. 2, pp. 113-124.

Peters, T.J. and Waterman, R.H. (1982), *In search of excellence: lessons from America's best-run companies*, Harper and Row, New York.

Pfeffer, J. and Salancik, G.R. (1978), *The External Control of Organizations: A Resource Dependence Perspective*, Harper and Row, New York.

Pohlmann, M. (2005), 'The Evolution of Innovation: Cultural Backgrounds and the Use of Innovation Models', *Technology Analysis and Strategic Management*, Vol. 17, No. 1, March, pp. 9-19.

Pohlmann, M., Gebhardt, C. and Etzkowitz, H. (2005), 'The Development of Innovation Systems and the Art of Innovation Management - Strategy, Control and the Culture of Innovation', *Technology Analysis and Strategic Management*, Vol. 17, No. 1, March, pp. 1-7.

Poole, M.S. and Van de Ven, A.H. (1989), 'Toward a General Theory of Innovation Processes', in Van de Ven, A.H., Angle, H.L. and Poole, M.S. (Editors), *Research on the Management of Innovation*, Harper and Row (Ballinger Division), New York, pp. 637-662.

Prahalad, C.K. (1998), 'Managing Discontinuities: The Emerging Challenges', *Research Technology Management*, Vol. 41, No. 3, May/June, pp. 14-22.

Prather, C.W. (2000), 'Keeping Innovation Alive After the Consultants Leave', *Research Technology Management*, Vol. 43, No. 5, September, pp. 17-22.

Puhlmann, M. and Gouy, M. (1999), 'Internal Barriers to Innovation', *Pharmaceutical Review*, Vol. 19, No. 6, June, pp. 84-95.

Quinn, J.B. (1985), 'Managing innovation: Controlled chaos', *Harvard Business Review*, Vol. 63, No. 3, May/June, pp. 73-84.

Quinn, R.E. and Spreitzer, G.M. (1991), 'The Psychometrics of the Competing Values Culture Instrument and an Analysis of the Impact of Organizational Culture on the Quality of Life', in Woodman, R.W. and Pasmore, W.A. (Editors), *Research in Organizational Change and Development*, JAI Press, Greenwich, CT, pp. 115-142.

Radhika, A.N. (2003), *BMW's Innovation Strategies*, Report no. 303-190-1. (Distributed by The European Case Clearing House, England and USA), ICFAI Center for Management Research, Hyderabad.

Reason, P. (1999), 'Integrating Action and Reflection Through Co-operative Inquiry', *Management Learning*, Vol. 30, No. 2, June, pp. 207-226.

Reigle, R.F. (2001), 'Measuring organic and mechanistic cultures', *Engineering Management Journal*, Vol. 13, No. 4, December, pp. 3-8.

Revans, R.W. (1980), *Action Learning*, Blond & Briggs, London.

Rice, M.P., Kelley, D., Peters, L. and O'Connor, G.C. (2001), 'Radical innovation: triggering initiation of opportunity recognition and evaluation', *R&D Management*, Vol. 31, No. 4, October, pp. 409-420.

Rice, M.P., Leifer, R. and O'Connor, G.C. (2002), 'Commercializing Discontinuous Innovations: Bridging the Gap From Discontinuous Innovation Project to Operations', *IEEE Transactions on Engineering Management*, Vol. 49, No. 4, November, pp. 330-340.

Rice, M.P., O'Connor, G.C., Peters, L.S. and Morone, J.G. (1998), 'Managing Discontinuous Innovation', *Research Technology Management*, Vol. 41, No. 3, May/June, pp. 52-58.

Rich, B.R. and Janos, L. (1994), *Skunk Works*, Little, Brown and Company, Boston.

Rickards, T. (1985), *Stimulating Innovation*, Frances Pinter, London.

Rickards, T. (1990), *Creativity and Problem Solving at Work*, Gower Publishing, Aldershot, England.

Rickards, T. (1996), 'The Management of Innovation: Recasting the Role of Creativity', *European Journal of Work and Organizational Psychology*, Vol. 5, No. 1, pp. 13-27.

Rickards, T., Chen, M.-H. and Moger, S. (2001), 'Development of a Self-Report Instrument for Exploring Team Factor, Leadership and Performance Relationships', *British Journal of Management*, Vol. 12, No. 3, September, pp. 243-250.

Ritzer, G. (2000), *The McDonaldization of Society*, Sage, Thousand Oaks, CA.

Roberts, E.B. (1988), 'Managing Invention and Innovation', *Research Technology Management*, Vol. 31, No. 1, January/February, pp. 11-27.

Rogers, E.D., Miles Jr, W.G. and Biggs, W.D. (1980), 'The Factor Replicability of the Litwin and Stringer Organizational Climate Questionnaire: An Inter- and Intra-Organizational Assessment', *Journal of Management*, Vol. 6, No. 1, Spring, pp. 65-78 .

Rose-Anderssen, C., Allen, P.M., Tsinopoulos, C. and McCarthy, I. (2005), 'Innovation in manufacturing as an evolutionary complex system', *Technovation*, Vol. 25, No. 10, October, pp. 1093-1105.

Rothwell, R. (1992), 'Successful industrial innovation: critical factors for the 1990s', *R&D Management*, Vol. 22, No. 3, pp. 221-239 .

Rothwell, R. and Dodgson, M. (1991), 'External linkages and innovation in small and medium-sized enterprises', *R&D Management*, Vol. 21, No. 2, April, pp. 125-137.

Ruth, K. (2003), 'Industrial culture and the innovation of innovation: enginology or socioneering?', *AI and Society*, Vol. 17, No. 3/4, November, pp. 225-240.

Sackmann, S.A. (1991), 'Uncovering Culture in Organizations', *Journal of Applied Behavioural Science*, Vol. 27, No. 3, September, pp. 295-317.

Saffold III, G.S. (1988), 'Culture Traits, Strength, and Organizational Performance: Moving Beyond "Strong" Culture', *Academy of Management Review*, Vol. 13, No. 4, October, pp. 546-558.

Sarvani, V. (2004), *Innovations at Harley Davidson*, Report no. 304-103-1. (Distributed by The European Case Clearing House, England and USA), ICFAI Center for Management Research, Hyderabad.

Schein, E. (1987), *The Clinical Perspective in Fieldwork*, Sage, Newbury Park, CA.

