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**INVESTIGATING INNOVATION: MEASUREMENT,  
STANDARDIZATION AND PRACTICAL APPLICATION.**

by

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Submitted in partial fulfilment of the requirements  
for the degree PhD in Human Resources Management in the Faculty of  
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## DECLARATION

I hereby declare that the thesis submitted by me for the degree Philosophiae Doctor at the University of Pretoria is my own work and was not submitted previously for a degree at this or any other tertiary institution.

A handwritten signature in black ink, appearing to read 'G.P. Boonzaaier', written in a cursive style.

Gerhardus Petrus Boonzaaier



**ABSTRACT:**

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**DEGREE: PhD Human Resources Management**

Growing competition, globalisation and changing circumstances make innovation a prerequisite for the growth, success and survival of any private or public organisation. While innovation in technology, production, marketing and finance all remain essential, it is innovation in management that is most desperately in short supply. A literature study could not reveal the existence of any scale that measures all the factors and processes relevant to organisational innovation.

A scale for managerial innovation was developed. This scale is based on the work of various researchers in the field of innovation. The major tasks in the process were connected to the structural arrangements and social patterns that facilitate the tasks are discussed. Innovation consists of a set of processes carried out at the micro-level, by individuals and groups of individuals, and these micro-processes are in turn stimulated, facilitated and enhanced - or the opposite - by a set of macro-structural conditions.

A semantic differential scale was developed to measure managerial innovation. The scale consists of 88 items and was designed to reflect the major factors and processes of organisational innovation.

Various statistical tests were used to evaluate the scale and data obtained through the scale. Five Factors were identified after the data was analysed using factor analysis. The five factors are Factor 1 (leadership and culture), Factor 2 (employee acquisition and development), Factor 3 (variables that facilitate problem solving and aid in innovation), Factor 4 (variables that impact negatively on innovation), and Factor 5 (variables external to the organisation that influence innovation).

The Alpha Cronbach test for reliability showed a very high degree of reliability and the scale conformed to the criteria of content validity.

Analysis Of Variance (ANOVA) was used to perform comparative analysis on the biographical variables. The relationships between age, gender, level of education, industry, length of service, and the combined effect of age and gender, age and length of service, gender and industry, and gender and length of service and the five factors were analysed. Age seems to play a significant role in Factor 1 and Factor 2 (i.e. leadership and culture as well as employee acquisition and development). For Factor 1 and Factor 2 average achievement in terms of innovation seems to increase with age. With regard to Factor 3, 4 and 5 age does not seem to impact on achievement significantly.

The results of this study indicate that there are no significant relationship between gender and innovation.

The results of this study indicate that there is a positive relationship between level of education and innovation for Factors 3, 4 and 5. It was found to differ significantly between the levels for two factors, namely Factor 1: leadership and culture, and Factor 2: employee acquisition and development. They seem to decline as the level of education increases.

The results of this study indicate that for all five factors there seem to be a very significant difference in average achievement when individuals from different industries are compared.

The results of this study indicate that there is not a significant relationship between length of service and innovation.

The ANOVA results for combined variables indicate a significant difference in average achievement Factor 1 (leadership and culture) when the research participants are grouped based on both age and gender.

In general, males of any age group tested equal to or higher than their female counterparts for Factor 1. Also apparent from the results is that generally the scores for Factor 1 seemed to increase with age.

For Factor 2, 3, 4, and 5 there is no significant difference in achievement when participants are grouped according to age and gender.

The results of the tests for difference in achievement when the research participants are grouped according to age and length of service, do not indicate that there is any significant difference in average achievement between the groups.

### **Key terms**

Necessity of innovation

Key role of management in innovation

Organisational innovation

Major tasks in innovation

Micro-processes

Macro-structural conditions

Measure managerial innovation

Construction of scale

Reliable and valid

Factor analysis

Analysis of variance

## **ACKNOWLEDGEMENTS**

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## **CHAPTER 1**

### **1 INTRODUCTION AND STATEMENT OF THE PROBLEM**

#### **1.1 Introduction**

Two major challenges that face us now more than ever are how to adapt successfully to change and how to bring about change in environments that are not conducive to our well-being and effectiveness. Work environments in particular are often directly damaging to our health and well being with stressors causing both physical and psychological damage to people. With the study of innovation and creativity at work, we can evolve strategies for meeting the challenge of how to bring about change in work environments.

However, there are broader reasons beyond those concerned with immediately psychological issues for studying creativity and innovation at work. Innovation and creativity are often associated not only with economic prosperity, but with specific advances in knowledge which improve the health and welfare of many in the population - ethically guided advances in medicine, education, science and psychology are some examples. Moreover, many of the most pressing human problems are institutionalised and it is only by bringing about innovative change that many of these problems can be overcome. For example, social systems and structures that institutionalise inequality in resource and opportunity distribution within communities can promote alienation and inter-group hostility. Effective responses to such problems require changes not only in individual behaviour, but innovative change in the organisations and institutions that perpetuate these problems (Storey & Salaman, 2005:4-5).

The study of innovation presents an optimistic picture of people's involvement in their social and organisational contexts. It promises to advance our understanding of how people can be effective in transforming and shaping organisations.

Growing competition, globalisation and changing circumstances make innovation an inevitable prerequisite for the growth, success and survival of any private or public organisation. Maxims such as 'innovate or die' are clear expressions of the necessity for innovation as a concept with practical applications and utility (Isaksen & Tidd, 2006: 4-5).

In what promises to be an even more volatile and demanding 21st century, the competitive ante will be raised even higher. Factors that were once genuine competitive advantages are now simply minimum admission requirements for staying in the game. The premium has shifted to the ability to manage major, strategic change effectively and almost continually - in short, to innovate consistently. Companies must innovate and innovate *continuously* to have any hope of survival, let alone dominance. While innovation in technology, production, marketing and finance all remain essential, it is innovation in management and strategy that is most desperately in short supply (Kiernan, 1996: 51).

The effective transformation and shaping of organisations is largely the responsibility of management. Management must create a vision of where the organisation wants to go and must create an environment that will enable the organisation to make the necessary changes to live up to its vision. This will include making the necessary adjustments to create favourable conditions for innovation to take place as well as enabling the management of the innovation process (Hales, 1993: 2).

## 1.2 Problem statement and study objectives

Innovation is a term that is used widely in management and organisational development literature. In business circles it is common to hear people talk about the importance of innovation. Management 'gurus' stresses the need for organisations to be innovative in order to survive. However, rarely do the people who talk about the need for innovation say exactly what they mean by it; and, more importantly, they do not explain in detail what an organisation must *do* in order to be innovative. They do not tell their audience what processes are involved in innovation; nor do they outline the factors that need to be taken into consideration.

During the literature search the author could not find any scale that sets out to measure the whole process of innovation and the factors involved in it. As stated in the Introduction to this study, it is ultimately the responsibility of management to create the most favourable conditions for innovation to take place - and to steer the whole process.

In a previous study (Boonzaaier, 2000), the author developed a scale to measure managerial innovation. The scale was developed to measure the following:

To establish whether people within management have the necessary skills and knowledge to be able to lead and manage innovation within their organisations;

To determine whether they know how to create the most favourable conditions for successful innovation; and

To determine whether they know what type of workers they must create in order to have a workforce capable of creative and innovative work.

In order to develop the scale of managerial innovation the work of various researchers were used, Amabile (1998; 1990; 1984; 1982), Bean and Radford (2002), Burnside (1990), Delbecq and Mills (1985), Drucker (1985), Duncan and Holbek (1973), Ettlie, (2006), Galbraith (1982), Gluckman and Liyanage (2006), Goffin and Mitchell (2005), Harvard Business Essentials Series (2003), Hennessey and Grossman (1986) Janssen, Van De Vliert and West (2008), Jehn and Bezrukova, (2004), Kanter (1990; 1983), Kimberly (1981) Kimberly and Evanisko (1979), King and Anderson (2002), Koestner, Ryan, Bernieri, and Holt (1984), McGraw & McCullers, (1979), Quinn (1985), Reuvers, Van Engen, Vinkenburg, and Wilson-Evered (2008), Rogers (1995), Trott (2008) Van den Ven (1986), Walton (1987), White and Bruton (2007), Zaltman (1973). All the factors that have an impact on the innovation process – from realising the need to innovate, through to the successful implementation of innovation – are discussed. The discussion of the factors that influence innovation used in this study is applicable to organisations in all the different economic sectors (Amabile, 1990; Daft, 1986; Galbraith, 1982; Kanter, 1990; Nyström, 1990; Walton, 1987). Thus, the questionnaire for the measurement of managerial innovation, which was developed from the work on innovation of the above-mentioned authors, can also be used in the different economic sectors.

The different aspects of organisational innovation that are covered are the following:

- Qualities of individuals that influence creativity;
- Qualities of the environment that influence creativity;
- The structural, collective, and social conditions for innovation in organisations.

The above-mentioned aspects also guided the construction of the questionnaire for managerial innovation.

### **1.2.1 Study objectives**

The following study objectives are addressed in this study:

1. To develop the questionnaire for managerial innovation further and,
2. Determine the relationship between innovation and selected biographical data.

To achieve the first study objective, Factor Analysis was used to further investigate the questionnaire for managerial innovation that the author had developed. In a previous study by Boonzaaier (2000), the researcher developed the measuring instrument for innovation. The study by Boonzaaier (2000) was for a Masters degree. The time limits, sample size and scope of the study did not allow for the use of Factor Analysis to be used with the data gathered. In the study of 2000, the items were evaluated by the use of correlation analysis to identify the items to be included and reliability analysis was used to establish whether the scale had a sufficient level of reliability. Furthermore, validation criteria were also established for the measuring instrument.

By using factor analysis in the present study, the measuring instrument can be developed more rigorously. The specific aims of doing Factor Analysis on the mentioned innovation questionnaire were the following:

- To determine the number of factors that explains the variance in the questionnaire for managerial innovation,
- Establish whether it would be possible to reduce the number of items in the questionnaire by the use of factor analysis.



The second study objective was to determine the relationship between:

- Age and innovation
- Gender and innovation
- Education and innovation
- Industry and innovation
- Length of service and innovation.

Analysis of Variance (ANOVA) was used to establish the relationship between the biographical data and innovation.

In order to achieve the above mentioned objectives, the researcher obtained 411 questionnaires. The following biographical data were obtained: age, gender, highest level of education completed, standard industrial classification for all economic activities as defined by the Central Statistical Service, length of service and seniority in the organisation concerned. The study was conducted in the Gauteng province and involved respondents from the different industrial categories as defined by the Central Statistical Service.

### **1.3 Importance and contribution of study**

The importance of innovation has already been outlined in the Introduction and in the Statement of the Problem. Since innovation is mainly the responsibility of management (all of management), a scale of innovation could be a valuable tool for organisations to establish whether their management team is up to the task. Because the scale covers all factors and processes involved in innovation, it could help management to establish whether or not management has covered all of the processes, and where it is lacking or weak. Once management has identified weaknesses or factors that are missing, corrective steps can be taken to

remedy the situation. At a more general level, this study can add to the body of existing work on innovation.

#### **1.4 Theoretical considerations**

For theoretical purposes, the author intends making use of Systems Theory. Systems Theory has the advantage that it clearly illustrates how the different subsystems of an organisation are linked to each other, and the interaction of the system with its environment (Bertalanffy, 1969; Beer, 1980; Chin, 1976; Jannov, 1994; Katz and Kahn, 1978; Kast and Rosenzweig, 1985; Liyanage, 2006; Rapoport, 1985; Skyttner, 2005).

When looking at the innovation process it is undeniable that innovation stems from individual talent and creativity, but whether individual skills are activated, exercised, supported and channelled into the production of a new model that can be used, is a function of organisational (structural) and inter-organisational context. To cover the detail of the innovation process the author made use of the work of various researchers on the subject of innovation: Amabile (1998; 1990; 1984; 1982), Burnside (1990), Delbecq and Mills (1985), Drucker (1985), Duncan and Holbek, (1973), Galbraith (1982), Gluckman and Liyanage, (2006), Harvard Business Essentials Series (2003), Hennessey & Grossman (1986) Kanter (1990; 1983), Kimberly (1981) Kimberly and Evanisko (1979), King and Anderson (2002), Koestner, Ryan, Bernieri, & Holt (1984), McGraw & McCullers, (1979), Quinn (1985), Rogers (1995), Van den Ven (1986), Walton (1987), Zaltman (1973). All aspects of the innovation process, from individual factors to institutional factors, are discussed.

## **CHAPTER 2**

### **2 LITERATURE STUDY: DEFINITIONS, CHARACTERISTICS, TYPES AND SOURCES OF INNOVATION**

#### **2.1 Introduction**

In Chapter 2, an overview of innovation will be presented before paying attention to organisational innovation in Chapter 3. A comprehensive understanding of the concept of innovation is presented through a discussion of the definitions of innovation, the relationship between innovation, creativity and change, as well as the characteristics of innovation, types of innovation and sources of innovation.

#### **2.2 Defining innovation**

The term innovation is used in many different ways that appear to vary systematically with the level of analysis employed. The more macro the approach (e.g. societal and cultural) the more varied and amorphous does the usages of the term become. The term innovation can be confined to original inventions, defined as implying something new for the organisation but perhaps not original, or synonymous with any kind of change.

There are literally hundreds of different definitions of innovation. A few examples will be presented here to show the different aspects that they highlight. A definition will then be presented which will be used for this study.

Innovation is any idea, practice, or material artefact perceived to be new by the relevant unit of adoption. The adopting unit can vary from a single individual to a business firm, a city, or a state legislature (Zaltman, 1973: 10).

According to Kanter (1983: 21) innovation refers to a process of bringing any new, problem solving idea into use. Ideas for reorganising, cutting costs, putting in new budgeting systems, improving communication, or assembling products in teams are also innovations. Innovation is the generation, acceptance, and implementation of new ideas, processes, products, or services. It can thus occur in any part of a corporation, and it can involve creative use as well as original invention. Application and implementation are central to this definition; it involves the capacity to change or adapt. There can be many different kinds of innovations, brought about by many different kinds of people: the corporate equivalent of entrepreneurs.

Drucker (1985: 31) has defined systematic innovation as a purposeful and organised search for changes, and in the systematic analysis of the opportunities such changes might offer for economic or social innovation. For Drucker (1985: 31) innovation is the basis of all competitive advantage, the means by which organisations anticipate and fulfil customer needs, and the method by which organisations utilise technology. Innovation endows resources with a new capacity to create wealth or creates a new resource. Innovation is the organisation's way of implementing new ideas, of turning the creative concepts of its members into realities. It can cause change or it can exploit change.

For Amabile (1990: 234) organisational innovation is the successful implementation of creative ideas within an organisation. Within this definition, the ideas in question can be anything from ideas for new

products, processes, or services within the organisation's line of business to ideas for a new procedures or policies within the organisation itself. The term "implementation" is used broadly here, to encompass elements of developing ideas and putting them to use.

Van de Ven (1986: 590) defines innovation as "... the development and implementation of new ideas by people who over time engage in transactions with others within an institutional order". According to Bray (1995: 2) innovation is a process that takes an idea, and successfully market it to such an extent that its concept becomes an excepted player in the marketplace. Nicholson (1990: 180) defines innovation as the initiating of "changes in task objectives, methods, materials, scheduling and in the interpersonal relationships integral to task performance".

Delbecq and Mills (1985: 25) define innovation as a significant change within the organisation or its line of services or products that (a) requires a substantial adjustment in functions and/or structures, and (b) is successfully introduced, decided upon, and incorporated into the organisation. As such it differs from incremental change (involving minimal disruption, usually within current tradition) and invention (which might not become institutionalised).

According to Greif and Keller (1990: 231) innovations can be any useful, new and different ideas, processes, products and procedures. Galbraith (1982: 10) contrasts innovation with invention. For Galbraith invention is the creation of a new idea and innovation is the process of applying a new idea to create a new process or product.

The definition of West and Farr (1990) will be used in this study because it gives a very complete discussion of what innovation entails. West and Farr (1990: 9) define innovation as the intentional introduction and

application within a role, group or organisation of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organisation or wider society.

Several aspects of the definition may be highlighted. First, innovation is restricted to intentional attempts to derive anticipated benefits from change. Second, a broad perspective on the anticipated benefits is adopted, rather than using a sole criterion of economic benefit. Thus, possible benefits might be personal growth, increased satisfaction, improved group cohesiveness, better interpersonal communication, as well as those productivity and economic measures more usually invoked (West & Farr, 1990: 9).

The definition also allows for the introduction of a new idea or design to benefit not only a role, or organisation, but also the wider society. The introduction of community members onto the management boards of nuclear processing plants is an example of an innovation that might not benefit the organisation, though benefiting the wider society. Further, the definition is not restricted to technological change but subsumes new ideas or processes in administration or human resource management. Indeed, it has been claimed that innovation occurs frequently in management methods and organisational practices as well as in technological domains, and that administrative innovation has a facilitating effect on technological innovation. The definition also requires an application component, thus encompassing what many would regard as the crucial social element of the process of innovation. Finally, the definition does not require absolute novelty of an idea, simply that the idea be new to the relevant unit of adoption. Therefore, if an individual brings new ideas to an organisation from his or her previous job, this

would be considered an innovation within the terms of the definition (West & Farr, 1990: 9).

### **2.3 Innovation, creativity and change**

According to most definitions of innovation it refers more to the doing of new things for a group, whereas creativity refers more to individual behaviour and to something that is totally new and novel.

Amabile (1983) makes a very useful distinction between creativity and innovation that will be used in this study. Amabile (1983: 358-359) defines creativity as "the production of novel and appropriate ideas by one individual or a small group working together". She introduces the notion of appropriateness to distinguish the creative from the merely chaotic. The distinction is one of emphasis rather than category but creativity appears to be understood more as absolute novelty (bring into existence) rather than the relative novelty of innovation (bring in novelties). Her concept of innovation is also concerned with broader processes of change in this definition. Another useful way of distinguishing the concepts is to see creativity as the ideation component of innovation and innovation as encompassing both the proposal and applications of the new ideas (Amabile 1983: 359).