Schein, E.H. (1984), 'Coming to a new awareness of organizational culture', *Sloan Management Review*, Vol. 25, Winter, pp. 3-16.

Schein, E.H. (1991), 'What is culture?', in Frost, P.J., Moore, L.F., Louis, M.R., Lundberg, C.C. and Martin, J. (Editors), *Reframing Organizational Culture*, Sage, Newbury Park, CA, pp. 243-253.

Schein, E.H. (1992), *Organizational Culture and Leadership* (Second edition), Jossey-Bass, San Francisco.

Schmitt, R.W. (2003), 'Leadership in Technological Innovation (and Elsewhere)', *Research Technology Management*, Vol. 43, No. 3, May, pp. 30-31.

Schneider, B., Brief, A.P. and Guzzo, R.A. (1996), 'Creating a Climate and Culture Change for Sustainable Organizational Change', *Organizational Dynamics*, Vol. 24, No. 4, Spring, pp. 7-19.

Schumpeter, J.A. (1961), *The theory of economic development*, Oxford University Press, Oxford.

Schwandt, T.A. (1998), 'Constructivist, Interpretivist approaches to Human Inquiry', in Denzin, N.K. and Lincoln, Y.S. (Editors), *The Landscape of Qualitative Research Theories and Issues*, Sage, Thousand Oaks, CA, pp. 221-259.

Selznick, P. (1984), *Leadership in Administration*, California Paperback Edition, USA.

Senge, P.M. (1990), 'The Leader's New Work: Building Learning Organizations', *Sloan Management Review*, Vol. 32, No. 1, Fall, pp. 7-23.

Sethi, R., Smith, D.C. and Park, C.W. (2002), 'How to Kill a Team's Creativity', *Harvard Business Review*, Vol. 80, No. 8, August, pp. 16-17.

Sharkey, L.D. (1999), 'Changing organizational culture through leadership development: A case in leadership transformation', *Organization Development Journal*, Vol. 17, No. 3, Fall, pp. 29-37.

Siegel, S.M. and Kaemmerer, W.F. (1978), 'Measuring the perceived support for innovation in organizations', *Journal of Applied Psychology*, Vol. 63, No. 5, pp. 553-562.

Simon, E.S., McKeough, D.T., Ayers, A.D., Rinehart, E. and Alexia, B. (2003), 'How do you best organize for radical innovation?', *Research Technology Management*, Vol. 46, No. 5, September/October, pp. 17-20.

Sims Jr, H.P. and LaFollette, W. (1975), 'An Assessment of the Litwin and Stringer Organization Climate Questionnaire', *Personnel Psychology*, Vol. 28, No. 1, Spring, pp. 19-38.

Sleezer, C.M. and Swanson, R.A. (1992), 'Culture Surveys', *Management Decision*, Vol. 30, No. 2, pp. 22-29.

Smircich, L. (1983), 'Concepts of culture and Organizational Analysis', *Administrative Science Quarterly*, Vol. 28, No. 3, September, pp. 339-358.

Song, X.M. and Montoya-Weiss, M.M. (1998), 'Critical Development Activities for Really New versus Incremental Products', *Journal of Product Innovation Management*, Vol. 15, No. 2, February, pp. 124-135.

Soriano de Alencar, E.M.L. and Bruno-Faria, M.d.F. (1997), 'Characteristics of an Organizational Environment which Stimulate and Inhibit Creativity', *Journal of Creative Behavior*, Vol. 31, No. 4, Fourth Quarter, pp. 271-281.

Sparrow, P.R. and Gaston, K. (1996), 'Generic climate maps: a strategic application of climate survey data?', *Journal of Organizational Behaviour*, Vol. 17, No. 6, November, pp. 679-698.

Stackman, R.W., Pinder, C.C. and Connor, P.E. (2000), 'Values Lost', in Ashkanasy, N.M., Wilderom, C.P.M. and Peterson, M.F. (Editors), *Handbook of Organizational Culture and Climate*, Sage, Thousand Oaks, California, pp. 37-54.

Sternberg, R.J., O'Hara, L.A. and Lubart, T.I. (1997), 'Creativity as Investment', *California Management Review*, Vol. 40, No. 1, Fall, pp. 8-21.

Stevens, G.A. and Burley, J. (2003), 'Piloting the rocket of radical innovation', *Research Technology Management*, Vol. 46, No. 2, March/April, pp. 16-25.

Stringer, R. (2000), 'How To Manage Radical Innovation', *California Management Review*, Vol. 42, No. 4, Summer, pp. 70-88.

Styhre, A. (2002), 'Non-linear change in organizations: organization change management informed by complexity theory', *Leadership and Organization Development Journal*, Vol. 23, No. 6, pp. 343-351.

Sutton, R.I. (2001), 'The weird rules of creativity', *Harvard Business Review*, Vol. 79, No. 8, September, pp. 94-103.

Sutton, R.I. and Kelley, T.A. (1997), 'Creativity Doesn't Require Isolation', *California Management Review*, Vol. 40, No. 1, Fall, pp. 75-91.

Syrett, M. and Lammiman, J. (Editor) (2002), *Successful Innovation How to Encourage and Shape Profitable Ideas*, The Economist in association with Profile Books, London.

Tang, H.K. (1998), 'An integrative model of innovation in organizations', *Technovation*, Vol. 18, No. 5, May, pp. 297-309.

Teece, D.J. (1996), 'Firm organization, industrial structure, and technological innovation', *Journal of Economic Behavior and Organization*, Vol. 31, No. 2, November, pp. 193-224.

Tellis, G.J. (2006), 'Disruptive Technology or Visionary Leadership?', *Journal of Product Innovation Management*, Vol. 23, No. 1, January, pp. 34-48.

Terziovski, M. (2002), 'Achieving performance excellence through an integrated strategy of radical innovation and continuous improvement', *Measuring Business Excellence*, Vol. 6, No. 2, pp. 5-14.

Terziovski, M., Sohal, A. and Howell, A. (2002), 'Best practice in product innovation at Varian Australia', *Technovation*, Vol. 22, No. 9, September, pp. 561-569.

Tesluk, P.E., Farr, J.L. and Klein, S.R. (1997), 'Influences of Organizational Culture and Climate on Individual Creativity', *Journal of Creative Behavior*, Vol. 31, No. 1, First Quarter, pp. 27-41.