Damanpour's (1990: 125) distinction between innovation and creativity also point to the type of distinction that is favoured by this study. Innovation according to Damanpour (1990: 125) involves intentionality of benefit. Such intentionality may not exist, for example, in case of a poet who writes creatively without expectation of benefit other than the reward of simply doing the writing. Innovation also has a clear social and applied component since it impacts directly or indirectly upon others affected by the role, or others in the work group, organisation or wider

society. This necessary applied social component perhaps most sharply distinguishes it from creativity. There is an interaction between those who innovate and those who are affected by the innovation and recognition that one's action will affect others will influence that action. Innovation is a social process with elements of the process being events that occur between people, whereas creativity is an individual, the thought process in which events occur within the person.

## **2.4 Characteristics of innovation**

Innovation, whether technological or administrative, whether in products or processes or systems-tends to have four distinctive characteristics (Kanter, 1990; Rogers, 1995).

### **2.4.1 The innovation process is uncertain**

The source of innovation or the occurrence of opportunity to innovate may be unpredictable. The innovation goal may involve little or no precedent or experience base to use to make forecasts about results. Hoped-for timetables may prove unrealistic, and schedules may not match the true pace of progress. Furthermore, anticipated costs may be overrun and ultimate results are highly uncertain. Analysts have variously estimated that it takes an average of 10 to 12 years before the return on investment of new ventures equals that of mature businesses. Analysts have estimated that it is 7 to 15 years from invention to financial success, and 3 to 25 years between innovation and commercial production (Kanter, 1990: 278; Rogers, 1995: 15).



#### **2.4.2 The innovation process is knowledge intensive**

The innovation process generates new knowledge intensively, relying on individual human intelligence and creativity and involving interactive learning. New experiences are accumulated at a fast pace; the learning curve is steep. The knowledge that resides in the participants in the innovation effort is not yet codified or codifiable for transfer to others. Efforts are very vulnerable to turnover because of the loss of this knowledge and experience. There need to be close linkages and fast communication between all those involved, at every point in the process, or the knowledge erodes (Kanter, 1990: 278; Rogers, 1995: 15).

#### **2.4.3 The innovation process is controversial**

Innovations always involve competition with alternative courses of action. Furthermore, sometimes the very existence of a potential innovation poses a threat to vested interests- whether the interest is that of a sales person receiving high commissions on current products, or of the advocates for a competing direction (Kanter, 1990: 278; Rogers, 1995: 15).

#### **2.4.4 The process of innovation crosses boundaries**

An innovation process is rarely if ever contained within one unit. First, there is evidence that many of the best ideas are interdisciplinary or inter-functional in origin or they benefit from broader perspectives and information from outside of the area primarily responsible for the innovation. Second, regardless of the origin of innovations, they inevitably sent out ripples and reverberations to other organisation units, whose behaviour may be required to change in light of the needs of

innovations, or whose co-operation is necessary if an innovation is be fully developed or exploited (Kanter, 1990: 278; Rogers, 1995: 15).

According to Kanter (1990: 278-279), Rogers (1995: 15-17), and Zaltman (1973: 32) one can also look at the following five characteristics of innovations, as perceived by individuals to help to explain their different rate of adoption. These are:

1. *Relative advantage* is the degree to which an innovation is perceived as better than the idea it supersedes. The economic terms, social prestige, convenience, and satisfaction are also important factors. The greater the perceived relative advantage of an innovation, the more rapid its rate of adoption will be.
2. *Compatibility* is the degree to which an innovation is perceived as being consistent with existing values, past experiences, and needs of potential adopters. An idea that is incompatible with the values and norms of a social system will not be adopted as rapidly as an innovation that is compatible.
3. *Complexity* is the degree to which an innovation is perceived as difficult to understand and use. Most members of a social system readily understand some innovations whereas other innovations are more complicated and will be adopted more slowly.
4. *Trialability* is the degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried on the instalment plan will generally be adopted more quickly than innovations that are not divisible. An innovation that is trialable represents less uncertainty to the individual who is considering it for adoption, as it is possible to learn by doing.
5. *Observability* is the degree to which the results of an innovation are visible to others. The easier it is for individuals to see the results of an

innovation, the more likely they are to adopt it. Such visibility stimulates peer discussion of a new idea, as friends and neighbours of an adopter often request innovation-evaluation information about it.

## **2.5 Distinctions between different types of innovations**

Although the overview of organisational innovation presented in Chapter 3 look at innovation in a general sense (also see Section 1.2), some useful distinctions have been drawn, such as that between product and process (Ettlie, 2006:263; Goffin & Mitchell, 2005:9; Meeus & Edquist, 2006:24; White & Burton, 2007:94). These distinctions are informative if one wants to pay attention to a *specific* form of innovation

According to White and Burton (2007:94), Meeus and Edquist (2006:24), Ettlie (2006:263), Goffin and Mitchell (2005:9) innovations can be classified in a number of ways; however, one of the most common is from the perspective of product and process innovations. Product innovations are new or better products being produced and sold. It is about *what* is produced. Product innovations include new material goods as well as new intangible services. Process innovations are new ways of producing goods and services. It is about *how* existing products are produced. Process innovation may be technological or organisational.

While discussed separately here, these concepts are intertwined, and there is rarely one without some effect on the other. After all, if a new product is developed, the firm needs to develop some way of producing and marketing the product, and this means new processes must also be put in place. Likewise, processes may lead to new interactions within the organisation. This, in turn, may lead to new products as different individuals exchange information and ideas within the organisation (White & Burton, 2007:94).

## **2.5.1 Product Innovation**

Damanpour and Aravind (2006:41), Ettlie (2006:265), Goffin and Mitchell (2005:9), Meeus and Edquist (2006:24), and White and Burton (2007:94) define product innovation as the introduction of a new good or product with which consumers are not yet familiar. For most organisations, product innovations are the center of their research and development (R&D) efforts. Although R&D can occur in a separate unit of the organisation, today it is more often spread throughout the firm. Thus, there is not always a single department or area called R&D. Instead, there are people focused on, and goals and objectives established for, R&D throughout the organisation. No matter how the firm chooses to structure its R&D efforts, it must be clear where it is in the R&D process and the type of innovation efforts that are needed. The types of innovation efforts found in the R&D process include:

1. Basic: pure research and development
2. Applied: new product development
3. Systems integration: product improvement or market expansion

A firm may have any or all of these different types going on at any given time.

### **2.5.1.1 Basic Research: Pure Research and Development**

According to Ettlie (2006:149), White and Burton (2007:96) and Zairi, (1999:116-117) basic research involves the creation of new knowledge. This knowledge may be new to the firm, or it may be an innovation that was unknown before this effort. Basic research is fundamentally risky, but it has the potential to provide great rewards such as leading to new products or ways of doing business. The goal of an innovation strategy is to create value for the firm and its customers. This goal cannot be

forgotten even in basic research. Thus, academic institutions, government agencies, and specialised research laboratories typically focus on basic research because value creation for these entities is typically not determined by monetary profit.

To illustrate, consider the investigation of particle physics. This area developed from nuclear physics and examines how particles in an atom interact. In the beginning, this research was undertaken to extend our knowledge of how nature works, not to make products. The basic research in this domain did not immediately lead to new products.

Basic science is motivated by the broad curiosity of the researcher, not specific product interests.

### **2.5.1.2 Applied Research: New Product Development**

Applied research builds on basic research. Applied research utilises the new knowledge developed by the basic research to create new products. The new product development can then lead to the firm changing its strategic position in the industry or, at least, changing its potential position in the industry. This should lead to the firm gaining some measure of competitive advantage (White and Burton, 2007:97).

According to Ettlé (2006:149), Heany (2006:293) and Zairi (1999:116-117) the purpose of applied research is to add value to the firm and its customers in the marketplace. The risks of applying the innovations from this type of research are less than in basic research. The probability of success and high reward is moderate. To continue our illustration of particle physics, basic research established the foundation of particle physics. Most people do not understand these principles, but the applications that have emerged from that technology are numerous and familiar to us.

### **2.5.1.3 Systems Integration: Product Improvement**

According to Heany (2006:298-299), and White and Burton (2007:97) systems integration is aimed at supporting existing business improvements in established products or opening new markets with an existing product. This type of R&D is incremental in nature. This type of integration has low risks and rewards associated with it. In fact, most of the risks are negative; not changing can lead to strategic disadvantage. This type of innovation involves adjusting the ways the firm organises its existing knowledge to increase its advantage. Systems integration is most concerned with the fit among parts of the organisation and how to improve the fit with existing knowledge bases. Thus, medical imaging was applied research that flowed from the basic research on particle physics. This was followed by systems integration research. This process has led to an improved CAT scan machine approximately every two years, with small changes more often, since the technology was introduced twenty-five years ago.

### **2.5.1.4 Which Type of Innovation Efforts Should a Firm Focus Upon?**

According to White and Burton (2007:98) the firm should match the type of research it wishes to pursue to its needs and capabilities in order to which of the three types of research is best for an organisation to pursue. One of the key elements in making such a determination is what the firm's competitors are doing. This analysis of strategic position-what is occurring in the industry now and what will occur in the industry in the future-is difficult to determine. However, it is helped by closely monitoring the competition.

The firm must first determine whom to monitor. There is no formula for determining which competitors to monitor. One means to quickly identify the position of the firm and its competitors is a strategic group map. A firm does not compete against everyone in its industry. Instead, it competes against some firms more directly than it does against others. Thus, a firm needs a means to segment its industry into relevant groups so the business can identify which firms to target.

White and Burton (2007:98) illustrate this with the following example. A firm like Nintendo with its product Game Boy is in the electronic gaming industry, but it is not a major competitor in the online pay-as-you-play electronic gaming segment. Small firms such as YPG dominate this segment. Nintendo would not be directly concerned with YPG unless Nintendo decided to enter the pay-as-you-play segment. Similarly, YPG would focus on other small firms such as WorldWinner rather than a firm like Nintendo. A strategic group map helps identify firms that should be monitored most closely.

To construct a strategic group map, a firm should generate two axes that represent critical factors in the industry. The factors on these axes can vary based on what the analyst feels is important. Typically, using factors like cost of product and quality in the same map are avoided. These two factors should be correlated and would not provide much insight. Instead, the analyst should look for two distinct factors that are relevant to the industry and differentiate segments in the industry. The distinct factors used may (or may not) include either cost or quality; the key is to gain the broadest insight by using factors that are not related. The analyst will then place the competitors in the industry on the map. It should become clear that various firms group together. Therefore, strategic groups may be determined by R&D expenditures (high and low) and specific areas of research. Once the firms in the same strategic

group are determined, the managers study the actions, including the products, processes, and potential actions of each competitor.

This information can come through a variety of sources, such as published articles, national associations, analytical reports by industry experts, academic studies, and so on. From the information gathered, managers may learn which firms are investing heavily in areas such as new product research, new processes, and new markets. If a firm is not where others are, it may be at risk. This does not mean that the firm needs to react, but it does need to balance the risks, rewards, and costs to ensure that it is making a conscious choice and that it has plans of actions if a competitor makes a strategic breakthrough (White & Burton, 2007:98-99).

### **2.5.2 Process innovation**

According to Damanpour and Aravind (2006:41; Ettlé (2006:265), Goffin and Mitchell (2005:9), Meeus and Edquist (2006:24) and Zairi (1999:15-16) the purpose of a process innovation is to increase the efficiencies or the effectiveness of an organisation. Changes in processes require the organisation and individuals to adapt. Because of this, process innovations can be viewed negatively. However, if properly applied, process innovations offer the organisation and its personnel opportunities to improve the value of the organisation and to continue the organisation's viability. Thus, process innovations help to improve the output-to-input ratio of the firm.

The most common actions that address process innovation are new product development, restructuring, reengineering, and downsizing destruction.



### **2.5.2.1 New product development**

This takes place when new products or services are introduced to meet an external user or market need (Damanpour and Aravind, 2006: 41; Ettlle, 2006:265).

### **2.5.2.2 Restructuring**

A major reorganisation of a firm is referred to as restructuring. It involves substantive changes including changes in communication and co-ordination patterns within the organisation. Most organisations experience a constant level of small changes in their processes, tasks, and people. However, periodically, the organisation needs to undertake a major review of what it does and why. A major re-evaluation is commonly caused by events such as:

1. Information is not getting to the proper people to make timely decisions. The result is slow decision making.
2. Opportunities and threats are being missed by the organisation.
3. A disruption has occurred in the firm's environment that has caused the firm extreme stress.

The most common restructuring activity in today's organisations is downsizing and reengineering (White & Burton, 2007:99).

### **2.5.2.3 Downsizing**

Downsizing is a type of restructuring that occurs when a firm either sells some of its units or lays off employees. Although employees generally view these as negative, the impact on the firm depends on the reasons for downsizing and the process that the firm is undertaking in response to those reasons. Many firms that downsize have experienced negative results. Survivors of the downsizing often feel overworked and are

uncertain if they might be laid off next. Therefore, the expected financial benefits of the restructuring are often not met. The planning for and the goals of downsizing should be extensive and clear (White & Burton, 2007:100).

#### **2.5.2.4 Reengineering**

Reengineering requires fundamental rethinking and radical redesign of work processes. Bennis and Mische (1995:11-14) state that reengineering has five specific goals:

Goal 1: Increasing productivity. Reengineering seeks to increase productivity by creating innovative and seamless processes that have an uninterrupted flow and occur in a natural order, with a natural velocity.

The paradigm of vertical "silos" of tasks and responsibilities is broken down and replaced with a cross-functional, flatter, networked structure. The classical, top-down approach to control and decision making is replaced with an approach that is organised around core processes, is characterised by empowerment, and is closer to the customer.

Traditional organisational boundaries, which create gaps and "pass-offs" in work (and diminish the value, speed, and quality of processes), are eliminated.

Goal 2: Optimising value to shareholders. Reengineering strives to optimise value to shareholders through doing things differently. Innovations in such functions as product design, manufacturing, and customer service are examples. Reengineering produces benefits for shareholders in these specific areas:

- Increased employee interest in and appreciation of the enterprise, its leadership, its products or services, and its customers.
- Improved internal co-operation, communication, teamwork, and understanding of needs.

- Increased employee knowledge of the organisation's direction, the organisation's role in the marketplace, its competitors, and its identity.
- Improved matching of employee skills to responsibilities and processes.
- New individual- and group-performance measures that are more closely aligned with the marketplace, the value of the work performed, and the contribution made.

Employees who are involved with reengineering recognise its benefits and develop a profound sense of ownership that helps the organisation to achieve greater long-term growth and competitiveness.

Goal 3: Achieving quantum results.

Reengineering sets out to achieve at least a 50-percent improvement; if the yield is not at least 50 percent, then the achievement, although it may be an impressive one, is not reengineering.

Goal 4: Consolidating junctions. Reengineering seeks to create an organisation that is leaner, flatter, and faster. The ability to rapidly assimilate innovations, market needs, technological developments, customer trends, and competitor initiatives is a trademark of the reinvented organisation.

Goal 5: Eliminating unnecessary levels and work. Reengineering constructively challenges and analyses the organisation's hierarchy and activities in terms of their value, purpose, and content. Organisational levels and activities that represent little value to shareholders or contribute little to competitiveness are either restructured or eliminated. Reinvention requires the continual assessment of the organisation, its management practices, its people, its systems, its customers, and the environment in which it operates.

Five questions are asked:

- Why does the organisation do the things it does in the way it does them?

- What value is produced for customers and shareholders by performing this activity in this way?
- How could the organisation perform this activity in a different way to enhance value?
- What innovative or breakthrough results does the organisation want to achieve?
- What talents are required, and who within the organisation has them.

According to Bennis and Mische (1995:11-14) the goal of reengineering is to identify processes within the organisation that create no value for the firm. Many firms gather a diverse group of individuals from the firm for reengineering. They focus on what their customers obtain from them and why the customers want it. The organisation then works backward from that initial point and examines each activity that goes into the production of the good or service. The firm should try to eliminate any activity that no longer provides value to the customers' stated outcome. In this manner of asking fundamental questions, the firm expects to eliminate unproductive and unnecessary activities and develop new ways of doing things.

#### **2.5.2.5 Choosing to Pursue Process Innovation**

Process innovation is difficult to plan and implement. However, the firm should constantly be on the lookout for improvements in systems and processes to pursue. The problem with most process innovations is that they require social as well as work design changes. Resistance to change is a concern even in organisations where innovation and change are part of the culture. Too often, firms wait to make process changes, such as restructuring and reengineering, until the organisation is in crisis.

Individuals may be more open to trying new things in times of crisis, but the level of trust and the fear of what happens next often hurt the effort to be innovative. Managers and agents of change need to make system and structural evaluation and innovation a continuing part of the organisation. If decision making is slow and information is not in place when decisions need to be made, then potential changes and innovations in the systems and structures of the organisation need to be examined (White & Burton, 2007:101).

## **2.6 Sources of innovation**

There are innovations that spring from a flash of genius but most innovations, especially the successful ones, result from a conscious, purposeful search for innovation opportunities, which are found only in a few situations (Drucker, 1985: 66-72).

Drucker (1985: 66) states that innovation opportunities can be classified as these that exist within company or industry and innovation opportunities that exist outside a company in its social and intellectual environment.

The four such areas of opportunity exist within a company or industry:

- Unexpected occurrence.
- Incongruities.
- Process needs.
- Industry and market changes.

Three additional sources of opportunities exist outside a company in its social and intellectual environment:

- Demographic changes.

- Changes in perception.
- New knowledge.

These sources overlap, different as they may be in the nature of their risk, difficulty, and complexity, and the potential for innovation may well lie in more than one area at a time. But among them, they account for the great majority of all innovation opportunities (Drucker, 1985: 66).