The Oxis Partnership (2004), *Discontinuous Innovation Forum*, available at: http://www.diforum.co.uk/ (accessed 9 April 2005).

Thomas, R.J. (1993), *New Product Development*, John Wiley & Sons, USA.

Thomke, S. (2001), 'Enlightened experimentation: The new imperative for innovation', *Harvard Business Review*, Vol. 79, No. 2, February, pp. 67-75.

Thomke, S.H. (2003), *Experimentation Matters*, Harvard Business School Press, Boston, MA.

Thompson, M., Ellis, R. and Wildavsky, A. (1990), *Cultural Theory*, Westview Press, USA.

Tidd, J., Bessant, J. and Pavitt, K. (2001), *Managing Innovation* (Second edition), Wiley, Chichester.

Tranfield, D. (2002), 'Future Challenges for Management Research', *European Management Journal*, Vol. 20, No. 4, August, pp. 409-413.

Tranfield, D., Parry, I., Wilson, S., Smith, S. and Foster, M. (1999), 'Teamworking: Redesigning the Organisation for Manufacturing Improvements', *Technology Analysis & Strategic Management*, Vol. 11, No. 2, June, pp. 143-158.

Tranfield, D. and Starkey, K. (1998), 'The Nature, Social Organization and Promotion of Management Research: Towards Policy', *British Journal of Management*, Vol. 9, No. 4, December, pp. 341-353.

Tripsas, M. and Gavetti, G. (2000), 'Capabilities, Cognition, and Inertia: Evidence from Digital Imaging', *Strategic Management Journal*, Vol. 21, November, pp. 1147-1161.

Trott, P. (2002), 'When market research may hinder the development of discontinuous new products', in Sundbo, J. and Fugelsang, L. (Editors), *Innovation as strategic reflexivity*, Routledge, London, pp. 112-124.

Tsang, E.W.K. and Kwan, K.-M. (1999), 'Replication and theory development in organizational science: A critical realist perspective', *Academy of Management Review*, Vol. 24, No. 4, October, pp. 759-780.

Tukey, J.W. (1977), *Exploratory Data Analysis*, Addison-Wesley, Reading, MA.

Tushman, M. and Nadler, D. (1986), 'Organizing for Innovation', *California Management Review*, Vol. 28, No. 3, Spring, pp. 74-92.

Tushman, M.L. and Anderson, P. (1986), 'Technological Discontinuities and Organizational Environments', *Administrative Science Quarterly*, Vol. 31, No. 3, September, pp. 439-465.

Tushman, M.L. and Moore, W.L. (Editors) (1988), *Readings in the Management of Innovation* (Second edition), Ballinger Publishing, USA.

Tushman, M.L. and O'Reilly III, C.A. (1996), 'Ambidextrous Organizations: Managing Evolutionary and Revolutionary Change', *California Management Review*, Vol. 38, No. 4, Summer, pp. 8-30.

Tushman, M.L. and O'Reilly III, C.A. (1997), *Winning through Innovation*, Harvard Business School Press, Boston MA.

Tushman, M.L. and O'Reilly III, C.A. (1999), 'Building Ambidextrous Organizations', *Health Forum Journal*, Vol. 42, March/April, pp. 20-23 and 64.

Tushman, M.L. and Smith, W.K. (2004), 'Innovation Streams, Organizational Designs, and Organizational Evolution', in Tushman, M.L. and Anderson, P. (Editors), *Managing Strategic Innovation and Change*, Oxford University Press, New York, pp. 2-17.

Utterback, J.M. (1994), *Mastering the Dynamics of Innovation*, Harvard Business School Press, Boston, MA.

van de Poel, I. (2000), 'On the Role of Outsiders in Technical Development', *Technology Analysis and Strategic Management*, Vol. 12, No. 3, September, pp. 383-397.

Van de Ven, A.H. (1986), 'Central problems in the management of innovation', *Management Science*, Vol. 32, No. 5, May, pp. 590-607.

Van de Ven, A.H. (1988), 'Approaches to Innovating and Organizing', in Tushman, M.L. and Moore, W.L. (Editors), *Readings in the Management of Innovation*, Ballinger Publishing, USA, pp. 103-122.

Van de Ven, A.H. and Poole, M.S. (1989), 'Methods for Studying Innovation Processes', in Van de Ven, A.H., Angle, H.L. and Poole, M.S. (Editors), *Research on the Management of Innovation*, Harper and Row (Ballinger Division), New York, pp. 31-54.

Vera, D. and Crossan, M. (2005), 'Improvisation and Innovation Performance in Teams', *Organization Science*, Vol. 16, No. 3, May-June, pp. 203-224.

Veryzer, R.W. (1998), 'Discontinuous Innovation and the New Product Development Process', *Journal of Product Innovation Management*, Vol. 15, No. 4, July, pp. 304-321.

Veryzer, R.W. (2005), 'The Roles of Marketing and Industrial Design in Discontinuous New Product Development', *Journal of Product Innovation Management*, Vol. 22, No. 1, January, pp. 22-41.

Vincent, L. (2005), 'Innovation Midwives: Sustaining Innovation Streams in Established Companies', *Research Technology Management*, Vol. 48, No. 1, January/February, pp. 41-49 .

von Bertalanffy, L. (1972), 'The history and status of general systems theory', *Academy of Management Journal*, Vol. 15, No. 4, December, pp. 407-426.

von Hippel, E. (1988), *The Sources of Innovation*, Oxford University Press, New York.

von Hippel, E. and Katz, R. (2002), 'Shifting Innovation to Users via Toolkits', *Management Science*, Vol. 48, No. 7, July, pp. 821-833.

von Hippel, E., Thomke, S. and Sonnack, M. (2000), 'Creating Breakthroughs at 3M', *Health Forum Journal*, Vol. 43, No. 4, July/August, pp. 20-27.

von Stamm, B. (2003a), *Managing Innovation, Design and Creativity*, John Wiley, Chichester.

von Stamm, B. (2003b), *The Innovation Wave. Meeting the Corporate Challenge*, John Wiley & Sons Ltd, Chichester, West Sussex, UK.

von Stamm, B. (2004), 'Collaboration with other firms and customers: innovation's secret weapon', *Strategy and Leadership*, Vol. 32, No. 3, pp. 16-20.

von Wartburg, I., Teichert, T. and Rost, K. (2003), 'Visioning for Innovation- How Firms Inject Knowledge about the Future into Innovation Activities', in *IEMC 03 Proceedings Managing Technologically Driven Organizations: "The Human Side of Innovation and Change"*, Albany, New York, IEEE, pp. 301-305.

Wagner, E.R. and Hansen, E.N. (2005), 'Innovation in large versus small companies: insights from the US wood products industry', *Management Decision*, Vol. 43, No. 6, pp. 837-850.

Walsh, S.T., Kirchoff, B.A. and Newbert, S. (2002), 'Differentiating Market Strategies for Disruptive Technologies', *IEEE Transactions on Engineering Management*, Vol. 49, No. 4, November, pp. 341-351.

Weber, M. (1964), 'The Types of Authority and Imperative Co-ordination', in Parsons, T. (Editor and Translator), *The Theory of Social and Economic Organization*, The Free Press (Division of Macmillan), New York, pp. 324-423.

Weick, K.E. (1985), 'The Significance of Corporate Culture', in Frost, P.J., Moore, L.F., Louis, M.R., Lundberg, C.C. and Martin, J. (Editors), *Organizational Culture*, Sage, Beverley Hills CA, pp. 381-389.

Weick, K.E. (1987), 'Organizational Culture as a Source of High Reliability', *California Management Review*, Vol. 29, No. 2, Winter, pp. 112-127.

Weisinger, J.Y. and Salipante, P.F. (2000), 'Cultural knowing as practicing: Extending our conceptions of culture', *Journal of Management Enquiry*, Vol. 9, No. 4, December, pp. 376-390.

West, M.A. (2002), 'Sparkling Fountains or Stagnant Ponds: An Integrative Model of Creativity and Innovation Implementation in Work Groups', *Applied Psychology: an International Review*, Vol. 51, No. 3, June, pp. 355-424.

Westwood, R. and Low, D.R. (2003), 'The Multicultural Muse: Culture, Creativity and Innovation', *International Journal of Cross Cultural Management*, Vol. 9, No. 2, pp. 235-259.

Wiener, Y. (1988), 'Forms of Value Systems: A Focus on Organizational Effectiveness and Cultural Change and Maintenance', *Academy of Management Review*, Vol. 13, No. 4, pp. 534-545.

Wilkins, A.L. and Dyer Jr, W.G. (1988), 'Toward Culturally Sensitive Theories of Culture Change', *Academy of Management Review*, Vol. 13, No. 4, October, pp. 522-533.

Wolff, M.F. (1988), 'Fostering Breakthrough Innovations', *Research Technology Management*, Vol. 31, No. 6, Nov/Dec, pp. 8-9.

Wolpert, J.D. (2002), 'Breaking Out of the Innovation Box', *Harvard Business Review*, Vol. 80, No. 8, August, pp. 77-83.

Wong-MingJi, D.J. and Millette, W.R. (2002), 'Dealing with the Dynamic Duo of Innovation and Inertia: The "In-" Theory of Organization Change', *Organizational Development Journal*, Vol. 20, No. 1, Spring, pp. 36-52.

Woodman, R.W., Sawyer, J.E. and Griffin, R.W. (1993), 'Toward a theory of organizational creativity', *Academy of Management Review*, Vol. 18, No. 2, April, pp. 293-321.

Yeung, A.K.O., Brockbank, J.W. and Ulrich, D.O. (1991), 'Organizational Culture and Human Resource Practices: An Empirical Assessment', in Woodman, R.W. and Pasmore, W.A. (Editors), *Research in Organizational Change and Development*, JAI Press, Greenwich, CT, pp. 59-81.

Yin, R.K. (2003), *Case Study Research Design and Methods* (Third edition), Sage, Thousand Oaks, CA.

Zacharias, C. (2004), *Project Platypus: Mattel's Unconventional Toy Development Process* , Report no. 404-005-1. (Distributed by The European Case Clearing House, England and USA), ICFAI Business School Case Development Centre, Hyderabad.

Zammuto, R.F. and Krakower, J.Y. (1991), 'Quantitative and Qualitative Studies of Organizational Culture', in Woodman, R.W. and Pasmore, W.A. (Editors), *Research in Organizational Change and Development*, JAI Press, Greenwich, CT, pp. 83-114.

Zien, K.A. and Buckler, S.A. (1997), 'Dreams to Market: Crafting a Culture of Innovation', *Journal of Product Innovation Management*, Vol. 14, No. 4, July, pp. 274-287.

APPENDICES

Appendix A Cerulean Organization Chart (as published in June 2005)

CERULEAN ORGANISATION CHART
20th July 2005

Patrick McLaughlin — Managing Director

Sue Turnbull — P.A. to Managing Director, P.A. to Sales and Marketing Director, Secretarial Support for Customer Service Dept.

Steve Wilkinson — Factory Service & Conformance Engineer

Ian McCoulough — Packing Director
- Don Carter — Applications Engineer
- Chris Mahon — Systems Project Engineer
- Vacant — PLC Engineer

Ruaridh Nicolson — Sales and Marketing Director
- Barry Clift — Sales Co-ordinator
- Claudio Gentil — Regional Sales Manager EMEA & Latin America (UK office)
- Paul Johnson — Regional Sales Manager EMEA (UK Office)
- David Walker — Regional Sales Manager EMEA (UK Office)
- Vincent Tong — Regional Sales Manager Asia Pacific (Kuala Lumpur Office)
- Dan Negron — Regional Sales Manager North America (Richmond Office)
- Terry Chai — Regional Sales Manager China (Shanghai Office)
  - Mark Liu — Assistant Sales Manager China (Shanghai Office)

Duncan Tyler — Finance Director
- Daniel Collings — IT Services Manager
  - Richard Meghani (206) — I.T. Services Technician
- David Pattison — Company Accountant
- Donna Johnson — Management Accountant
- David Foster — Assistant Management Accountant
- Ann Hutchison — Credit Controller
- Judy Salamon — Accounts Clerk