### **2.6.1 Unexpected occurrences**

According to Drucker (2003: 115) one of the easiest and simplest sources of innovation opportunity is the unexpected. Often opportunities arise where least expected.

For example in the early 1930s, IBM developed the first modern accounting machine, which was designed for banks, but the banks in 1933 did not buy new equipment. What saved the company was its exploitation of an unexpected success: the New York Public Library wanted to buy a machine. Unlike the banks, libraries in those early New Deal days had money, and IBM sold more than a hundred of their otherwise unsaleable machines to libraries.

The unexpected failure may be an equally important innovation opportunity source. For instance, Ford Motor Company Edsel is the biggest new car failure in automotive history. However, what few people seem to know is that the Edsel's failure was the foundation for much of the company's later success. Ford realised that something was happening in the automobile market that ran counter to the basic assumptions on which GM and everyone else had been designing and marketing cars. No longer did the market segment primarily by income

groups, suddenly the new principal segmentation was what we now call "life-styles". Ford's immediate responses were the Mustang and the Thunderbird- the cars that gave the company a distinct personality and re-established it as an industry leader.

Unexpected successes and failures are such productive sources of innovation opportunities because most businesses dismiss them, disregard them, and even resent them.

That attitude that managers often take to the unexpected is by saying that it should not have happened. Corporate reporting systems further ingrain this reaction, for they draw attention away from unanticipated possibilities. There is usually in their monthly or quarterly report listings of the areas where the results fall short. Such information is needed, of course, as it helps prevent deterioration of performance.

But it also suppresses the recognition of new opportunities. The first acknowledgement of a possible opportunity usually applies to an area in which a company does better than budgeted. Thus genuinely entrepreneurial businesses have two first pages - a problem page and an opportunity page - and managers spend equal time on both (Drucker, 2003: 115-116).

### **2.6.2 Incongruities**

According to Von Hippel (1988: 11) incongruity within the logic of a process is a possibility out of which innovation opportunities may arise. Another source is incongruity between economic realities.

For instance, whenever an industry has a steadily growing market but falling profits margins - as, say, in the steel industries in developed

countries between 1950 and 1970 - an incongruity exists. The innovative response: mini-mills. An incongruity between expectations and results can also open possibilities for innovation. For 50 years after the turn of the century, shipbuilders and shipping companies worked hard to make ships faster and to lower their fuel consumption. Even so, the more successful they were in boosting speed and trimming fuel needs, the worse ocean freighter's economics became. By 1950 or so, the ocean freighter was dying (Drucker, 2003: 116-118).

All that was wrong was an incongruity between the industries assumptions and its realities. Costs did not come from doing work (that is, being at sea) but from not doing work (that is, sitting idle in port). Once managers understood where costs truly lay, the innovations were obvious: the role-on and roll-off ship and container ship. A shift in viewpoint, not in technology, totally changed the economics of ocean shipping and turned it into one of the major growth industries of the last 20 to 30 years (Drucker, 2003: 116-118).

### **2.6.3 Process needs**

According to Smith (2006:96), Bean and Radford (2002:99), Zairi (1999:19) and Drucker (1985: 69) when a process is not working any more/or not working satisfactorily a minor invention can be implemented to solve the problem. The focus is more on *how* to make the product more functional.

Drucker (2003:118) give the example AT&T. Around 1909, a statistician at the American Telephone and Telegraph company projected two curves 15 years out: telephone traffic and American population. Viewed together, they showed that by 1920 or so every single female in the United States would have to work as a switchboard operator. The process



need was obvious, and within two years, AT&T had developed and installed the automatic switchboard.

#### **2.6.4 Industry and market changes**

According to Drucker (2003:119) and Holt (1992:13) changes in the industry and market can create tremendous opportunities for innovation. When an industry grows quickly its structure changes. Established companies, concentrating on defending what they already have, tend not to counter-attack when a newcomer challenges them. Indeed, when market or industry structures change, traditional industry leaders repeatedly neglect the fastest growing market segments. New opportunities rarely fit the way that the industry has always approached the market, defined it, or organised to serve it.

Innovators therefore have a good chance of being left alone for a long time to exploit the new niche in the market.

#### **2.6.5 Demographic changes**

According to Goffin and Mitchell (2005:4) and Holt (1992:15-16) of the outside sources of innovation opportunity, demographics are the most reliable. The demographics for the next 50 years show that many markets will evolve. For instance, the ageing population in many countries will have different requirements, and the size and the nature of many consumer markets will change. In contrast, other markets (for example Southeast Asia) are made up of young consumers with different aspirations. The innovation opportunities that changes in the numbers of people, and their age distribution, education, occupations, and geographic location make possible are among the most rewarding and least risky of entrepreneurial pursuits. Those who are aware of changing demographics can exploit the opportunities and reap great rewards.

Changing demographics also means that traditional market segments are disappearing or fragmenting and companies will need to adjust their product ranges accordingly. For example, car manufacturers now target over 15 key segments in the USA, as opposed to only 5 in the late 1960s (Goffin and Mitchell, 2005:4).

### **2.6.6 Changes in perception**

The glass is half-full and the glass is half-empty are descriptions of the same phenomenon but have vastly different meanings. Changing a manager's perception of a glass from half-full to half-empty opens up big innovation opportunities.

All factual evidence indicates, for instance, that in the last 20 years, American's health has improved at unprecedented speed. Even so, collective hypochondria grip the nation. Never before has there been so much concern with health or so much fear about health. Suddenly everything seems to cause degenerative heart disease or damage your loss of memory. The glass is clearly half-empty. This is why there has been such a tremendous growth in new product for the health market the last decade.

What determines whether people see glass as half-full or half-empty are mood rather than fact, and change in mood often defies quantification. However, it is not exotic or intangible. It is concrete. It can be defined. It can be tested. In addition, it can be exploited for innovation opportunity (Drucker, 2003:121-122).

### **2.6.7 New knowledge**

According to Damanpour and Aravind, (2006: 19-20), Ettlie, 2006:8), Meeus and Hage (2006:12-13), Goffin and Mitchell (2005: 2-3) and Drucker (2003:122) among the history making innovations, those based on new knowledge - whether scientific, technical, or social - rank highly. They are the superstars of entrepreneurship; they get the publicity and money. New technologies have a major influence on markets

Knowledge based innovations differ from all others in the time they take, in their casualty rates, and in the predictability, as well as in the challenges they pose to entrepreneurs. They can be temperamental, capricious, and hard to direct. They have the longest lead-time of all innovations. There is a protracted span between emergence of new knowledge and its distillation into usable technology. Then, there is another long period before this new technology appears in the marketplace in products, processes, or services. Overall, the lead-time involved is something like 50 years, a figure that has not shortened appreciably throughout history.

According to Bean and Radford (2002:91) to become effective innovation of this sort usually demands not one kind of knowledge but many.

Drucker (2003:122-123) give the example of one of the most potent knowledge based innovations: modern banking. The theory of the entrepreneurial bank - that is, of the purposeful use of capital to generate economic development - was formulated by the Comte de Saint Simon. Despite Comte de Saint Simon's extraordinary prominence, it was not until 30 years after his death in 1826 that two of his disciples, the brothers Jacob and the Isaac Pereire, established the first entrepreneurial bank, and ushered in what we now call "finance capitalism". The Pereirs, however, did not know modern commercial banking, which developed at about the same time across the channel in England. The Credit Mobilier failed ignominiously. Ten years later, two

young men-one an American, J.P. Morgan, and one a German, Georg Siemens- put together the French theory of entrepreneurial banking and the English theory of commercial banking to create the first successful modern banks.

Although it seems difficult, knowledge-based innovation can be managed. Success requires careful analysis of the various kinds of knowledge needed to make an innovation possible. Careful analysis of the needs and, above all, the capabilities of the intended user are also essential. It may seem paradoxical, but knowledge-based innovation is more market dependent than any other kind of innovation.

## **CHAPTER 3**

### **3 LITERATURE STUDY: SYSTEMS THEORY AND AN OVERVIEW OF ORGANISATIONAL INNOVATION**

#### **3.1 Introduction**

In Chapter 2, an overview of the concepts of innovation and creativity were presented.

In Chapter 3, Systems Theory and an overview of organisational innovation will be discussed. According to Liyanage (2006: 10) Systems Theory allows us to view organisations in their totality and emphasise the interaction and interdependence between the various subsystems of an organisation. Furthermore it also draws our attention to the fact that the organisation do not operate in a vacuum but rather we must pay attention to the environment in which the organisation finds itself and how the system interacts with the environment.

#### **3.2 Introduction to Systems Theory.**

Organisation theory and management practices are evolving continually. Traditional theory has been modified and enriched by knowledge from a variety of underlying disciplines. Scientific research and conceptual endeavours have, at times, resulted in divergent theories; however, in recent years an approach has emerged that offers an opportunity for convergence in organisation and management theory. The systems approach provides a basis for integration by giving us a way to view the total organisation in

interaction with its environment and for conceptualisation of relationships among internal components or subsystems. Systems concepts provide the basic frame of reference for the development of contingency views of organisations and their management (Kast & Rosenzweig, 1985:103).

### **3.2.1 General Systems Theory**

Over the past several decades the development of General Systems Theory has provided a basis for the integration of scientific knowledge across a broad spectrum. A system can be defined as an organised, unitary whole composed of two or more interdependent parts, components, or subsystems and delineated by identifiable boundaries from its environmental suprasystem. The term system covers a broad spectrum of our physical, biological, and social world (Kast & Rosenzweig, 1985:103; Skyttner, 2005:59; Von Bertalanffy, 1969:55).

According to Skyttner (2005: 58 -59) it is important to keep in mind that something is only a system if there is a functional division and co-ordination of labour among the parts. This implies that the components have to be assembled in a certain way in order to build a system. Furthermore, a system is distinguished from its parts by its *organisation*. A random assembly of elements constitutes only a structureless mass unable to accomplish anything. Nor does an orderly assembly of elements necessarily form a system. The organisation of the atoms of a crystal does not qualify it to be a system. It is an end product in itself, one not performing any function.

To qualify for the name system, two conditions apart from organisation have to be present: *continuity of identity* and *goal directness*. Something that is not able to preserve its structure amid changes is never recognised as a system. Goal directedness is simply the existence of a function. The *structure* of a system is the arrangement of its subsystems and components in three-dimensional space at a certain moment in time. Systems differ from each other in the way they are organised, in the particular mechanisms and dynamics of the interrelations among the parts and with the environment. This may also be expressed as order in the relationship among the components that enter into a system.

In the past, traditional knowledge has been developed along well-defined subject matter lines. Von Bertalanffy (1969:55) suggests that the various fields of modern science have had a continual evolution toward a parallelism of ideas. This parallelism provides an opportunity to formulate and develop principles that hold for systems in general. In modern science, dynamic interaction is the basic problem in all fields, and its general principles will have to be formulated in General System Theory. General Systems Theory provides the broad macro view from which we may look at all types of systems.

According to Kast and Rosenzweig (1985:103), Skjottner (2005:63) and Von Bertalanffy (1969:55), there is a distinction between closed systems and open systems. Physical and mechanical systems can be considered as closed in relationship to their environment. On the other hand, biological and social systems are not closed but are in constant interaction with their environment. This view of biological and social phenomena as open systems has profound importance for the social sciences and organisation theory

According to Skyttner (2005: 62) an open system is always dependent upon an environment with which it can exchange matter, energy and information. Its main characteristic is its organisation that is controlled by information and fuelled by some form of energy. Other qualities are that they are selective and within certain limits, self regulating. Proceeding up in a hierarchy of system levels, the systems become more and more open when they engage in a wider interchange with a greater variety of aspects of the environment. More complex systems move toward growth and expansion when they tend to import more matter and energy than is required for the output. This should not be taken as a contradiction of their strive for dynamic equilibrium. The ever-existing dynamics makes a system understandable only over time.

Common characteristics of an open system have been defined by Katz and Kahn (in Skyttner, 2005:63) according to the following ten points:

- Importation of energy
- The throughput
- The output
- Cycles of events
- Negative entropy
- Information input and the coding process
- Equilibrium and dynamic homeostasis including adaptation
- Differentiation (elaboration, complexification)
- Integration and co-ordination
- Equifinality.

The ten points will be discussed in more detail in 3.2.3 and 3.2.4



### **3.2.2 The emergence of Systems Theory**

The emergence of the systems approach in the study of organisations is a reflection of an even broader theoretical development. General Systems Theory provides a basis for understanding and integrating knowledge from a wide variety of specialised fields. In complex societies with rapid expansion of knowledge, the various scientific fields become highly differentiated and specialised. In many scientific fields, the concentration over the past several decades has been on analytical, fact-finding, and experimental approaches in highly specific areas. This has been useful in helping to develop knowledge and to understand the details of specific but limited subjects. At some stage, however, there should be a period of synthesis, reconciliation, and integration, so that the analytical and fact-finding elements are unified into broader, multidimensional theories. There is evidence that every field of human knowledge passes alternately through phases of analysis and fact finding to periods of synthesis and integration. Systems Theory provides this framework in many fields-physical, biological, and social (Kast & Rosenzweig, 1985:103).

According to Kast and Rosenzweig (1985:104) the development and contagion of the modern systems perspective can be traced in part to the concern of several disciplines to treat their subject matter - whether the organism, the species, or the social group -as a whole, an entity in its own right, with unique properties understandable only in terms of the whole, especially in the face of a more traditional reductionistic or mechanistic focus on the separate parts and a simplistic notion of how these parts fit together.

The application of systems thinking has been particularly relevant to the social sciences. In sociology, Talcott Parsons led in the adoption of the general systems viewpoint. Parsons has fully utilised the open-systems approach for the study of social structures. He not only developed a broad social system framework but also related his ideas to the organisation.

According to Kast and Rosenzweig (1985:104-105) and Skyttner (2006:50) the systems approach has achieved prominence in the field of psychology. Specifically in the Gestalt school of thought. The word *gestalt* is German for configuration or pattern. The Gestaltists early adopted the concept of system, which is more than the sum of its components, and which determines the activity of these components. Kurt Lewin (in Kast and Rosenzweig, 1985:104-105) was among the first to apply the tenets of Gestalt psychology to the field of individual personality. He found that purely psychological explanations of personality were inadequate and that socio-cultural forces had to be taken into account. He viewed personality as a dynamic system, influenced by the individual's environment. Harry Stack Sullivan (in Kast and Rosenzweig, 1985:104-105), in his *Interpersonal Theory of Psychiatry*, went even further in relating personality to the socio-cultural system. He viewed the foundation of personality as an extension and elaboration of social relationships. A further extension of psychology to give greater consideration to broader interpersonal and social systems is seen in the rapidly expanding field of social psychology.

According to Kast and Rosenzweig (1985:104) modern economics has also increasingly used the systems approach. Equilibrium concepts are fundamental in economic thought, and the very basis of this type of analysis is consideration of subsystems of a total system. Economics is moving away from static equilibrium models

appropriate to closed systems toward dynamic equilibrium considerations appropriate to open systems.

This discipline of cybernetics is based on a systems approach. It is primarily concerned with communication and information flow in complex systems. Although cybernetics has been applied primarily to mechanistic engineering problems, its model of feedback, control, and regulation has a great deal of applicability for biological and social systems as well.

Another similar point of view permeating many of the social and physical sciences is the concept of holism-the view that all systems-physical, biological, and social-are composed of interrelated subsystems. The whole is not just the sum of the parts, but the system itself can be explained only as a totality. Holism is the opposite of elementarism, which views the total as the sum of its individual parts. The holistic view is basic to the systems approach. In traditional organisation theory, as well as in many of the sciences, the subsystems have been studied separately, with the view to later putting the parts together into a whole. The systems approach emphasizes that this is not possible and that the starting point has to be with the total system (Kast & Rosenzweig, 1985:104-105).

The foregoing discussion has attempted to show how the systems approach has become the operating framework for many physical and social sciences.

Psychologists, sociologists, anthropologists, economists, and political scientists have been "discovering" and using the system model. In so doing, they find intimations of an exhilarating "unity" of science, because the system models used by biological and physical scientists

seem to be exactly similar. Thus, some system theorists regard the system model as universally applicable to physical and social events, and to human relationships in small or large units (Chin, 1976:92).

### **3.2.3 Key concepts from General Systems Theory**

General concepts applicable to many different types of systems have been set forth by various writers (Ackoff, 1971; Berrien, 1968; Boulding, 1956; Buckley, 1968; Champion, 1975; Hall and Fagen, 1956; Miller, 1978; Shafritz and Ott, 1996; Van Gigch, 1978; Von Bertalanffy, 1968). They reflect a broad eclectic overview. The key concepts of General Systems Theory are the following.

#### *Subsystems or Components.*

A system by definition is composed of interrelated parts or elements. This is true for all systems-mechanical, biological, and social. Every system has at least two elements, and these elements are interconnected (Beer, 1980:17).

#### *Holism, Synergism, Organicism, and Gestalt.*

The whole is not just the sum of the parts; the system itself can be explained only as a totality. Holism is the opposite of elementarism, which views the total as the sum of its individual parts (Janov, 1994:120).

#### *Open Systems View.*

Systems can be considered in two ways: (1) closed or (2) open. Open systems exchange information, energy, or material with their environments. Biological and social systems are inherently open systems; mechanical systems may be open or closed. The concepts of open and closed systems are difficult to defend in the absolute. Open-closed can be

viewed as a dimension; i.e., systems are relatively open or relatively closed (Kast & Rosenzweig, 1985:105; Skyttner, 2006:62).

#### *Input-Transformation-Output Model.*

The open system can be viewed as a transformation model. In a dynamic relationship with its environment, it receives various inputs, transforms these inputs in some way, and exports outputs (Kast & Rosenzweig, 1985:105).