Phil Talbot — Operations Manager
- Emmanuel Hue — Purchasing Manager
- Chris Rouse — Supplier Quality Dev. Eng.
- Will Commercial — Assistant Buyer
- Packing Cell — Alan Torrey — Team Leader
  - Alan Mains
  - Nigel Stacey
  - Phil Rees
- Smoking Machine Cell — Robin Hill — Team Leader
  - Naz Baksh
  - Andrew Byson
- Instrument Cell and Despatch — Mick Green — Team Leader
  - John Wilford
  - Ray Walker
  - Mark Stanley
  - Bob Albery
  - Albert Oates
  - Reg Harris
  - Neville Folwell
- John Patterson — Materials Co-ordinator
- Mick Swan — Materials Co-ordinator
- Tony Bennett — Spares Co-ordinator

Ian Tindall — Technical Director
- Sue McCormick — also PA to Finance Director & PA to Packing Director
- Keith Jarman — Product Dev. Manager
  - Euan Bruce — Mechanical Eng.
  - Gary Pitt — Software Eng.
  - Brian Wheeldon — Technical Author
  - Alan Hetherington — Product Conformance Eng.
  - Alan Jones — Product Conformance Eng.
- Project Manager — Nigel Minchin
  - Edward Baker — Senior Software Eng.
  - Iavor Bojinov — Software Eng.
  - Ray Marshall — Electronics Design Eng.
  - Tim Mason — Development Scientist
  - Brian Reeve — Mechanical Engineer
  - Haroon Sheikh — Electronics Design Eng.
  - Chris Westcott — Software Eng.
  - Andy Wilkin — Electronics Design Eng.
  - Ron Wilson — Mechanical Engineer
- Project Manager — Judith Hankey
- Martin Twelftree — Strategic Development Engineer

Vicky Diamond — Customer Services Manager
- Sue Tofield — Receptionist pt pm
- Donna Kerr — Receptionist pt pm
- Mike Cadby — Standards Lab. Technician
- Neil Haggar — Commercial Team Leader
- Adelina Cicone — Service Administrator
- Fabrice Bernaudon — Service Administrator
- Paula Williams — Service Administrator
- Shirley Tam — Office Manager Malaysia
- Guru Prasad — Customer Services Office India
- Ms Zhou Wei (Vivw) — Customer Services Co-ordinator China
- Daphne Foo Soo Ching — Accounts and Admin Exec.Malaysia
- Gary Hawksworth — Technical Services Manager
  - Neil Walduck — Service Engineer
  - Peter Jordan — Service Engineer
  - Keith Shepherd — Service Engineer
  - Franco Paolucci — Service Engineer
  - Paul Gibson — Base Repairs Engineer
  - Marius Joubert — Technical Helpdesk Eng.
  - Shabir Moghal — Service Eng. (South Africa)
  - Luca Musto — Service Engineer
  - John Campbell — Service Eng. (Italy)
  - Kahled (1st July) — Site Maintenance Eng. (BAT Shampton)
  - Service Engineer (Egypt)
- Evelyn Muench — Manager Cerulean GmbH
  - Jorg Augustin — Service Engineer (Hamburg)
  - Vadim Krasnapolsky — Service Engineer (Moscow)
- Sea Theam Meng — Technical Services Manager (Asia Pacific)
  - Hanizam Bin Idris — Senior Service Engineer (Malaysia)
  - Mike Chong — Service Engineer (Malaysia)
  - Yi Guangbin (Alfred) — Service Engineer (Shanghai China)
  - Hou Ming — Service Engineer (Shanghai China)
  - Vacant — Service Engineer (Shanghai China)
  - Chen Bin — Service Engineer (Kunming China)
  - D Kannan — Service Team Leader (India), South Asia Region
  - Mahesh Banakar — Service Engineer (India)
- Keith Lytton — Technical Service Manager (Americas)
  - Peggy Puryear — Service Administrator (Americas)
  - Greg Faulkner — Service Engineer (Richmond)
  - Rob Smith — Service Engineer (Winston Salem)
  - Danny Wood — Service Engineer (Winston Salem)
  - Ricardo Vales — Service Engineer (Venezuela)
  - Carlos Amorim — Service Engineer (Brazil)
  - Dionisimo Martinez — Service Eng (Mexico)

Appendix B Research plan

Project 1

- Interviews to gather data
- Review results
- Analysis of data
- Aspects of culture
- Refine data with team
- Feedback
- Develop themes of innovation culture
- Synthesis of archetypes model
- Desired Type II innovation culture

Project 2

- Evaluate Climate tools
- Evaluate Culture tools
- Create composite tool
- Assess climate and culture
- Discuss results with team
- Develop innovation culture tool
- Cerulean – extant innovation culture position
- Assess innovation culture
- Discuss results of assessment

Project 3

- Interventions from case examples
- Interventions from literature
- Interventions from DIF companies
- Possible interventions
- Cerulean suggested interventions to develop innovation culture
- Proposed interventions for Cerulean

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Appendix C OCAI Assessment Questionnaire

Radical Innovation Project

As part of the project to develop a radical innovation capability within Cerulean, an assessment of the organizational culture is being undertaken. The assessment will take place at several points during the next twelve months as part of gauging how the innovation culture within this group is changing. This assessment will be restricted to the Development Team and feedback will be to the Development Team only. The individual information provided is confidential and will not be shared with any other person in Cerulean. The feedback on the results will be at a group level only.

The OCAI (Organizational Culture Assessment Instrument) is an established tool for gauging organizational culture. It is one of a number of tools available and is considered to be the most suitable for this project. It will be run alongside the KEYS assessment tool to assess creative climate.

The purpose of the Organizational Culture Assessment Instrument (OCAI) is to assess six key dimensions of organizational culture. In completing the assessment, you will be providing a picture of how the Development Team operates and the values that characterize it. No right or wrong answers exist for these questions just as there is no right or wrong culture. Therefore be as accurate as you can in responding to the questions so that your resulting cultural diagnosis will be as precise as possible.

You are asked to rate your "organization" in the questions. Consider the "organization" to be the Development Team within Cerulean. You are asked to assess the Development Team as it exists now, and as you would prefer it to be in the future. The preference relates to a Development Team that has an innovation culture that supports and facilitates radical as well as incremental innovation.

The OCAI consists of six questions. Each question has four alternatives. Divide 100 points among these four alternatives depending on the extent to which each alternative is similar to your own organization. Give a higher number of points to the alternative that is most similar to your organization. For example, in question 1, if you think alternative A is very similar to the Development Team, alternatives B and C are somewhat similar, and alternative D is hardly similar at all, you might give 55 points to A 20 points each to B and C and 5 points to D. Just be sure your total equals 100 for each question.

Note that in pages 1 and 2, the response column for the assessment is labelled "Now". These responses mean that you are rating the Development Team as it is *currently*. The assessment in pages 3 and 4 has a response column labelled "Preferred". In this part of the assessment you rate the Development Team as you think it *should be in the future* in order to be capable of delivering both incremental and radical innovation in product developments. You will note that the two assessments are identical except for the response column.

If you have any questions about completion of the assessment please do not hesitate to ask. The results of the assessment will be fed back to the Development Team, and the intention is to use these results as a starting point for making changes within and around the Development Team. These changes are intended to move the innovation culture in the direction of being more able to facilitate radical innovation. It is important therefore that you are as honest as possible in your responses, as these will form the basis for a series of actions to be undertaken by the team members. Please return your completed assessments to Patrick McLaughlin.

Name:_____   Date: _____

The Organizational Culture Assessment Instrument – <u>Current</u>

1. **Dominant Characteristics**		**Now**	
A	The organization is a very personal place. It is like an extended family. People seem to share a lot of themselves.		
B	The organization is a very dynamic and entrepreneurial place. People are willing to stick their necks out and take risks.		
C	The organization is very results oriented. A major concern is with getting the job done. People are very competitive and achievement oriented.		
D	The organization is a very controlled and structured place. Formal procedures generally govern what people do.		
	Total	100	
2. **Organizational Leadership**		**Now**	
A	The leadership in the organization is generally considered to exemplify mentoring, facilitating, or nurturing.		
B	The leadership in the organization is generally considered to exemplify entrepreneurship, innovating or risk taking.		
C	The leadership in the organization is generally considered to exemplify a no-nonsense, aggressive results-orientated focus.		
D	The leadership in the organization is generally considered to exemplify co-ordinating, organising or smooth-running efficiency.		
	Total	100	
3. **Management of Employees**		**Now**	
A	The management style in the organization is characterised by teamwork, consensus and participation.		
B	The management style in the organization is characterised by individual risk-taking, innovation, freedom and uniqueness.		
C	The management style in the organization is characterised by hard-driving competitiveness, high demands and achievement.		
D	The management style in the organization is characterised by security of employment, conformity, predictability and stability in relationships.		
	Total	100	
4. **Organizational Glue**		**Now**	
A	The glue that holds the organization together is loyalty and mutual trust. Commitment to this organization runs high.		
B	The glue that holds the organization together is commitment to innovation and development. There is an emphasis on being on the cutting edge.		
C	The glue that holds the organization together is the emphasis on achievement and goal accomplishment. Aggressiveness and winning are common themes.		
D	The glue that holds the organization together is formal rules and policies. Maintaining a smooth-running organization is important.		
	Total	100	

Page 1 of 4

The Organizational Culture Assessment Instrument – <u>Current</u>

5. Strategic Emphases		Now	
A	The organization emphasises human development. High trust, openness and participation persist.		
B	The organization emphasises acquiring new resources and creating new challenges. Trying new things and prospecting for opportunities are valued.		
C	The organization emphasises competitive actions and achievement. Hitting stretch targets and winning in the marketplace are dominant.		
D	The organization emphasises permanence and stability. Efficiency, control and smooth operations are important.		
	TOTAL	100	
6. Criteria of Success		**Now**	
A	The organization defines success on the basis of the development of human resources, teamwork, employee commitment and concern for people.		
B	The organization defines success on the basis of having the most unique or newest products. It is a product leader and innovator.		
C	The organization defines success on the basis of winning in the marketplace and outpacing the competition. Competitive market leadership is key.		
D	The organization defines success on the basis of efficiency. Dependable delivery, smooth scheduling, and low-cost production are critical.		
	TOTAL	100	

The Organizational Culture Assessment Instrument – <u>Preferred</u>

1. Dominant Characteristics			Preferred
A	The organization is a very personal place. It is like an extended family. People seem to share a lot of themselves.		
B	The organization is a very dynamic and entrepreneurial place. People are willing to stick their necks out and take risks.		
C	The organization is very results oriented. A major concern is with getting the job done. People are very competitive and achievement oriented.		
D	The organization is a very controlled and structured place. Formal procedures generally govern what people do.		
	Total	100	
2. Organizational Leadership			**Preferred**
A	The leadership in the organization is generally considered to exemplify mentoring, facilitating, or nurturing.		
B	The leadership in the organization is generally considered to exemplify entrepreneurship, innovating or risk taking.		
C	The leadership in the organization is generally considered to exemplify a no-nonsense, aggressive results-orientated focus.		
D	The leadership in the organization is generally considered to exemplify co-ordinating, organising or smooth-running efficiency.		
	Total	100	
3. Management of Employees			**Preferred**
A	The management style in the organization is characterised by teamwork, consensus and participation.		
B	The management style in the organization is characterised by individual risk-taking, innovation, freedom and uniqueness.		
C	The management style in the organization is characterised by hard-driving competitiveness, high demands and achievement.		
D	The management style in the organization is characterised by security of employment, conformity, predictability and stability in relationships.		
	Total	100	
4. Organizational Glue			**Preferred**
A	The glue that holds the organization together is loyalty and mutual trust. Commitment to this organization runs high.		
B	The glue that holds the organization together is commitment to innovation and development. There is an emphasis on being on the cutting edge.		
C	The glue that holds the organization together is the emphasis on achievement and goal accomplishment. Aggressiveness and winning are common themes.		
D	The glue that holds the organization together is formal rules and policies. Maintaining a smooth-running organization is important.		
	Total	100	

The Organizational Culture Assessment Instrument – <u>Preferred</u>

5. **Strategic Emphases**			**Preferred**
A	The organization emphasises human development. High trust, openness and participation persist.		
B	The organization emphasises acquiring new resources and creating new challenges. Trying new things and prospecting for opportunities are valued.		
C	The organization emphasises competitive actions and achievement. Hitting stretch targets and winning in the marketplace are dominant.		
D	The organization emphasises permanence and stability. Efficiency, control and smooth operations are important.		
	TOTAL	100	
6. **Criteria of Success**			**Preferred**
A	The organization defines success on the basis of the development of human resources, teamwork, employee commitment and concern for people.		
B	The organization defines success on the basis of having the most unique or newest products. It is a product leader and innovator.		
C	The organization defines success on the basis of winning in the marketplace and outpacing the competition. Competitive market leadership is key.		
D	The organization defines success on the basis of efficiency. Dependable delivery, smooth scheduling, and low-cost production are critical.		
	TOTAL	100	