#### *System Boundaries.*

It follows that systems have boundaries that separate them from their environments. The concept of boundaries helps us understand the distinction between open and closed systems. The relatively closed system has rigid, impenetrable boundaries, whereas the open system has permeable boundaries between itself and a broader suprasystem. Boundaries are relatively easily defined in physical and biological systems but are *very* difficult to delineate in social systems such as organisations (Kast & Rosenzweig, 1985:105; Janov, 1994:127; Skyttner, 2006:64).

#### *Negative Entropy.*

Closed physical systems are subject to the force of entropy which increases until eventually the entire system fails. The tendency toward maximum entropy is a movement to disorder, complete lack of resource transformation, and death. In a closed system, the change in entropy must always be positive. However, in open biological or social systems, entropy can be arrested and may even be transformed into negative entropy - a process of more complete organisation and ability to transform resources. This is possible because in open systems, resources (material, energy, and information) utilised to arrest the entropy process, are imported from the external environment. The contrived, or social,

organisation, which can continue to import new human components and other resources in order to continue its functioning, may be capable of indefinitely offsetting the entropy process. However, the only way in which the organisation can offset entropy is by continually importing material, energy, and information in one form or another, transforming them, and redistributing resources to the environment. (Kast & Rosenzweig, 1981:51).

*Steady State, Dynamic Equilibrium, and Homeostasis.*

The concept of steady state is closely related to that of negative entropy. A closed system must eventually attain an equilibrium state with maximum entropy - death or disorganisation. An open system, however, may attain a state where the system remains in dynamic equilibrium through the continuous inflow of material, energy, and information. This is called a steady state.

The steady state for the open system, as contrasted to the closed system subject to entropy, occurs while the system can still maintain its functions and perform effectively. Under this concept, an organisation is able to adapt to changes in its environment and to maintain a continual steady state. Obviously, there are limits to the degree to which the social organisation can maintain a steady state in response to environmental changes. Massive environmental changes may be so great that it is impossible for the system to adapt. In such an instance the social organisation is disbanded.

An additional meaning of the steady state is that within the organisational system the various subsystems will achieve a balance of relationships and forces, which allows the total system to perform effectively. For social organisations, it is not an absolute steady state but rather a dynamic or moving equilibrium, one of continual adjustment to

environmental and internal forces. The social organisation will attempt to accumulate sufficient resources, which helps it to maintain its equilibrium and to mitigate some of the possible variations in the inflow and environmental requirements (Kast & Rosenzweig, 1981:51; Kast & Rosenzweig, 1985:106).

### *Feedback.*

The concept of feedback is important in understanding how a system maintains a dynamic equilibrium. Through the process of feedback, the system continually receives information from its environment, which helps it adjust. Feedback can be both positive and negative. For the purposes of analysing organisations the most important consideration is that of negative feedback. Negative feedback is informational input, which indicates that the system is deviating from a prescribed course, and should readjust to a new steady state. Feedback is of vital importance in complex organisations that must continually receive informational inputs from its environment. Management is involved in interpreting and correcting for this information feedback. This is a vital part of the organisational control function (Beer, 1980: 17; Kast & Rosenzweig, 1981:52).

### *Hierarchy.*

In general, all systems - physical, biological, and social can be considered in a hierarchical sense. A system is composed of subsystems of a lower order and is part of a supersystem. Thus, there is a hierarchy of the components in the system. Large organisations are almost universally hierarchical in structure. People are organised into groups; groups are organised into departments; departments are organised into divisions; divisions are organised into companies; and companies are part of an industry and economy.

The hierarchical structure is not only related to levels but is based upon the need for more inclusive clustering of subsystems into a broader system, in order to co-ordinate activities and processes. In complex organisations, there is a hierarchy of processes as well as structure (Kast & Rosenzweig, 1981:50; Kast & Rosenzweig, 1985:106).

*Growth through internal elaboration.*

In the closed system subject to the laws of physics, the system moves toward entropy and disorganisation. In contrast, open systems appear to have the opposite tendency and move in the direction of greater differentiation and a higher level of organisation. This same process appears to hold true for most social systems. There is a tendency for social systems to elaborate their activities and to reach higher levels of differentiation and organisation. An examination of certain attributes of complex organisations may help explain this tendency. Complex social organisations are made up of many subsystems, some of which have excess capacity or resources that create a continual pressure toward growth. Furthermore, social organisations will often try to encompass within their boundaries additional activities in order to limit uncertainties and to ensure their survival. The business organisation may use vertical integration in order to ensure a continual source of raw materials. The pattern of conglomerate diversification and mergers by many corporations in the United States is another indication of this process. In many cases, these mergers result from product innovation and technological breakthroughs that provide opportunities for the organisation to extend its boundaries into new areas. It may be attributed to an imbalance of managerial and technical skills that are seeking outlets for their activities and creativity. An indication of this elaboration has been the expansion of many of our large corporations into international activities, significantly increasing the boundaries of their operations.



There is also a tendency for complex organisations to achieve greater differentiation and specialisation among internal subsystems. The increased number of specialised departments and activities in complex business organisations is an example. The great proliferation of departments, courses, and subject matter in universities is another example of differentiation and elaboration (Kast & Rosenzweig, 1981:52).

#### *Multiple Goal Seeking.*

Biological and social systems appear to have multiple goals or purposes. Social organisations seek multiple goals, if for no other reason than that they are composed of individuals and sub-units with different values and objectives (Kast & Rosenzweig, 1985:106).

#### *Equifinality of Open Systems.*

In physical/mechanistic systems there is a direct cause and effect relationship between the initial conditions and the final state. Biological and social systems operate differently. The concept of equifinality suggests that final results may be achieved with different initial conditions and in different ways. This view suggests that the social organisation can accomplish its objectives with varying inputs and with varying internal activities. Social systems are not restrained by the simple cause and effect relationship of closed systems.

The equifinality of social systems has major importance for the management of complex organisations. The closed system cause and effect relationship adopted from the physical sciences would suggest that there is one best way to achieve a given objective. The concept of equifinality suggests that the manager can utilise different inputs into the organisation and can transform these in a variety of ways to achieve a satisfactory output. From this viewpoint, the management function is

one of having available a variety of satisfactory solutions to decision problems (Beer, 1980: 17; Kast & Rosenzweig, 1981:53).

Although all of these concepts have some relevance, several are particularly important in the study of organisation.

According to Skyttner (2006:62) the concept of boundaries helps us understand the distinction between open and closed systems. The closed system has rigid, impenetrable boundaries, whereas the open system has permeable boundaries between itself and a broader super system. The boundaries set the domain of the organisation's activities. In a physical, mechanical, or biological system the boundaries can be identified. In a social organisation, the boundaries are not easily definable and are determined primarily by the functions and activities of the organisation. Such an organisation is characterised by rather vaguely formed, highly permeable boundaries.

Many systems grow through internal elaboration. In the closed system, subject to the laws of physics, the system moves toward entropy and disorganisation. In contrast, open systems appear to have the opposite tendency and move in the direction of greater differentiation and a higher level of organisation. In biological organisms, there is continual elaboration that takes place through organic development and evolution. A transition toward states of higher order and differentiation seems to occur. The tendency toward increasing complication has been indicated as a primary characteristic of the living, as opposed to inanimate, nature.

According to Liyanage (2006: 13), this same process appears to hold true for most social systems. There is a tendency for them to

elaborate their activities and to reach higher levels of differentiation and organisation. There is a tendency for complex organisations to achieve greater differentiation and specialization among internal subsystems. The increased number of specialized departments and activities in complex business organisations is readily apparent. The great proliferation of departments, courses, and subject matter in universities is another example of differentiation and elaboration.

According to Katz and Kahn, (1978:36) equifinality is also an important characteristic of social systems. In physical systems there is a direct cause-and-effect relationship between the initial conditions and the final state. Biological and social systems operate differently.

The concept of equifinality says that final results may be achieved with different initial conditions and in different ways. This view suggests that the social organisation can accomplish its objectives with varying inputs and with varying internal activities. Thus, the social system is not restrained by the simple cause-and-effect relationship of closed systems.

The equifinality of social systems has major importance for the management of complex organisations. A closed-system cause-and-effect view adopted from the physical sciences would suggest that there is one best way to achieve a given objective. The concept of equifinality suggests that the manager can utilise a varying bundle of inputs into the organisation, can transform them in a variety of ways, and can achieve satisfactory output. Extending this view further suggests that the management function is not necessarily one of seeking a precise, optimal solution but rather one of having available a variety of satisfactory alternatives.

Organisations utilise many of the general concepts of General Systems Theory. However, it is important to recognise that there are significant differences among various types of systems. Social organisations are not natural like physical or biological systems; they are contrived. They have structure, but it is the structure of events rather than of physical components, and it cannot be separated from the processes of the system. The fact that human beings contrive social organisations suggests that they can be established for an infinite variety of objectives and do not follow the same life-cycle pattern of birth, maturity, and death as biological systems. According to Katz and Kahn (1978:37):

“Social structures are essentially contrived. People invent the complex patterns of behavior that we call social structure, and people create social structure by enacting those patterns of behavior. Many properties of social systems derive from these essential facts. As human inventions, social systems are imperfect. They can come apart at the seams overnight, but they can also outlast by centuries the biological organisms that originally created them. The cement that holds them together is essentially psychological, rather than biological. Social systems are anchored in the attitudes, perceptions, beliefs, motivations, habits, and expectations of human beings”.

Recognizing that the social organisation is a contrived system cautions us against making an exact analogy between it and physical or biological systems.

The foregoing are a few of the characteristics of open systems.

Attention will now be paid at the direct relationship between the systems approach and organisation theory.

### **3.2.4 Systems approach and organisation theory**

According to Kast and Rosenzweig (1985:103) traditional organisation theory used a highly structured, closed-system approach. Modern theory has moved toward the open-system approach. The historical roots of systems thinking related to organisation and management goes back many years. Mary Parker Follett, writing at the time of the classical management theorists, expressed many views indicative of a systems approach. She considered the psychological and sociological aspects of management, described management as a social process, and viewed the organisation as a social system.

According to Kast and Rosenzweig (1981:47) Herbert Simon and his associates viewed the organisation as a complex system of decision-making processes. Simon has ranged widely in seeking new disciplinary knowledge to integrate into his organisation theories. However, the one broad consistency in both his research and his writings has been the utilization of the systems approach. The term 'systems' is being used more and more to refer to methods of scientific analysis that are particularly adapted to the unraveling of complexity. He emphasizes the importance of the systems approach for the management sciences.

A professor of business administration, West Churchman (1971), has provided a further perspective on systems. According to Churchman (in Skyttner, 2006: 53) the characteristics of a system are the following:

- It is teleological (purposeful).
- Its performance can be determined.

- It has a user or users.
- It has parts (components) that in and of themselves have purpose.
- It is embedded in an environment.
- It includes a decision maker who is internal to the system and who can change the performance of the parts.
- There is a designer who is concerned with the structure of the system and whose conceptualisation of the system can direct the actions of the decision maker and ultimately affect the end result of the actions of the entire system.
- The designer's purpose is to change a system so as to maximise its value to the user.
- The designer ensures that the system is stable to the extent that he or she knows its structure and function.

According to Kast and Rosenzweig (1985:104) sociologist George Homans used systems concepts as the basis for his empirical research on social groups. He developed a model of social systems that is appropriate for small groups and for large organisations. In his view, an organisation is comprised of an external environmental system and an internal system of relationships that are interdependent. There are three elements in a social system. *Activities* are the tasks that people perform. *Interactions* occur between people in the performance of these tasks, and *sentiments* develop between people. These elements are mutually reinforcing; i.e., joint activities lead to interactions and common sentiments.

According to Kast and Rosenzweig (1985:104) and Skyttner (2006:366), Philip Selznick used structural functional analysis and the systems approach in his studies of organisations. The institutional leader is concerned with the adaptation of the organisation to its external systems. The organisation is seen as a dynamic system, constantly

changing and adapting to internal and external pressures, and is in a continual process of evolution. Organisations are seen as cooperative systems constituted of individuals interacting as wholes in relation to a formal system of coordination. The concrete structure is therefore a resultant of the reciprocal influences of the formal and informal aspects of organisation. Furthermore, this structure is itself a totality, an adaptive 'organism' reacting to influences upon it from an external environment.

According to Kast and Rosenzweig (1985:104-105) and Skyttner (2006:362) the organisational researchers at the Tavistock Institute of Human Relations have viewed the organisation as a socio-technical system with a structuring and integration of human activities around various technologies toward the accomplishment of certain goals. Burns and Stalker have also made substantial use of systems views in setting forth their concepts of mechanistic and organic managerial systems.

According to Kast and Rosenzweig (1981:47) and Skyttner (2006:362) the systems approach has also been adopted by social psychologists as a basis for studying organisations. Using open Systems Theory as a general conceptual scheme, Katz and Kahn present a comprehensive theory of organisation (1978). They suggest that the psychological approach has generally ignored or has not dealt effectively with the facts of structure and social organisation, and they use systems concepts to develop an integrated model.

According to Skyttner (2006:366) the starting point for contingency theory is that organisations are open systems. As such, the exchange with the environment is of basic importance when understanding them. This theory presumes that organisational structures are neither freely

chosen, nor incidental. Instead, they are developed under the influence of external demands, size and above all, technology. The aim of contingency theory is to show that under given assumptions, certain types of organisational design are more efficient than others and give better adaptability. Design parameters or contingencies of great importance (also called classic contingency variables) are:

- organisational strategy
- organisational size
- organisational technology
- organisational environment

The organisations need to adapt their structure to these contingency factors. The situational imperative states that in reality there is no strategic choice. Relationships between the contingency of strategy and the structure of divisionalisation, between size and bureaucratisation, between environmental uncertainty and organic are generally valid. The general theory also relates organisational size and overall standardisation and formalisation positively.

Formalisation is the extend to which the specific structure seeks to regulate employee behaviour. This is done through written job definitions, manuals of procedure, written communications and written records of role performance. Organisational challenges and demands are often conflicting and it is not possible to satisfy all of them. A common solution is to compromise, something which is not especially inspiring for the involved parties but many times gives rise to stable solutions.

These examples of the trend toward adapting the systems approach to modern organisation theory and management practice are by no means exhaustive; they merely illustrate recent developments. They



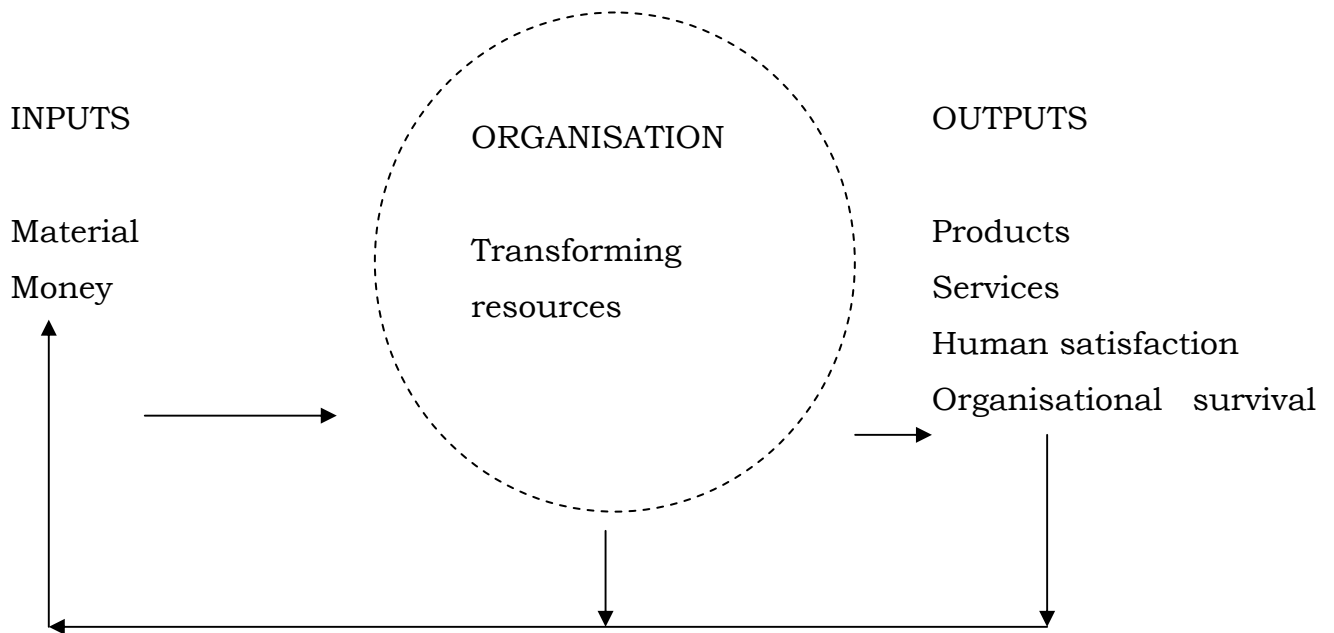
indicate the increasing attention being given to the study of organisations as complex systems.

Systems Theory provides a paradigm for the study of organisations and their management, a basis for thinking of organisations as open systems in interaction with their environment. It also helps us understand the interrelationships between the major components of an organisation - its goals, technology, structure, and psychosocial relationships. It provides frame of reference for managerial practice.

### **3.2.5 Organisation as an open system**

According to Kast and Rosenzweig (1985:112-113), Katz and Kahn (1966:284), Liyanage, (2006:13), Skyttner, (2006:62) the organisation can be considered in terms of a general open-system model, as illustrated in Figure 1. The open system is in continual interaction with its environment and achieves a "steady state" or dynamic equilibrium while retaining the capacity for work or energy transformation. The survival of the system, in effect, would not be possible without continuous inflow; transformation, and outflow. In the biological or social system this is a continuous recycling process. The system must receive sufficient input of resources to maintain its operations and to export the transformed resources to the environment in sufficient quantity to continue the cycle.