Appendix D Innovation culture assessment scoring sheet

Type II innovation culture Radical "Do different"	Disagree very strongly	Disagree strongly	Generally Disagree	Disagree somewhat	Disagree a little	Agree a little	Agree somewhat	Generally Agree	Agree strongly	Agree very strongly
Exploration and discovery are part of the way things are done. Opportunity is provided to try new ideas. The team have a high degree of control over what steps they take to achieve the objective	1	2	3	4	5	6	7	8	9	10
Taking risks is encouraged. Uncertainty is a part of the environment and discovery is accepted as being linked to taking risk.	1	2	3	4	5	6	7	8	9	10
There is a desire to grow and develop the ability and knowledge of the group. A hunger to know more and know why. The team are encouraged to gain new skills.	1	2	3	4	5	6	7	8	9	10
People outside the team expect a "do differently" approach to new product development. People outside the team have confidence that the team will develop a radically different solution that will resolve the problem.	1	2	3	4	5	6	7	8	9	10
The team are confident that they can find a radically new solution. Working with and respecting the individual talents of the other team members is a normal way of working. The team is comfortable with a questioning, and challenging of new ideas, and this is usually built upon to develop useable new ideas. The team is an autonomous unit that believes it can "do differently" to provide the radical solutions.	1	2	3	4	5	6	7	8	9	10
Alternative perspectives and awareness of new technologies are constantly being sought by the team. These provide an array of possibilities that the team can call upon to resolve internal problems.	1	2	3	4	5	6	7	8	9	10
Overall objectives are not specific but outline targets. These allow the team to make decisions about how to achieve these objectives. A degree of latitude in the set objectives is provided to the team.	1	2	3	4	5	6	7	8	9	10
There is a mix of creative individuals in the team who have sufficient experience inside or outside the subject area such that they can apply lateral thinking to provide a radical solution. The team comprises different minded individuals who can work with some degree of uncertainty and conflict as part of the day-to-day activities. If disagreement happens because of this, then that is accepted.	1	2	3	4	5	6	7	8	9	10
A management style that encourages risk taking is prevalent. Rule following and conformance to procedures is not enforced and not considered to be necessary. Resources are neither abundant nor too tightly restricted. A "Champion" provides support for new product projects at a high level in the company.	1	2	3	4	5	6	7	8	9	10

Appendix E Proposed intervention plan for Cerulean

Proposal for developing a radical innovation culture in Cerulean:
Introduction
During 2005 the Cerulean Development Team suggested six interventions to help create an innovation culture which facilitated radical innovation. These interventions were:-

1 Better time management, to allow slack, to allow some personal (radical) development projects to take place.
2 Development Team members to be permitted and supported to undertake personal development projects that would be available for an "Ideas Market" session. This venue to be used as a forum to allow decisions to be made on what should be allowed to continue and what should be dropped amongst the personal (radical) development projects.
3 Resource allocation to be made available to support these personal (radical) development projects.
4 Visits to external sources for ideas. Other companies, suppliers, customers, universities would provide sources of ideas for what is possible.
5 Exposure to the Sales team members and customers to better understand the potential issues facing customers, the industry and the company.
6 Management to work with the Development Team to facilitate these actions and to demonstrate trust in the team.

Since that time, other interventions from companies that wished to develop a similar innovation culture have been evaluated. These companies included 3M, BMW, Hewlett Packard and Mattell. The actions taken by these companies have been examined in relation to the nine themes originally derived by the team and against the six proposed interventions. From this list of actions, an implementation plan consisting of a series of seven interventions is proposed for Cerulean.

Proposed interventions for Cerulean
The interventions form a holistic approach to developing a radical innovation culture. They take place sequentially and culminate in the team selecting and developing a "do different" product for the company. Each intervention on its own is unlikely to develop the desired culture, but taken together they form a series of interventions that inter-relate and lead to the team undertaking a project of their own.
  1. Team membership
Team membership strengthened to add in "do different" skills and attitude.
This intervention seeks to add individuals to the team who have a "can-do" attitude, who have a high level of training or skills and who are willing to think of "do different" solutions to problems. Selection of such individuals will necessitate some form of assessment of their attitude and skills levels. Innovative or adaptive behaviour can be assessed using the Kirton Adaptation Innovation (KAI) measure. Attitude and psychological profile could be assessed by using Myers Briggs Type Indicator (MBTI) psychometric evaluations. Skills can be assessed by using specific skill assessment techniques or by past performance and delivering results by using those skills.

This intervention seeks to add people to the Development Team, rather than develop the ability of the existing team. This is suggested on the basis that the skills level and psychological profile that the current team has is unlikely to be significantly changed in the short-term by retraining the team members. Adding people with higher degrees and post degree experience is likely to improve the skill levels in the team. The desired artefacts from this intervention are presence of skilled individuals in the team. The values being developed are a desire to question and challenge existing beliefs, to re-frame problems and re-use knowledge from external sources to solve those problems. The extant Cerulean team shows significant risk aversion, and is comprised of individuals with long service. Many of them have no degree level qualification. Adding in the "do different" attitudes of new team members is likely to begin to change the attitude of the team members to risk taking and thinking of "do different" solutions.

   2. Idea knowledge gathering and sharing system
This system can be achieved through two different interventions. Firstly, creating and operating a system that traps ideas and facilitates sharing across all team members. This system would be based on a database, possibly an SQL database, and be used to log ideas and facts about new technologies. This intervention is at the artefact level, in that it provides a system and process to use the system, thus acting as a tool to gather and share new ideas and facts. The system on its own will not provide radical breakthroughs, but it can act to support the values of the team members in making these breakthroughs. A hard copy print would be made at regular intervals for record purposes. The ideas would be reviewed on a regular basis to identify those that might be worth developing. Secondly, the creation of an ideas area for the team. This is a physical space where ideas can be put forward in physical form, refined, critiqued, where new technology can be examined, interesting pieces of equipment can be evaluated and retained for future inspection. It would act in the same way as the first intervention, the database, but in this case it would retain physical objects rather than ideas or knowledge. Having a display area for team members to add or critique ideas related to the physical objects would act in conjunction with the knowledge based system. This intervention would provide some of the framework to support the "do different" behaviours.

   3. External input
This intervention would elicit input from external sources. These are sources outside the company which may also be outside the tobacco or tube packing industry. The team members would be encouraged to visit external sources for ideas and new knowledge. This information would be recorded in the system described in Intervention 2. The external sources would include exhibitions of technology, trade fairs, university contacts, Discontinuous Innovation Forum and other companies who offer access to new technologies. In addition, external speakers, "experts" in their own area would be asked to present their ideas and views to the team at regular intervals to support the external input. The contact with universities would be a suitable initial source for these external speakers. This intervention is designed to develop a sense that going outside for ideas is part of the way things are done.

   4. Idea gathering as a process
The objective of this intervention is to develop the first three interventions into a process whereby idea gathering is perceived to be part of the routine of the group. A weekly brainstorming session is proposed to initiate this. This session would be held each Wednesday at 2pm, in order to provide regularity and embed the process into the

behaviour of the group. This session would be facilitated by different people each week. The output would be input into the idea gathering system described in Intervention 2. This would also be a suitable venue to have people external to the company to attend.

This external input would add new ideas to the group knowledge. It is proposed that each session selects a particular focus that is relevant to the business, and allows the session to generate multiple ideas for resolving the issue. The generation of these ideas would be enhanced by the external knowledge gained as part of Intervention 3.

   5. *New product areas to be identified*

This intervention takes the ideas and knowledge generated from interventions 2, 3 and 4. The proposal for this intervention is to ask the team to create a list of potential new product areas. These product areas should be described in sufficient detail to allow the team to select one and develop a product that fits into the new product area. The product areas should be new to the company and new to the industry, or for a different industry. The objective of this intervention is to encourage the team to develop possible opportunities for product development that moves the team into the radical innovation area. The specification for the product groups should be sufficiently clear to indicate that an iteration of an existing product would not be suitable, but sufficiently open-ended to allow the creativity of the team to provide a series of potential new areas for product development. The task would be defined as identifying a new product area, potential product applications, benefits to the business, estimated costs and selling process along with the associated outline plan for development. Depending on the constitution of the team following Intervention 1, it may be more appropriate to allocate this task to a number of teams created from the whole Development Team, rather than each Development Team member. This intervention builds on the preceding interventions to produce a number of possible development routes for the company.

   6. *Show and tell presentation*

This intervention takes the new product opportunities created in Intervention 5 and with input from the commercial and operations areas of the business selects one suitable for developing into a new product for the business. The proposal is for a group evaluation of the product opportunities. Each idea would be presented by the individual or team responsible for its creation. These proposals would be evaluated at a session where other members of the company had the opportunity to test the thinking and feedback their view of the probability of the product proposal being of benefit to the company. It may be suitable to run such a session internally with the Development Team, prior to opening the ideas up to the company at large. This venue would be used to discuss the relative merits and drawbacks of each of the product proposals. This intervention would provide a showcase for the creative output of the Development Team. This would provide a degree of confidence in the team being able to think of "do different" solutions. This would in turn, strengthen the confidence of the team.

   7. *"Do different" project*

This is the final stage in this series of interventions. This builds on the preceding steps and uses one of the product opportunities from Intervention 6 as the basis of a radical innovation project. This project would be initiated on the basis that it may, or may not, become a production product, but that the development of the product would still take place. The selection of a "do different" project would have a degree of ownership by the team as it would flow from their involvement in the preceding interventions. The project would be given to a team drawn from the Development Team members with a

clear overall goal, but without a high degree of specification being provided. As the product opportunity will have evolved from the work of the team this would be a different scenario from providing a full specification for a new product.

This ownership of the project would be important to reinforce the willingness to undertake the development of such a "do different" project. A segregated area should be provided if possible, to create the perception that the project is "different". Resource allocation would be provided as per other development projects, as it would be a legitimate product development. A bonus for completion of project deliverables would be offered to the project team. These deliverables should reflect that the project may or may not deliver a viable product, but nevertheless would contribute to the knowledge of the team. This step would again build the confidence of the team and those outside the team that "doing-different" in product development was an acceptable, and indeed expected, behaviour for the Development Team.

Carrying out the proposed interventions
This plan focuses specifically on the Development Team and senior management in Cerulean. The interventions are not a set of stand alone actions. They operate as a sequence of interventions that build on the preceding activity to develop a culture that facilitates radical innovation within the company. The interventions themselves should not be adopted as a prescriptive set of instructions. Implementation should be in the same participative manner as the early stages of the innovation project research, where there was regular feedback to the team and validation of what was being developed. This allowed understanding by all members of the team and facilitated input from those who wished to influence the outcome. The same approach is suggested for the implementation of this set of interventions.

Measuring progress
It is proposed that regular reviews are carried out to gauge the progress with developing the innovation culture. The climate and culture assessments carried out previously should be used to provide a starting point and progress guide for the duration of the interventions. However, it is suggested that this gauging be undertaken no more frequently than every three months in order to allow sufficient time for the interventions to have an influence on the behaviour of the team. The assessments should also not be the sole method for gauging progress. The regular reviews, through workshop sessions would provide good feedback as to the effect of the interventions.

Conclusion
The interventions have been developed by examination of examples from several companies. The format of the interventions is designed to suit Cerulean, but the implementation will need to recognize that adaptation will be required as the interventions progress, depending on the response of the Development Team and their attitude to the change. The active involvement of the team and senior management is essential to allow the interventions to influence the behaviour of the team. A prescriptive following of interventions 1 to 7 without recognizing the progress at each stage and reviewing with the team is unlikely to produce the desired culture. Culture is "the way we do things round here". It is a series of learned responses that provide an acceptable outcome. The desired outcome is an innovation culture that facilitates radical innovation, and since this is a "do different" activity, there is no "one right way"

of achieving this. In addition culture is created and maintained by the people in the organization. The involvement of the team and senior management, (the group of people who have the most influence on the Development Team culture), is an essential part of making the change.