**Figure 1: Input Output Model**



For example, the business organisation receives inputs from the society in the form of people, materials, money, and information; it transforms these into outputs of products, services, and rewards to the organisational members sufficiently large to maintain their participation. For the business enterprise, money and the market provide a mechanism for recycling of resources between the firm and its environment. The same kind of analysis can be made for all types of social organisations.

It is important to recognise that the concept of open or closed is a matter of degree. In an absolute sense, all systems are open or closed, depending on the point of reference. Thus, all systems are "closed" in some degree from external forces. The system's boundaries always

prevent *some* environmental factors from affecting the system; it provides for selective inputs.

### **3.2.6 An Integrated Systems view of organisations**

According to Beer (1980:18-21), Janov (1994:127-129), Kast and Rosenzweig (1985:112-113), Katz and Kahn (1966:284) and Liyanage, 2006: 13) the organisation can be viewed as an open, sociotechnical system composed of a number of subsystems, as illustrated in Figure 2 (see page 60). Under this view, an organisation is not simply a technical or a social system. Rather, it is the structuring and integrating of human activities around various technologies. The technologies affect the types of inputs into the organisation, the nature of the transformation processes, and the outputs from the system. However, the social system determines the effectiveness and efficiency of the utilisation of the technology.

The internal organisation can be viewed as a composed of several major subsystems. The organisational **goals and values** are one of the more important of these subsystems. The organisation takes many of its values from the broader sociocultural environment. A basic premise is that the organisation as a subsystem of the society must accomplish certain goals that are determined by the broader system. The organisation performs a function for society, and if it is to be successful in receiving inputs, it must conform to social requirements (Beer, 1980:18-21; Janov, 1994:127-129; Kast & Rosenzweig, 1985:112-113; Katz & Kahn, 1966:284; Liyanage, 2006: 13).

The **technical** subsystem refers to the knowledge required for the performance of tasks, including the techniques used in the transformation of inputs into outputs. It is determined by the task

requirements of the organisation and varies depending on the particular activities. The technology for manufacturing automobiles differs significantly from that used in an oil refinery or an electronics company. Similarly, the task requirements and technology in a hospital are different from those in a university. The technical subsystem is shaped by the specialization of knowledge and skills required, the types of machinery and equipment involved, and the layout of facilities. The technology affects the organisation's structure as well as its psychosocial subsystem (Beer, 1980:18-21; Janov, 1994:127-129; Kast & Rosenzweig, 1985:112-113; Katz & Kahn, 1966:284; Liyanage, 2006: 13).

Every organisation has a **psychosocial** subsystem that is composed of individuals and groups in interaction. It consists of individual behavior and motivation, status and role relationships, group dynamics, and influence systems. It is also affected by sentiments, values, attitudes, expectations, and aspirations of the people in the organisation. These forces set the "organisational climate" within which the human participants perform their roles and activities. We would therefore expect psychosocial systems to differ significantly among various organisations. Certainly, the climate for the person on the assembly line is different from that of the scientist in the laboratory or the doctor in the hospital (Beer, 1980:18-21; Janov, 1994:127-129; Kast & Rosenzweig, 1985:112-113; Katz & Kahn, 1966:284; Liyanage, 2006: 13).

**Structure** involves the ways in which the tasks of the organisation are divided (differentiation) and coordinated (integration). In the formal sense, structure is set forth by organisation charts, by position and job descriptions, and by rules and procedures. It is also concerned with patterns of authority, communication, and workflow.

The organisation's structure provides for formalization of relationships between the technical and the psychosocial subsystems. However, it should be emphasized that this linkage is by no means complete and that many interactions and relationships occur between the technical and psychosocial subsystems that bypass the formal structure (Beer, 1980:18-21; Janov, 1994:127-129; Kast & Rosenzweig, 1985:112-113; Katz & Kahn, 1966:284; Liyanage, 2006: 13).

The *managerial* subsystem spans the entire organisation by relating the organisation to its environment, setting the goals, developing comprehensive, strategic, and operational plans, designing the structure, and establishing control processes (Beer, 1980:18-21; Janov, 1994:127-129; Kast & Rosenzweig, 1985:112-113; Katz & Kahn, 1966:284; Liyanage, 2006: 13).

Figure 2 (see page 60) provides one way of viewing the organisation. The goals and values, as well as the technical, structural, psychosocial, and managerial sub-systems are shown as integral parts of the overall organisation.

### **3.2.7 Systems view of the innovation process**

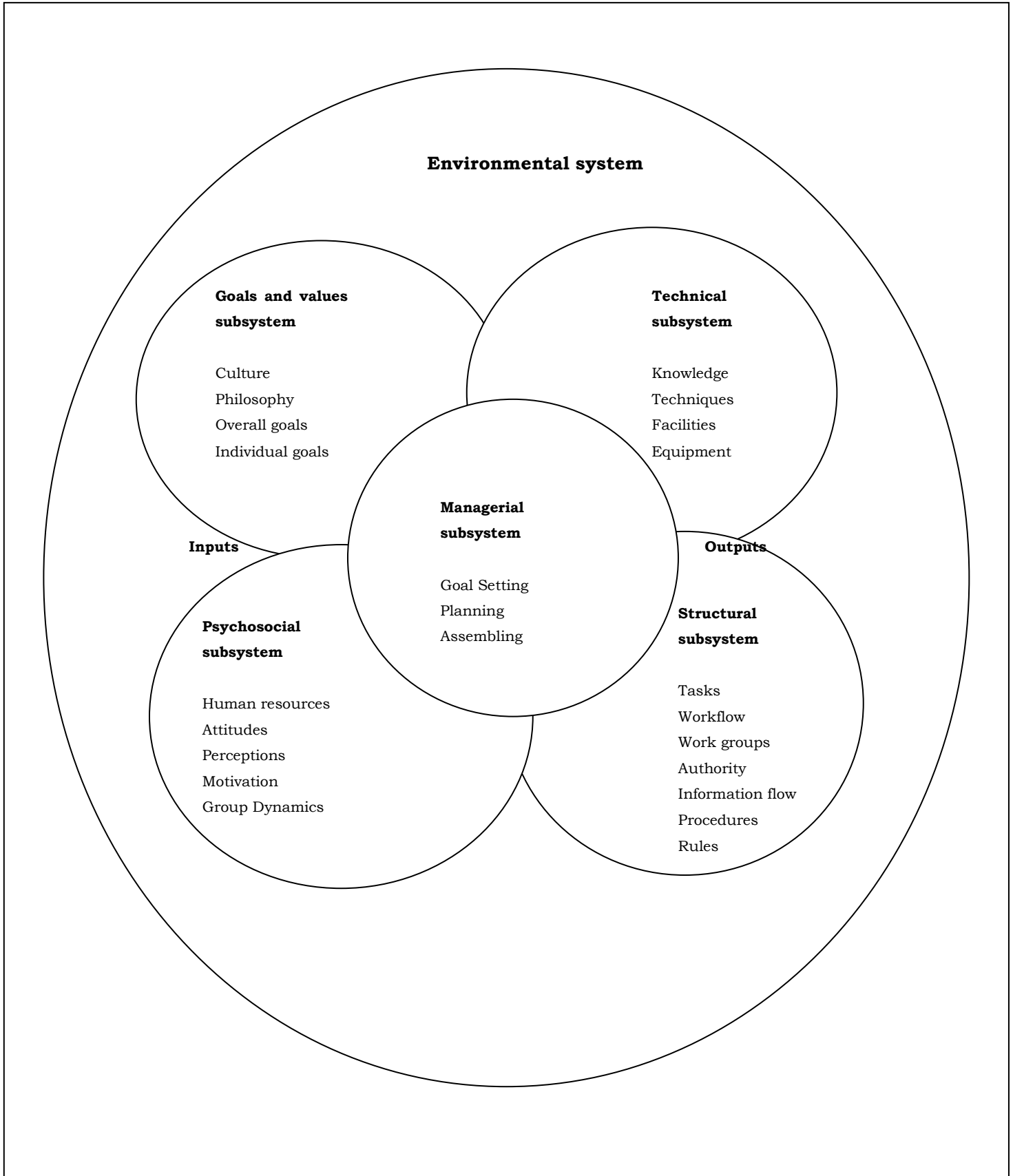
Innovation consists of a set of processes carried out at micro level, by individuals and groups of individuals; and these micro processes are in turn stimulated, facilitated, and enhanced-or the opposite-by a set of macro-structural conditions. Overall, the common organisational threads behind innovation are breath of reach, flexibility of action, and above all, integration between those with pieces to contribute, whether inside or outside a single organisation. An alignment of culture of operations and organisation's specific routines and procedures contributes to the internal and external acquisition of resources in building capacity. None

of these processes can be viewed in isolation, and they are interconnected and interrelated. Thus, innovation is a result of system dynamics and operations and links to the system's philosophy. The basic premise for systems thinking was the consideration of a system consisting of sets of components that work together for the overall objective of the whole. The whole is more than the sum of its parts was the underlying philosophy of systems thinking (Liyanage, 2006: 11).

The concept of systems theory is useful in the explanation of innovation for several reasons. The knowledge, organisation, people, and strategy are an ensemble of components, and the relationships among them are simply a way of thinking about these components and the relationship as a whole. The system will function if a sufficient proportion of the components, actors, and relationships perform with an adequate degree of effectiveness and consistency. In Systems Theory it is important to look at the whole. This approach is critical in an examination of innovation because of interrelation and extended value chains of innovation beyond the firm's boundaries. Innovation is a synthesis of components and their interactions across several individuals and organisations. The connectedness and synthesis of various ideas are essential for the progress of innovation functions such as the generation of knowledge, production and manufacturing, and marketing and sales (Liyanage, 2006:11-12).



**Figure 2: Integrated Systems Theory View of Organisations**



### **3.2.8 Innovation systems and General Systems Theory**

Innovation functions proceed through different stages of development and often receive inputs from a variety of internal and external sources. These stages involve the continuous renewal of knowledge and understanding of inventive steps and the acquisition of dynamic capabilities and resources. Innovation often thrives as a result of both internal and external conditions that sustain knowledge, understanding, and effective action. In this sense, the entire innovation process exhibits complex system characteristics. The important elements that determine innovation in a system include the following considerations:

1. Innovative environment.
2. Existence of defined boundaries of the system and its components.
3. Existence of inputs and outputs into the system.
4. State of a system and availability of functions and processes.
5. Ability to connect with different functions and system components.
6. Hierarchy of activity in the system.
7. Presence of a goal directed and strategic purpose.

What makes systems thinking appropriate for the process of innovation? Innovation is essentially multidisciplinary, involving interactions and a convergence of various skills, competencies, and disciplinary inputs. There are several subsystems within the innovation process and its organisation. The subsystems that support the innovation processes are resources, knowledge, capabilities and relationships. General Systems Theory, through the convergence of different disciplines, can explain the complex interactions and



relations. The basic principle is analogous to combining the individual sciences and bringing all knowledge closer to a unity of science forming holistic, teleological, synthetic, and cross-conceptual thinking. Innovation also proceeds through the complementary activities of several stakeholders and actors. It is also about building value across internal and external actors involved in a firm's growth. The complementarity of systems components paves the way for understanding complex phenomena using more than one perspective. This is an essential characteristic of innovation that forms the foundation for critical systems thinking. The operational functions and methods in the innovation process follow the systems methodology along a specific development path (Liyanage, 2006:12). The important structural and process characteristics between Systems Theory and innovation systems concepts are outlined in Table 1.

Systems thinking, however, need to be considered in relation to non-formal knowledge that resides in social structures. In the innovation process, people can exercise conscious choices and can make rational decisions in selecting innovative imperatives. Not all innovation functions will be accepted as socially desirable. Innovation systems have the characteristics of refutability, disorder, instability, and difficulty of sustaining or maintaining it over long periods. Therefore, the application of systems thinking in innovation process must be regarded as having characteristics of both open (exchanging matter with their environments) and closed (able to be manipulated by logically closed theoretical models) systems (Liyanage, 2006: 13).

**Table 1: Systems characteristics of the innovation system**

<b>System Characteristics</b>	<b>Innovation Systems</b>
Systems environment and existence of boundary	The process and network characters of innovation – boundaries are defined in terms of fields of sciences and socio-economic objectives
System inputs and outputs	Inputs at various stages; financial and labour inputs and outcomes and impact indicators – often refers to subsystems such as knowledge; patenting activity; product process development
State of the system – reaching equilibrium and the presence of system functions and processes	Existence of ideal conditions for innovation, process characteristics by technological trajectories and guideposts
Goal-directed behavior and systems hierarchy	Existence of market pull, technological push conditions of innovation; outcome drives, the existence of uncertainty and chance processes. There is an order of hierarchy – some activities must be conducted before proceeding to the next stage.
Flow of information – open systems	Flow of knowledge; reciprocity and reflective action through learning and change

	management; deal with multiple objectives
Adaptive and complexity	Adaptive and connects with systems components; link between knowledge, people, strategy, and organisation – existence of network characteristics; involves risk and decision management points
Stable and dynamic systems	Complexity grows as knowledge intensity of innovation

(Liyanage, 2006: 14)

Attention will now be given to the different aspects that make up innovation. These range from individual characteristics, work structures, organisational culture to external influences

The different aspects that make up innovation are not discussed under the subsystems (goals and values subsystem, psychosocial subsystem, technical subsystem, structural subsystem, and managerial subsystem) of Systems Theory. Such a discussion will make it simpler but it will be an oversimplification of the innovation process. Rather innovation is made up of a combination of the elements of the different subsystems of Systems Theory. At the beginning of each aspect of the innovation process that will be discussed, it will be indicated which subsystem/s of Systems Theory is involved.

### **3.3 Qualities of individuals that influence creativity**

#### **3.3.1 Qualities of problem solvers that promote creativity**

The qualities of problem solvers that promote creativity are part of the psychosocial subsystem of Systems Theory.

Amabile (1998: 82-87; 1990: 236-237) Burnside (1990: 268-269), Gluckman and Liyanage, (2006:161-162), Janssen, Van De Vliert and West (2008:129-145) and West (1997:15) have identified the following qualities of problem solvers that promote creativity:

- Various personality traits: qualities in the personality of the problem solver, including persistence, attention to detail and conscientiousness, curiosity, energy, and intellectual honesty.
- 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 commitment to the idea.
- Special cognitive abilities: special talents in the problem solver's particular field, as well as general problem solving abilities and tactics for creative thinking.
- Expertise in the area: talent, experience, and acquired knowledge in the particular field.
- Risk orientation: unconventional, attracted to challenge, oriented toward risk taking and doing things differently.
- Qualities of the group: synergy arising from the intellectual, personal, and social qualities of individuals making up the project team.
- Diverse experience: broad general knowledge and experience in a wide range of domains.

- Social skill: good social and/or political skills, good rapport with others, being a good listener and a good team player, and being broadminded or open to others' ideas.
- Brilliance: a high level of general intelligence.
- Naiveté: being naive or new to the field, not biased by preconceptions or bound by old ways of doing things.

### **3.3.2 Qualities of problem solvers that inhibit creativity**

The qualities of problem solvers that inhibit creativity are part of the psychosocial subsystem of Systems Theory.

Amabile (1998: 82-87; 1990: 236-237) and Burnside (1990: 268-269) have also identified the qualities of problem solvers that inhibit creativity

- Unmotivated: lack of motivation for the work, not being challenged by the problem, having a pessimistic attitude towards the likely outcome; complacent, lazy.
- Unskilled: lack of ability or experience in the problem area.
- Inflexible: being set in one's own ways, opinionated, unwilling to do things differently, too constrained by one's education or training.
- Externally motivated: being motivated primarily by money, recognition, or other factors aside from the work itself, responding primarily to restrictions and goals set by others, being competitive and jealous of someone else's success.
- Socially unskilled: lack of social or political skills, such as being a poor team player.

### **3.4 A model of individual creativity**

The discussions of points 3.4 to 3.4.3 are all aspects that are part of the psychosocial subsystem and managerial subsystem of Systems Theory.

According to Amabile (1990: 238), the list of 10 personal qualities that promotes creativity and the list of 5 personal qualities inhibiting creativity can be viewed as a complete set of personal factors influencing creativity in an organisational setting. Using the personal qualities that promote/inhibit creativity she developed a model of individual creativity that was designed to account for several well-established phenomena: the importance of talents, education, cognitive skills, interest patterns, and personality dispositions, all functioning interactively to influence creative behaviour, as well as a motivational state marked by both deep involvement and intellectual playfulness. The model outlines three major components necessary for individual creativity in any particular domain: domain-relevant skills, creativity-relevant skills and intrinsic task motivation.

#### **3.4.1 Domain-relevant skills**

According to Amabile (1990:238) and Styhre and Sundgren (2005:74) these skills are the basis from which any performance must proceed. Domain-relevant skills include factual knowledge, technical skills and special talents in the domain in question. They comprise an individual's complete set of response possibilities - response possibilities from which the new response is to be synthesised and information against which the new response is to be judged. This component can be viewed as the set of cognitive pathways for solving a given problem or doing a given task. Some of the pathways are more common, well-practised, or obvious than others, and the set of pathways may be large or small. The larger the set,

the more numerous the alternatives available for producing something new, for developing a new combination of steps.

A number of personal qualities that can be grouped as elements within this component of domain-relevant skills are the positive characteristics of expertise in the specific area, brilliance and special cognitive abilities, and (in opposite form) - the negative characteristic of being unskilled. Broadly conceived, this component includes familiarity with and factual knowledge of the domain in question: facts, principles, attitudes towards various issues in the domain, knowledge of paradigms, performance scripts for solving problems in the domain and aesthetic criteria.

Domain relevant-skills constitute the individual's 'raw materials' for creative productivity. Domain relevant-skills appear to depend on innate cognitive, perceptual and motor abilities, as well as on formal and informal education in the domain of endeavour (Amabile, 1990: 238-239).

### **3.4.2 Creativity-relevant skills**

Amabile (1998:80), Styhre and Sundgren (2005:74) and White and Bruton (2007:108) states that creative individuals can have a tremendous impact on innovativeness in organisations. Assuming that an individual has some incentive to perform an activity, performance will be 'technically good' or 'adequate' or 'acceptable' if the requisite domain-relevant skills are present. However, even with these skills at an extraordinarily high level, an individual may not produce creative work if creativity-relevant skills are lacking. Creativity-relevant skills include a cognitive style favourable to taking new perspectives on problems, an application of heuristics for the exploration of new cognitive pathways, and a working style conducive to a persistent, energetic pursuit of one's

work. The positive personal qualities that would fall within creativity-relevant skills are the various personality traits (persistence, curiosity, energy, and intellectual honesty), risk orientation, qualities of the group, diverse experience, social skills, naiveté, and special cognitive abilities. The negative personal qualities include (in opposite form) in this component inflexibility and lack of social skill.

According to Amabile (1998: 80; 1990: 239-240) and Burnside (1990:269-270) the cognitive-perceptual style most conducive to creativity appears to be characterised by a facility in understanding complexities and an ability to break a mental sets during problem solving.

The creativity-relevant skill component also includes knowledge of heuristics for generating novel ideas. A heuristic can be defined as "any principle or device that contributes to a reduction in the average search to solution, reduction over any blind or random process. Thus, a heuristic may be considered a general strategy that can be of aid in approaching problems or tasks.

The component of creativity-relevant skills also includes a work style conducive to creativity. For example, an ability to concentrate effort for long periods of time, along with an ability to use 'productive forgetting' - the ability to abandon unproductive search strategies and temporarily put aside stubborn problems.

According to Amabile (1998:80) and Burnside (1990: 269-270) creativity-relevant skills dependent on the following personality characteristics: independence, self-discipline, an ability to delay gratification, perseverance in the face of frustration, and an absence of conformity in thinking and not dependent on social approval. In addition, though,



creativity-relevant skills depend on training (through which it may be explicitly taught) or simply on experience with idea generation, through which an individual may devise his or her own strategies for creative thinking.

### **3.4.3 Intrinsic task motivation**

According to Amabile (1990:241), Styhre and Sundgren (2005:75) among the personal qualities that enhance creativity, self-motivation is second only to the collection of various personality traits (persistence, curiosity, energy, and intellectual honesty). Of the five personal qualities that inhibit creativity, two concern motivation: being unmotivated and being externally motivated. Motivation of problem solvers accounts for a great deal of the difference between successful and unsuccessful attempts at creativity.

To some extent, a high degree of proper motivation *can* make up for deficiency in domain-relevant skills or creativity-relevant skills. Task motivation makes a difference between what an individual *can* do and what one *will* do. The former depends on the level of domain-relevant skills and creativity-relevant skills. But it is task motivation that determines the extent to which domain-relevant skills and creativity-relevant skills are fully and appropriately engaged in the service of creative performance.

There is another reason for the importance of the motivational component in individual creativity. Task motivation appears to depend strongly on work environment; it may vary not only from one domain to another but from one task to another within a domain, depending on the work environment. Thus, motivation may simply be the most straightforward component to address in attempts to stimulate creativity.

Relatively subtle changes in the work environment can make possible substantial increases in individual creativity.

According to Amabile (1990:241) and Styhre and Sundgren (2005:75) task motivation includes two elements: the individual's baseline attitude toward the task, and the individual's perceptions of his or her reasons for undertaking the task in a given instance. A baseline attitude toward the task is simply the person's natural inclination toward or away from activities of that sort.

The second element of task motivation according to Amabile (1990:241) and Styhre and Sundgren (2005:75), is the individual's perception of his or her reasons for undertaking the task in a given instance. Perceptions of one's own motivation appear to depend largely on external social and environmental factors - the presence or absence of salient extrinsic constraints in the work environment. Extrinsic constraints are external factors intended to control or seen as controlling the individual's performance on the task in a particular instance. As such, the constraint is extrinsic to the work itself; it is not an essential feature of task performance, but the social environment introduces it. A salient extrinsic constraint is one whose controlling implications are clear to the individual during task engagement. The negative impact of extrinsic motivators are: being motivated primarily by money, recognition, or other factors aside from the work itself, responding primarily to restrictions and goals set by others, being competitive and jealous of someone else's success.

In addition to external constraints, internal factors, such as a person's ability to cognitively minimise the salience of such extrinsic constraints or turn them into personal challenges, might also influence the self-perception of motivation. The final level of task motivation in a particular

instance thus varies from the baseline level of intrinsic motivation as a function of extrinsic constraints that may be present in the situation and the individual's strategies for dealing with these constraints (Amabile 1990:241; Styhre and Sundgren, 2005:75).

According to Amabile (1990:241) over the past few years, a number of studies have shown that extrinsic constraints in the work environment can indeed undermine individual creative performance. They have demonstrated the negative impact of constraints as varied as evaluation, surveillance, reward, competition, and restricted choice (e.g., Amabile, 1979; 1982; Amabile & Gitomer, 1984; Amabile, Goldfarb & Brackfield, 1982; Hennessey, & Grossman, 1986; Koestner, Ryan, Bernieri, & Holt, 1984; McGraw & McCullers, 1979). Thus, any of a wide variety of extrinsic constraints will, by impairing intrinsic motivation, have detrimental effects on creative performance.

### **3.5 Qualities of work environments that influence creativity**

#### **3.5.1 Qualities of work environments that promote creativity**

The qualities of work environment that promote creativity contain elements from the goals and values subsystem, psychosocial subsystem, technical subsystem, structural subsystem and the managerial subsystem of Systems Theory.

Amabile (1998: 82-87; 1990: 244-245), Bean and Radford (2002:69-71), Burnside (1990: 265-271), Ekvall (1991:71-75), Janssen, Van De Vliert and West (2008:129-145), King and Anderson (2002:50), The Harvard Business Essentials Series (2003: 85-95) and Trott (2008:80-90) have identified several qualities of the work environment that promotes creative behaviour. These are:

- Freedom: freedom in 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 of a project.
- Good project management: a manager who serves as a good role model, is enthusiastic, has good communication skills, protects the project team from outside distractions and interference, matches tasks to workers' skills and interests, and sets a clear direction without managing too tightly. Immediate supervisors/managers are a crucial party in the social work environment that can make or break innovative ideas of employees. In the authority ranking relationship, an innovative employee depends on his or her supervisor for the information (data, expertise, political intelligence), resources (materials, space, time), and socio-political support (endorsement, legitimacy, backing) necessary to further develop, protect, and implement the innovation-in-progress. Previous research by Axtell et al. (in Janssen, Van De Vliert & West, 2008:133-134) indeed suggested that an effective implementation of innovative ideas generated by innovative employees depend on a supportive supervisory style. Based on the achievement goal theory and research, the type of goals supervisors/managers tend to adopt in work situations might influence how they approach, interpret, and respond to innovative ideas voiced by employees. According to Janssen, Van De Vliert and West (2008:133-134) supervisors/managers with a mastery orientation strive to develop their competence, skills, and ability. Given this focus, innovative ideas voiced by employees should be of interest because these ideas provide supervisors not only with valuable information about emerging work-related problems identified by innovative employees but also with creative concepts for the

resolution of these problems. Mastery-oriented supervisors/managers may tend to utilise those sources of information and solutions to adapt to problems or opportunities emerging in their domain of responsibility. As such, supervisors/managers with a mastery orientation seek to learn from innovative employees in order to safeguard their goal of improving ability and skill. In contrast, supervisors/managers with a performance orientation strive to demonstrate their superiority in competence towards subordinate employees. Given this focus, superiority-oriented supervisors/managers tend to perceive innovative employees as a threat because their ideas for change make problems and irregularities in the workplace manifest for which they as supervisors/managers can be held accountable. Moreover, when subordinate employees generate creative ideas for adjusting to these problems, it might seem that their intelligence and ability are superior to those of the supervisor/manager. Consequently, supervisors/managers with a performance orientation have interests in disqualifying innovative ideas voiced by employees in order to uphold their goal of demonstrating superior competence. Conclusively, innovative employees are likely to gain more profits and to pay less cost when their supervisors approach and manage their innovative ideas from a mastery orientation rather than a performance orientation.

- Sufficient resources: access to necessary resources, including facilities, equipment, information, funds and people.
- Encouragement: management enthusiasm for new ideas, creating an atmosphere free of threatening evaluation.
- Various organisational characteristics: a mechanism for considering new ideas, a corporate climate marked by co-operation and

collaboration across the levels and divisions, an atmosphere where innovation is prized and failure is not fatal.

- Recognition: a general sense that creative work will receive appropriate feedback, recognition, and reward.
- Sufficient time: time to think creatively about the problem, to explore different perspectives rather than having to impose an already determined approach.
- Challenge: a sense of challenge arising from the intriguing nature of the problem itself or its importance to the organisation (internalised by the individual as a personal sense of challenge).
- Pressure: a sense of urgency that is internally generated from competition with outside organisations, or from a general desire to accomplish something important.

### **3.5.2 Qualities of work environments that inhibit creativity**

The qualities of work environment that inhibit creativity contain elements from the goals and values subsystem, psychosocial subsystem, structural subsystem and the managerial subsystem of Systems Theory.

King and Anderson (2002:50), Amabile (1998: 82-87; 1990: 244-245) and Burnside, (1990: 265-271) have also identified the qualities in the work environment that inhibit creative behaviour.

- Various organisational characteristics: inappropriate reward systems in the organisation; excessive red tape; a corporate climate marked by a lack of co-operation across divisions and levels, little regard for innovation in general.
- Constraint: lack of freedom in deciding what to do or how to accomplish tasks, lack of sense of control over one's own work and ideas.

- Organisational disinterest: a lack of organisational support, interest, or faith in a project; a perceived apathy toward any accomplishments coming from the project.
- Poor project management: manager unable to set clear direction, manager with poor technical or communication skills, manager who controls too tightly or allows distractions and fragmentation of the team's efforts.
- Evaluation: inappropriate or inequitable evaluation and feedback systems, unrealistic expectations, an environment focused on criticism and external evaluation.
- Insufficient resources: a lack of appropriate facilities, equipment, materials, funds, or people.
- Time pressure: insufficient time to think creatively about the problem; too great a workload within an unrealistic time frame; high frequency of "fire-fighting".
- Overemphasis on the Status Quo: reluctance of managers or co-workers to change their way of doing things; an unwillingness to take risks.
- Competition: interpersonal or intergroup activity within the organisation, fostering a self-defensive attitude.

### **3.6 The delicate balance**

The following discussion of 3.6 contains aspects of the managerial subsystem, structural subsystem and the psychosocial subsystem of Systems theory.

Not surprisingly, there are several pairs of clear opposites on the lists of creativity promoters and creativity inhibitors (for instance freedom and constraint). Freedom is the most prominent environmental promoter of

creativity, and constraint is the second most prominent environmental inhibitor of creativity. Several other pairs of opposites are apparent. A good project manager is skilled technically and socially, and can successfully protect the project team. The poor manager is unskilled and allows distractions or fragmentation of the team's efforts. Co-operation and collaboration among different areas of the organisation mark good organisational climate; poor organisational climate is marked by the absence of these factors. In addition, while sufficient time and sufficient resources serve as stimulants to creativity, insufficient time and insufficient resources serve as obstacles (Amabile, 1990: 258).

Despite the presence of these pairs of clear opposites, not all of the elements in these lists of environmental factors are quite so straightforward. The appropriate management climate for creativity involves setting a delicate balance in several arenas. Goal setting provides the most striking example. Project managers can stifle creativity if their goal setting is either too loose or too tight. If they fail to provide a clear direction for the project as a whole, if they fail to carefully conceptualised and communicate the overall mission, members of the project team may make fragmented and disjointed efforts (at best) or may fail to make any difference at all (at worst). On the other hand, if project managers attempt to manage too tightly at the procedural level- the day-to-day carrying out of specific tasks-team members may become demotivated and their efforts may be uninspiring rote responses. The delicate goal setting balance that the manager needs to achieve is a balance between co-ordination and freedom.

Reward systems also require a balancing act. If employees feel that every move they make is tied to bonuses, awards, salary increases, or promotions, they are unlikely to take risks in trying out new ideas. On the other hand, if there are no rewards for creative efforts, employees



may feel that creativity is not valued by the organisation. The trick is to establish a reward system that generously and equitably recognises and rewards good work (a good effort as well as a good outcome) after it has been produced, without holding out salient rewards as carrots for each phase of each task. If people work in an organisation where they have seen creative efforts rewarded in the past, they will feel that there is a value placed on creativity, and that their own work will be rewarded equitably when the time comes (Amabile, 1990: 257).

Evaluation is a similar issue. Evaluation pressure, where people feel threatened by unfavourable performance reviews for failures, can lead to extremely low levels of risk taking and, as a result, low levels of creativity. On the other hand, people do need to feel that attention is being paid to their work, that management cares about it enough to find out what is going on, and to give constructive feedback. The nature and timing of the feedback are crucial. If employees only find out how they are doing once or twice a year in very formal performance appraisal settings, creativity is likely to be undermined. If, however there is a constant, constructive, less formal exchange of information about a project's progress on part of all team members and management, evaluation can be seen as useful and supportive.

Pressure presents perhaps the most interesting set of factors to balance. On the list of inhibitors to creativity, we find time pressure and competition (which is another form of pressure). But competition also appears on the list of creativity promoters, as one of a few pressure sources that can actually stimulate creativity; time pressure appears here, too. It appears that a balanced amount of pressure is appropriate to creativity. If there is no sense of time the urgency, people may feel that their project is unimportant. If time pressure is too great, it may force people to take the simplest, most unimaginative route. If competition is

perceived as threatening, as is often the case with in-group competition, creativity will tend to be affected negatively. However, positive effects on creativity can result if competition with an outside group or corporation pulls the team closer together. Under these circumstances, the competition may just add to the positive tension of challenge (Amabile, 1990: 256-258).

### **3.7 The structural, collective, and social conditions for innovation in organisations**

Thus far, most of the emphasis was on the micro processes and individual characteristics of individuals that facilitate/inhibit creativity. The emphasis is now shifted to the macro-structural that influence creativity. Although innovation consists of a set of tasks carried out at the micro level by individuals and groups of individuals within an organisation, these micro processes are stimulated, facilitated, and enhanced by a set of macro level conditions. Some of these structural and social factors are more important at certain stages than others. A dynamic model of innovation is one that connects the major tasks in the innovation process to those structural arrangements and social patterns, which facilitates each. Four major innovation tasks are identified:

1. Idea generation;
2. Coalition building;
3. Idea realisation; and
4. Transfer, or diffusion.

According to Kanter (1990: 278) organisational conditions - structure and social arrangements - can actively stimulate and produce innovation, as long as those conditions take into account the "organic", "natural", and even the "wild" side of innovation. Innovation is the creation and exploitation of new ideas. At its very root, the

entrepreneurial process of innovation and change is at odds with the administrative process of insuring repetitions of the past. The development of innovation requires a different set of practices and different modes of organisation than the management of ongoing established operations where the desire for or expectation of change is minimal. Structures and practices that may work well for the perpetuation of the now tend to be at odds with innovation.

Innovation is most likely to flourish where conditions allow flexibility, quick action and intensive care, coalition formation, and connectedness. It is most likely to grow in organisations that have integrative structures and cultures emphasising diversity, multiple structural linkages both inside and outside the organisation, intersecting territories, collective pride and faith in other people's talents, collaboration, and teamwork. The organisations producing more innovation have more complex structures linking people in multiple ways and encourage them to do what needs to be done within strategically guided limits, rather than confining themselves to the letter of their job. Such organisations are also better connected with key external resources and operate in a favourable institutional environment. Some of these structural and social conditions are more important at some points in innovation process than at others (Kanter, 1990: 279).

The structural and social conditions for innovation can be understood best if the innovation process is divided into its major tasks. While sometimes occurring in sequence, these tasks also overlap. However, by understanding the nature of each task, we can see more easily why certain properties of organisations are related to the success of innovation. This, in turn, contributes to our knowledge of the relationship between structure and behaviour, between macro-context and micro-processes (Kanter, 1990: 279).

According to Kanter (1990: 280-281) there are four major innovation tasks, which correspond roughly (but nowhere near exactly) to the logic of the innovation process as it unfolds over time and to empirical data about the history of specific innovations. These tasks are:

1. Idea generation and activation of drivers of innovations (the "entrepreneurs" or "innovators");
2. Coalition building and acquisition of the power necessary to move the idea into reality;
3. Idea realisation and innovation production turning the idea into a model - a product or plan or prototype that can be used;
4. Transfer or diffusion, the spreading of the model - the commercialisation of the product, the adoption of the idea.

### **3.7.1 Idea generation and innovation activation**

According to Holt (1992:5), Rosenfeld and Servo (1991:34), Zairi (1999:6) innovation begins with the activation of some person or persons to sense or seize a new opportunity. Such individuals are able to initiate a process of departing from the organisation's established routines or systems.

Once the opportunity is appreciated, someone needs to supply the energy necessary to raise the idea over the threshold of consciousness. The first key problem in the management of innovation, then, is how to get people to pay attention-how to trigger the action thresholds of individuals to appreciate and pay attention to new ideas, and opportunities.

It is important to look at the structural conditions that facilitate the ability to see new opportunities.

### **3.7.1.1 Close connection with need sources**

The following discussion regarding the close connection with need sources contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

According to Bean and Radford (2002:218-219) opportunity exists because need exists, so it is so not surprising that close customer or user contact is an important innovation activator. It is possible to use the marketplace to help define the innovation, but only if the innovation is to be product-based. Effective innovation can be derived from active awareness of changing user needs and sometimes from direct user demands or solutions. Therefore, structural arrangements and social patterns that facilitate contact across boundaries, between potential innovators and their market, help produce more innovation. Potential innovators benefit from being linked directly to the market, to gain a fuller personal appreciation for what users need, as well as from being connected with those functions inside the organisation that manage the interface with the outside. High innovation companies is characterised by strong market orientations at the top of the company and mechanisms to ensure interaction between technical and marketing people at lower levels.

Bean and Radford (2002:218-220) stated that 3M has another way to involve the marketplace by drawing upon what have been called "lead users" – customers themselves working at the leading edge of technologies, and often innovating in the product area themselves - can dramatically improve the effectiveness of a new product launch. 3M's approach has four phases:

1. Laying the foundation for the innovation by identifying the target market segment.

2. Determining the trends in the target market by asking experts in various technologies.
3. Identifying the lead users in the target market by networking with market members and, in the process, developing product ideas from discussions with the lead users.
4. Developing the breakthroughs by working with lead users, which may involve hosting one or a series of workshops with groups of lead users to determine what breakthroughs are required, and the potential market size for each breakthrough.

3M's approach is therefore much focused. It is focused, first, on products used by customers; second, in an attractive market segment; third, by expressed customer need; and fourth, by potential return to 3M. Companies of any size can use this approach but must realise that focus and painstaking research are critical to success.

Extra-organisational ties with users can be formalised, to ensure continuing close connection. Many computer and software companies have formed user groups, which allow them to gather ideas for new products and product improvements.

These principles apply to internal administrative or organisational innovations as well as technological or product innovations. Staff groups who are successful at creating innovations are the ones with the closest connections with the needs in the field (Bean and Radford, 2002: 219-221).

### **3.7.1.2 Kaleidoscope thinking: cross fertilisation**

The following discussion regarding kaleidoscope thinking contains elements that are part of the structural subsystem, psychosocial

subsystem, goals and values subsystem and managerial subsystem of Systems Theory.

Awareness of need is one element; ability to construct new ways to address the need is a second.

According to Kanter, (1990: 283) the kaleidoscope is an apt metaphor for the creative process, because the kaleidoscope allows people to shake reality into a new pattern. In a kaleidoscope a set of fragments form a pattern. But the pattern is not locked into place. If the kaleidoscope is shaken or twisted, or the angle of perspective is change, the same fragments form an entirely new pattern. Often, creativity consists of rearranging already existing pieces to create a new possibility.

Contact with those who see the world differently is a logical prerequisite to seeing it differently ourselves. "Cosmopolitan" rather than "local" orientations-seeing more of the world-has been identified by many researchers as a factor in high rates of innovation. So the more innovative organisational units who face outward, as well as inward, taking in more of the world around them, and taking better advantage of "boundary spanners" to bring them intelligence about the world beyond. At the same time the danger of closing down is also clear. Sociologists used the terms "occupational psychosis" and "trained incapacity" to describe the tendency for those who concentrate on only one area and interact only with those who are similar in outlook to become less able over time to learn new things (Kanter, 1990: 283).

According to Janssen, Van De Vliert, and West (2008:138) diversity of knowledge and skills in groups will also moderate the relationship between innovation and outcomes, dependent partly upon the sophistication of group processes. Groups composed of people with

different professional backgrounds, knowledge, skills, and abilities will more successfully manage innovation processes than those whose members are similar, because they bring usefully different perspectives on issues to the group. Their divergence of views offers multiple perspectives, and the potential for constructive controversy. Diversity contributes to the team's total pool of task-related skills, information, and perspectives, and to the potential for more comprehensive or creative decision-making about the innovation process via informational conflict.

According to Kanter (1990: 284) creativity may also derive from uncomfortable situations that can lead to innovation. This is situations where basic beliefs are challenge and alternatives suggested. It is not surprising, then, that the patterns in most large, established bureaucracies inhibit rather than activate innovation. Once people enter a field, they spent most of their time (especially their discretionary time) with other people just like them who share their beliefs and assumptions. At the top, leaders are increasingly insulated from jarring experiences or unpleasant occurrences that causes them to confront their assumptions about the world, and they spend an increasing portion of their time with people exactly like themselves. And if corporate culture encourages orthodoxy of beliefs and a non-confrontational stance, then idea generation is further discouraged.

Cross-fertilisation of ideas instead comes from cross-disciplinary contact. Creativity often springs up at the boundaries of specialities and disciplines, rather than squarely in the middle. It is often a matter of combining two formally separated ideas-wafers and ice cream making the world's first ice cream cone.

But when departments of specialities are segmented and prevented from contact, when career paths confine people to one function or discipline



for long periods of time, and when communication between fields is difficult or excessively formal, creativity is stifled.

Under this kind of circumstances, outsiders may be able to see the big picture and take a new angle on the pattern, because they are not yet aware of all the details the "experts" see that inevitably confirm the view that no change is possible. People too close to a situation often become hopeless about change, blind to the possibilities (Kanter, 1990: 283-285).

### **3.7.1.3 Structural integration: intersecting territories**

The following discussion regarding structural integration contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

According to Kanter (1990: 285) activation of innovation is encouraged by structural integration across fields-by intersecting territories. Researchers have long observed that communication integration (closer interpersonal contacts or connectedness via interpersonal communication channels in an organisation) is positively related to the innovation rate. Isolation of individuals and units tends to reduce innovation at the idea generation stage by limiting the awareness of opportunity, alternative approaches, and the perspectives of those functions that need to contribute to other "parts to make the innovation add up to a whole. These who are isolated, in short, are less attuned to alternatives than those who are well-connected.

According to Ettlie (2006:176-177) Matrix organisation structures are highly integrated and are found more frequently in rapidly changing, highly innovative organisations. Matrix organisations, in which mid-level employees report to both a project boss and a functional boss, force

integration and cross-area communication by requiring managers from two or more functions to collaborate in reaching a decision or taking some action.

By requiring extensive cross-functional consultation, the matrix diffuses authority among a group of managers. In many instances, this opportunity can be used in a positive manner by particularly entrepreneurial managers who are able to envision alternatives and assume responsibility for pursuing them-alternatives that cuts across territories.

According to Kanter (1990: 285-286) measures of complexity and diversity in an organisation are positively related to initial development of innovations (though they are sometimes negatively related to eventual acceptance of the same innovation by the rest of the organisation). Diversity gives the individual more latitude for discovery, but may make it difficult later to get agreement on which of the many proposals or demonstration projects should be implemented on a wider scale.

One does not need a formal matrix structure to do this. Indeed, it is the general characteristics of an integrated structure that make a difference in terms of encouraging innovation: looser boundaries, crosscutting access, flexible assignments, open communication, and use of multi-disciplinary project teams. So specifying multiple links between managers in a formal sense is merely a way of acknowledging the interdependencies that complex product and innovative projects require.

Dividing the organisation into smaller units based on a common end use but not around functions or speciality also aids activation of innovation by producing structural integration at micro-level.

#### **3.7.1.4 Broad jobs**

The following discussion regarding broad jobs contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

According to Kanter (1990: 288) idea generation is also aided when jobs are defined broadly rather than narrowly, when people have a range of skills to use and tasks to perform to give them a view of the whole organisation, and when assignments focus on results to be achieved rather than rules or procedures to be followed. This, in turn, gives people the mandate to solve problems, to respond creatively to new conditions, to note changed requirements around them, or to improve practices, rather than mindlessly following procedures derived from the past.

Furthermore, when broader definitions of jobs permit task domains to overlap rather than divide cleanly, people are encouraged to gain the perspective of others with whom they must now interact and therefore to take more responsibility for the total task rather than simply their own small piece of it. This leads to the broader perspectives that help stimulate innovation.

In areas that benefit from more enterprise and problem solving on the part of job holders, broader jobs seem to work better. This is the principle behind work systems that give employees responsibility for a major piece of a production process and allow them to make decisions about how and when to divide up the tasks. Pay-for-skill systems similarly encourage broader perspectives by rewarding people for learning more jobs.

While specialised knowledge is an asset, confinement to a limited area and minimal contact with other professionals inhibits the ability for experts to use their knowledge in the service of change.

According to Kanter (1990:288) potential innovators can become interested in a particular issue that develops into an innovation for several reasons. The initial impetus for the innovation activation can stem from:

- (a) An obligation of his or her position;
- (b) A direct order;
- (c) A stimulus from the environment or "galvanising event";
- (d) Self- motivated, entrepreneurial behaviour;
- (e) Organisational rewards and payoffs; or
- (f) Accidental conditions.

While much of the literature emphasises the random, spontaneous, or deviant aspects of idea generating, some research has found that the nature of job assignments can be an activating force-either directly, because the assignment requires a new solution, or indirectly by allowing a scanning process to occur beyond what is programmed into the position. Job assignments stimulate a high proportion (51%) of innovations in one study (Kanter, 1990:288).

What is important is not whether there is an assignment, but its nature: broad in scope, involving change, and leaving the means unspecified, up to the doer. Indeed, the more jobs are formalised, with duties finely specified and codified, the less innovation is produced in the organisation. An emphasis on numbers (a quantitative versus a qualitative thrust in jobs) and on efficiency also depresses the amount of innovation. Low formalisation on the other hand, is associated with more innovativeness.

Broad assignments are generally characteristics of staff managers in problem solving or bridging positions who have a general change mandate to invent something or improve something. The innovation producing companies are often marked by a large proportion of problem solvers in operating departments who float freely without a "home" in the hierarchy and thus must argue for a budget or find a constituency to please.

The more routinised and rules-bound a job is, the more it is likely to focus its performers on a few already known variables and to inhibit attention to new factors. Overly elaborated and finely detailed structures and systems make organisational participants unable to notice shifts in their environment and the need for innovation, especially if they are required to send "exceptions" somewhere else for processing.

Where jobs are narrowly and rigidly defined, people often have little incentive to engage in either spontaneous innovation or to join together across job categories for larger directed innovation efforts-especially if differences in classifications also confer differential status or privilege (Kanter, 1990: 288).

### **3.7.1.5 Organisational expectations for innovation**

The following discussion regarding organisational expectations for innovation contains elements that are part of the structural subsystem, technical subsystem, goals and values subsystem and managerial subsystem of Systems Theory.

Even if people are able to generate new ideas in the innovation activation stage, they must also feel confident that their attempts at innovation will

be well received. The signals they receive about the expectations for innovation play a role in activating or inhibiting innovation.

According to Kanter (1990:289) one way organisations signal an expectation for innovation is by allocating funds specifically for it.

Since innovations generally require resources beyond those identified in operating budgets for reasons that are logical - the exact nature and timing of innovation is often unpredictable - the existence of multiple sources of loosely committed funds at local levels make it easier for potential innovators to find the money, the staff, the materials, or the space to proceed with an entrepreneurial idea. Because no one area has a monopoly on resources, there is little incentive to hoard them as a weapon; instead, a resource holder can have more influence by being one of those to fund an innovative accomplishment.

Sheer availability of resources helps, of course. Research shows that richer and more successful organisations innovate more than poorer and less successful ones, especially in technology areas.

There are a variety of ways that high innovation companies make resources accessible locally or middle-level people alternatives to tap when seeking money or materials for projects. One is to have formal mechanisms for distributing funds outside the hierarchy. 3M has put in place "innovation banks" to make "venture capital" available internally for development projects.

Some innovations, particularly organisation ones, can be handled without money at all. Instead, the most common resource requirement is staff time. This can also be decentralised in the form of "slack" and local control: people locally available with uncommitted time or with time that

they could decide to withdraw from other endeavours to be attached to an appealing project. Because mid-level personnel, professionals, and staff experts have more control over the use of their time in the more frequently innovating companies, it is easier to find people to assist in a project, or to mobilise subordinates for a particular activity without needing constant clearances from higher-level, and non-local bosses (Kanter, 1990: 289-290).

A second general source of expectations of innovation lies in whether the organisation's culture pushes "tradition" or "change" and whether it value creative individuals. A study by Janssen, Van De Vliert and West (2008:129-145) has found that the personal characteristic of creativity on its own is insufficient for achieving innovative performance. Personal initiative and an innovative culture are necessary conditions for creative employees to implement their creative ideas and produce innovative products. Innovators and innovative organisations generally come from the most modern "up to date" areas rather than traditional ones with preservationist tendencies, and they are generally the higher-prestige "opinion leaders" that others seek to emulate. But opinion leaders are innovative only if the organisation's norms favour change and innovation.

A study by Dombrowski, Kim, Desouza, Braganza, Balohnd and Sanjeev (2007:190-202) also indicate that organisational culture is an important determinant of sustained innovativeness and financial performance.

According to the Harvard Business Essentials (2003:116-117) pride in the company, coupled with knowing that innovation is mainstream rather than counter-cultural, help to stimulate innovation. A feeling that people inside the company are competent leaders, that the company has been successful because of its people, supports this.

According to the Harvard Business Essentials (2003:118) and Kanter (1990:290-291) innovative cultures stand out in sharp distinction to the cultures of inferiority that leads less innovating companies to rely on outsiders for all new the ideas, rather than on their own people.

Success breeds success. Where there is a "culture of pride", based on high performance in the past, people's feeling of confidence in themselves and others go up. They are more likely to take risks and also to get positive responses when they request co-operation from others. Mutual respect makes teamwork easier. High performance may cause group cohesion and liking for colleagues as well as result from it; pride in the capacity and ability of others makes teamwork possible.

It is a self-reinforcing cycle-performance stimulating pride stimulating performance-and is especially important for innovation. Change requires a leap of faith, and faith is so much more plausible on a foundation of successful prior experiences.

Finally, feeling valued and secure helps people relax enough to be creative (Amabile, 1998: 82-87; 1990: 244-245).

### **3.7.1.6 Integration versus isolation**

The following discussion regarding integration versus isolation contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

Kanter (1990: 291) argue that generation of new ideas that activates innovation is facilitated by the following:

- organisational complexity



- diversity of experience, including experts who have a great deal of contact with experts in other fields
- links to users
- links with outsiders
- openness to the environment
- integration across fields via intersecting territories
- multiple communication links
- and smaller interdisciplinary business units.

### **3.7.2 Coalition building**

The following discussion regarding coalition building contains elements that are part of the structural subsystem, psychosocial subsystem and managerial subsystem of Systems Theory.

According to Kanter (1990:293) once a specific project idea has taken shape, the necessary support for it must be secured -a necessity even when the innovator was initially been handed the area as an assignment. It must be sold because the initial assignment, though bearing some legitimacy, may contain no promises about the availability of resources or support required doing something of greater magnitude than routine activities. Thus, the second task of the innovation process involves coalition building, acquiring power by selling the project to potential allies.

Studies of innovation show the importance of backers and supporters, sponsors and friends in high places, to the success of innovation. Galbraith (1982: 10-11) distinguished the roles of "sponsor"-those who discover and fund the increasingly disruptive and expensive development and testing efforts that shape an initial innovation - and 'orchestrator' - managers of politics surrounding a new idea.

Galbraith (1982: 10-11) argued that someone who comes up with great, innovative, applicable ideas and likes to experiment with them will not necessarily also have the personal or managerial skills to find resources and persuade top management to support his/her idea. Idea sponsors step in to fill that role, but not all managers are suitable as idea sponsors. According to Galbraith (1982:10-11) innovators don't want supervisors; they usually reject supervision and derive pleasure from executing the idea properly, not from external rewards. So idea sponsors are sounding boards and offer advice and expertise, and therefore can't be evaluators in the sense of traditional managers. Idea sponsors need a well-developed gut feeling about the innovation process and the task at hand. Sponsors are in the middle of ideas all day long and should also be considered idea generators and blenders of ideas from different projects. Managers are also responsible for making deals (particularly for resources) and brokering ideas to outside departments and within the reservation. Knowledge of business models and strategies is also generally required. Since an innovator may be a production line specialist or a customer with little business model knowledge, idea sponsors can help in the advocacy and screening stages of the innovative process particularly well.

Another approach is to find or cultivate the skills used in idea sponsorship in each section of an organisation. Heng et al. (in Dombrowski, Kim, Desouza, Braganza, Papagari, Baloh, and Sanjeev, 2007:199) have examined 10 champions of IT innovation and found that they were different from traditional IT workers. Understanding and manipulation of organisational structure and behaviour was seen in these employees; hence, they were given the name of 'organisational champions' for their promoting and advocacy roles during the innovation process. Champions often showed deep investment in an idea, and

although they accepted failure, would use persuasion and coercion to avoid abandoning an idea.

According to Dombrowski, Kim, Desouza, Braganza, Papagari, Baloh, and Sanjeev (2007:199) innovation champions used informal networks to convince others to support new ideas. Innovations need top management support and various techniques can be used to create fertile environments for innovation. Lowe et al. (in Dombrowski, Kim, Desouza, Braganza, Papagari, Baloh & Sanjeev, 2007:199) examined over 13 'innovative' companies ('innovative' as compared to companies that introduced less successful strategies). All big innovators had a few things in common: big aspirations, a flexible definition of their businesses, and a habit of experimentation, but the overall organisational cultures differed dramatically because management styles were strikingly different.

Change does not just happen; change is absorbed into corporate culture via advocacy and consistent proselytising. Top management must be aware of and committed to being leaders and create avenues for the non-traditional types of idea management and leadership necessary to encourage innovation. Arguably, intellectual and practical complacency often results in a leader or champion being an individual that has responsibility for turning an innovative idea into reality. This is hardly a helpful way of thinking about leadership in innovation projects. Instead, leaders and champions are all members of the senior management team, key influencers, and those that have informal power in the organisation. It is essential that leaders and champions be more broadly defined because innovations usually require the organisation to change in some way (Dombrowski, Kim, Desouza, Braganza, Papagari, Baloh & Sanjeev, 2007:199).

Delbecq and Mills (1985: 31-33) states that while the role of the innovation champion or sponsor is important, detailed accounts of the history of innovations reveals the importance of a whole coalition, embryonic and informal or assembled and formal for the success of an innovative idea. Thus, it is more appropriate to conceptualise the second major innovation task as coalition building, a broader notion that ties in more of the organisation, rather than as seeking sponsorship, a narrower concept. In general, the success of an innovation is highly dependent on the amount and kind of power behind it. In contrast, innovation failures are characterised by ambivalent support; inadequate resources during the initial fragile stages of development; constant efforts to 'sell' and 'justify' and personalised in-fighting over resources.

According to Kanter (1990: 293) the effectiveness of political activity the innovation entrepreneur engages in, coupled with structural conditions conducive to power acquisition and coalition building, may largely account for whether an idea ever moves into the later phase of innovation production. Social and political factors, such as the quality of the coalition building, may account for as much or more than technical factors, such as the quality of the idea, in determining the fate of innovation.

According to Zaltman et al. (1973: 98-99) there are some kinds of ideas that are inherently better able to attract support. The most saleable projects are:

- likely to be trialable (can be demonstrated on a pilot basis)
- reversible (allowing for the organisation to go back to pre-project status if they do not work)
- devisible (can be done in steps or phases)
- consistent with sunk costs (built on prior resource commitments)
- concrete (tangible, discrete)

- familiar or compatible (consistent with a success past experience and compatible to existing practices)
- congruent (fit the organisation's direction)
- and have publicity value (visibility potential if they work).

When these features are not present, then projects are likely to move ahead if they are either marginal (appear off-to-the-side-lines so they can slip in unnoticed, or idiosyncratic (can be accepted by a few people with power and without requiring much additional support).

According to Kanter (1990: 294) the features of successful ideas have more to do with the likelihood of gathering political support than with the likelihood of the idea to produce results. In general, the relative economic advantage of a new idea, as perceived by members of an organisation, is only weakly related to its rate of adoption. Instead, political variables may play a larger role, especially the acquisition of power tools to move the idea forward.

### **3.7.2.1 Power tools**

The following discussion regarding power tools contains elements that are part of the technical subsystem, structural subsystem and managerial subsystem of Systems Theory.

Organisational power tools consist of supplies of three "basic commodities" that can be invested in action: information (data, technical knowledge, political intelligence, and expertise); resources (funds, materials, space, time) and support (endorsement, backing, approval, and legitimacy) (Kanter, 1990: 294; Delbeq & Mills, 1985: 33).

Each of the three "basic commodities" is shaped in different ways by conditions in the environment (e.g., critical contingencies, resource

scarcity), and by organisational structure and rules (e.g., how openly information is exchanged, how freely executives render support). Each gives the person a different kind of "capital" to invest in a "new venture".

Little innovative behaviour is likely in organisations where there is no market for exchanging or re-arranging resources and data and for acquiring support to do something outside the formal structure, because it is tightly controlled either by a hierarchy or by a few people with a monopoly over power. Indeed, when people feel powerless through structural locations that limit them access to the organisational power tools, they become more controlling and conservative.

The organisation's structure determines the amount and availability of power via both the distribution of power tools and the ease with which coalitions can be formed. Access to external and internal sources of power increases an innovation entrepreneur's chances of successfully creating an innovation (Kanter, 1990: 295).

### **3.7.2.2 Coalition structure**

The following discussion regarding coalition structure contains elements that are part of the structural subsystem, psychosocial subsystem and managerial subsystem of Systems Theory.

According to Gluckman and Liyanage (2006:163-164) coalition members are those on whom the innovator may be dependent - where there is interdependency affecting the fate of the idea. The concept of organisational interdependency has a technological and a political component.

First, people often form interdependent relationship because of mutual task dependence.

Second, interdependencies may be political in nature, since organisations are "tools" for multiple stakeholders; managers identify and seek out others with complementary and sometimes competing interests for the purpose of trading resources, demands, ect. Networks of interdependent members also form where people are joined by a variety of links through which goods, services, information, affect and influence flow.

According to Galbraith (1982: 20-21) there are the many types of interdependent relationships: hierarchical, lateral, and oblique. In addition, people also work in the midst multiple political constituencies that are defined by a common political or organisational interests and include persons outside the formal boundaries of the organisation. Constituencies may form around task, issues, and attempts to create change or block change, or salient values.

According to Galbraith (1982: 21) the size of the coalition is affected by how many territories the innovation crosses. The broader the ramifications of the issues involved in a proposed innovation and the greater the attendant uncertainties, the larger the coalition of supporters needs to be if the idea for innovation is to result in product action.

The inducements an innovator can offer to participate in a coalition includes a variety of payments, such as financial incentives, resources, information, policy promises, a learning experience, personal development, or emotional satisfaction. The exchange of inducements for coalition participation can also extend across both vertical and lateral levels of an organisation.

Mobilising coalition members through exchange assumes that "commodities" are available for trade, and that the organiser had some control over their distribution. Such commodities used to mobilise coalition members can also serve as the basis of organisational power; e.g., resources, slack, information, and political support.

Access to these commodities depends to a large degree on their distribution within the firm; their munificence increases the ability to draw people into coalition that can work on an innovation.

According to Galbraith (1982:23) and Kanter (1990:295-296) corporate entrepreneurs work is facilitated by integrative devices that aid work formation and collaboration across areas: open communication; frequent mobility, including lateral career moves; extensive use of formal team mechanisms; and complex ties permitting crosscutting access.

### **3.7.2.3 Communication density**

The following discussion regarding communication density contains elements that are part of the structural subsystem, technical subsystem and managerial subsystem of Systems Theory.

According to White and Bruton (2007:111) knowledge management involves "spreading the word" through communication channels about both the needs and the opportunities for the organisation. These needs and opportunities should then be integrated into the planning process. Good communication not only makes individuals in the planning process aware of needs and opportunities; it also helps ensure that the organisation is working toward a common direction as it performs innovation planning. It is easy for one part of the organisation to believe it understands the problem that the organisation should address in its



planning, while another part of the organisation is building a plan that sees the problem from a very different perspective.

According to Burns and Stalker (1994: 85-86), Gluckman and Liyanage (2006:164-166), Rogers (1995: 218-219) and White and Bruton (2007:111) the sharing of knowledge can be both formal and informal. Formal communication is required by the organisation and includes such things as posting on e-mail major points of a staff meeting or a weekly report to all key personnel. The organisational structure typically indicates the lines of formal communication. The firm should develop those formal communication processes that ensure everyone in the organisation receives the necessary formal information. Informal communication takes the form of e-mails, telephone calls, and face-to-face visits that managers take upon themselves to do. The organisation should keep the reality of informal communication in mind and develop mechanisms that encourage building rich networks among individuals across the organisation. One benefit of training and development, which draws on individuals from a variety of departments and units, is the development of such informal networks. In encouraging formal and informal knowledge sharing, the organisation also needs to keep in mind that to day's firms often has an overload of unnecessary information. The organisation should encourage both formal and informal communication while limiting that, which dogs the system. Periodically, the organisation needs to evaluate the flow of information to be sure that communication (particularly formal) is getting the right information to the right people at the right time to make timely plans and take timely actions.

Innovation flourishes where "communication integration" is high. Open communication patterns make it easier to identify and contact potential coalition members and tap their expertise.

According to Burns and Stalker (1994: 85-86), Gluckman and Liyanage (2006:164-166) and Rogers (1995:218-219) informal and open communication norms acknowledge the extent of interdependence that people in all areas need information from each other.

"Openness" at such organisations is reflected in physical arrangements as well. There may be a few private offices, and those that do exist are not very private.

Open communication serves a very important function for a potential innovator. Information and ideas flow freely and is accessible; technical data and alternative points of view can be gathered with greater ease than in companies without these norms and systems. And thus both the creative and political sides of innovation are facilitated (Burns & Stalker, 1994: 85-86; Gluckman & Liyanage, 2006:164-166; Rogers, 1995: 218-219).

#### **3.7.2.4 Network density**

The following discussion regarding network density contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

According to Galbraith (1982: 22-24) and Kanter (1990: 297) coalition formation in the interest of innovation is also aided by conditions that facilitate dense ties through networks. Circulation of people is a first network-facilitating condition. Mobility across jobs means that people rather than formal mechanisms are the principal carriers of information, the principal integrative links between parts of the system. Communication networks are facilitated, and people can draw upon first hand knowledge of each other in seeking support. Knowledge about the

operations of neighbouring functions is often conveyed through movements of people into and out of jobs in those functions. As a set of managers or professionals disperse, they take with them to different parts of organisation their 'intelligence', as well as the potential for the members to draw on each other for support in a variety of new roles. In just a few moves, a group that has worked together is spread around, and each member now has a close colleague in any part of the organisation to call on for information or backing.

A second network-forming device is more explicit: the frequent use of integrative team mechanisms at middle and upper management levels. These both encourage the immediate exchange of support and information and create contacts to be drawn on in the future

According to Galbraith (1982: 22-24) and Kanter (1990: 297) the legitimacy of crosscutting access promotes the circulation of all three of the power tools: resources, information, and support. This allows innovators to go across formal lines and levels in the organisation to find what they needed-vertically, horizontally, or diagonally-without feeling that they are violating protocol. They can skip a level or two without penalty. This is essential if there is to be hands-on involvement of managers up several levels.

According to Kanter (1990: 297-298) matrix designs, though not essential for crosscutting access, can be helpful in legitimising it, for the organisation chart shows a number of links from each position to others. There is no "one boss" to be angered if a subordinate manager goes over his head or around to another area; it is taken for granted that people move across the organisation in many directions; and there are alternative sources of power. Similarly, formal cross-area and cross-

hierarchy teams may provide the occasion and the legitimacy for reaching across the organisation chart for direct access.

### **3.7.3 Idea realisation and innovation production**

The following discussion regarding idea realisation and innovation production contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

According to Kanter (1990:298) the first task of the innovation process involves assembling a working team to "complete" the idea by turning it into a concrete and tangible object (physical or intellectual) that can be transferred to others. The idea becomes a reality; a prototype or model of innovation is produced that can be touched or experienced, that can now be diffused, mass produced, turned to productive use, or institutionalised.

There are a number of critical organisational issues related to the ability to move an innovation through this phase. These issues join with social psychological (intragroup) variables to account for the performance of the group responsible for producing the innovation model.

#### **3.7.3.1 Physical separation**

The following discussion regarding physical separation contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

While structural isolation is a liability for idea generation or innovation activation, it is an asset for idea completion or innovative production.

Differentiated innovation units, separated from ongoing operations in both a physical and an organisational sense, are not necessary to stimulate or activate innovation (a task for which isolation is counter productive), but they do allow individuals room to think, experiment, discuss ideas and be creative. Lockheed's "skunkworks" has been used to refer to the special setting where innovation teams can create new things without distractions (Galbraith, 1982: 23-24; Kanter, 1990: 299; Trott, 2008:86).

According to Quinn (1985: 78-79) high innovation companies in the United States, Europe, and Japan have flatter organisations, smaller operating divisions, and smaller project teams. Small teams of engineers, technicians, designers, and model makers are placed together in "skunkworks" with no intervening organisational or physical barriers to developing the idea to prototype stage. This approach eliminates bureaucracy, allows fast and unfettered communication, enables rapid turnaround time for experiments, and instils a high level of group loyalty and identity by maximising communication and commitment among team members.

### **3.7.3.2 Boundary management**

The following discussion regarding boundary management contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

According to Kanter (1990:300) if small, separate units aid in turning an innovative idea into a concrete product, then boundary management is a particular problem. The team must continue to procure information and resources and return output to the rest of the organisation, but without

becoming so outwardly focused that their ability to do the job is jeopardised.

The group must both buffer itself against too much input from its environment and manage the demand for what it is producing so that it has an appropriate level-of exchange with the world around it-not too much, and not too little.

Gladstein and Cladwell (in Kanter, 1990: 300) have identified four boundary management roles in the new product teams they studied, roles that can all be played by one person or distributed throughout the group:

1. 'Scouts', bringing in information or resources needed by the group;
2. 'Ambassadors', carrying out items/ideas that the group wants to transmit to others;
3. 'Sentries', controlling the transactions that occur at the boundaries, deciding how much can come in;
4. 'Guards', controlling how much goes out of the group.

Whereas scouts and ambassadors keep extragroup relationships smooth and get the group its needed supplies, sentries and guards buffer the group from outside interference. But note that all these roles may be played by one person or just a few people, allowing the rest of the group to work on tasks without paying any attention to the world outside the project team.

Boundary management is important not merely to get the working group what it needs and save it from unnecessary interference but also to handle any subtle threats to the continue existence of the innovation projects (Kanter, 1990: 300).

Kanter's (1990: 301-302) research has identified a number of tactics innovators use to disarm opponents who want to derail the innovation project:

- waiting it out (when the entrepreneur has no tools with which to directly counter opposition);
- wearing them down (continuing to repeat the same arguments and not giving ground);
- appealing to larger principals (tying the innovation to an unassailable value or person);
- inviting them in (finding a way that opponents could share the spoils of the innovation);
- sending emissaries to smooth the way and plead the case (picking diplomats on the project team to periodically visit critics and present them with information);
- displaying support (asking sponsors for a visible demonstration of backing);
- reducing the stakes (de-escalating the number of losses or changes implied by the innovation); and
- warning the critics (let them know they would be challenged at an important meeting-with top management, for example).

Many of these tactics are more likely to succeed when the innovation group has a strong coalition backing it.

### **3.7.3.3 Continuity**

The following discussion regarding continuity contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

According to Quinn (1985: 79) structural and social conditions within the innovation team also make a difference in success. Because "interactive learning" is so critical to innovation, innovation projects are particularly vulnerable to turnover. Continuity of personnel, up to some limits, is an innovation supporting condition.

There are sometimes good reasons, from the project's standpoint, for people to leave: inadequate performance, interpersonal tensions, and the wrong skills. However, every loss and replacement can jeopardise the success of the innovation process, in three different ways:

1. Each person leaving removes knowledge from the pool that has not yet been routinised or systematised.
2. Each person entering deflects the energies and attention of the others from knowledge development to education - to try to duplicate the experience base of current staff and avoid reinventing the wheel. However, telling about is not only time consuming, it is no substitute for having been there.
3. Each person entering in an important position may wish to change course in order to exercise his or her own power, thereby failing to take advantage of accumulated knowledge. So every new boss is indeed a new beginning.

Turnover in important positions outside the project team can also create problems, though not necessarily as severe: the division is reorganised, for example, and the new management does not "understand" the venture. The coalition is disrupted and needs to be rebuilt. An organisation can easily undermine an innovation without "officially" stopping it simply by reorganising and changing its reporting relationships.



According to Kanter (1990:303) creating change requires stability-continuity of people especially during the information-rich, knowledge-intensive development stage. However, established corporations often exacerbate the vulnerabilities of their new ventures and innovation efforts by the instability they encourage in and around them. Lock-step career systems that tie rewards to promotions, thus requiring job changes in order to "advance", or that put more value on "safer" jobs in already-established businesses, encourage people to abandon development efforts before their knowledge has been "captured". Thus, organisational structures and cultures that allow continuity on innovation teams by facilitating unusual or "off-line" career paths, allocating human resources on a projects basis rather than a time bases, and rewarding completion are helpful ingredients for successful innovation production.

According to Kanter (1990:303) continuity is also supported where strong commitment is generated, so that people want to stay and want to contribute. Three kinds of commitment mechanisms are relevant to innovation efforts:

1. Conditions encouraging a rational calculation of the benefits of continuing participation;
2. Those encouraging strong social and emotional ties with the group;
3. And those encouraging a strong belief in the fundamental values or purposes of the efforts.

Structural and social facilitators of commitment to innovation teams would thus include these kinds of things, among others: a financial stake in outcomes that grows with time spent might produce a sense of investment. A sense of communion might come from clear group identity and sense of specialness through team names, rituals, and celebrations.

A sense of strong values might come from reminders of the connection to user needs.

It is important to note, however, if too much time goes by before innovation completion, then team loyalty and stability can become a liability instead of an asset. Katz (in Kanter, 1990: 304) found that the ideal longevity of Research and Development teams is between two and five years. It takes two years to begin to work well together, but after five years, the group becomes stale.

#### **3.7.3.4 Flexibility**

The following discussion regarding flexibility contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

According to Kanter (1990:305) flexibility is another requirement for idea realisation. It is quite common for innovations to fail to proceed as planned but instead to encounter unexpected roadblocks that require re-planning and redirection if the innovation is ever to be produced. Cost overruns and missed deadlines are common, due to the inherent high uncertainty of the development process. Because of the unpredictable nature of innovation, flexibility is needed in order to assist with a project.

Quinn (1985: 75-76) has found across three countries, multiple approaches, flexibility, and quickness are required for innovation because of the advance of new ideas through random and often highly intuitive insights and because of the discovery of unanticipated problems. Project teams need to work unencumbered by formal plans, committees, board approvals, and other "bureaucratic delays" that might act as constraint against the change of direction.

Furthermore, innovations often engender secondary innovations, a number of other changes made in order to support the central change. As necessary, new arrangements might be introduced in conjunction with the core tasks. Methods and structure might be reviewed and when it seems that a project is bogging down because everything possible has been done and no more results are on the horizon, then a change of structure or approach, or a subsidiary project to remove roadblocks, can result in a redoubling of efforts and a renewed attack on the problem (Quinn,1985: 75-76).

According to Quinn (1985: 76) flexibility is an organisational rather than a purely individual variable. Those organisations that permit re-planning, give the working team sufficient operating autonomy, and measure success or allocate rewards for results rather than adherence to plan are likely to have higher rates of innovation production. Because of the inherent uncertainty of innovation, advance forecasts about time or resources requirements are likely to be inaccurate; it is difficult to budget or to forecast when lacking an experience base by definition, in case of a new idea. Requiring commitment to predetermined course of action interferes with the flexibility needed for innovation.

### **3.7.3.5 Balancing autonomy and accountability**

The following discussion regarding balancing autonomy and accountability contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

If some innovation projects fail because they are overly constrained by the need to follow bureaucratic rules and seek constant approvals, others

may equally fail because they are over funded and under managed by top leaders, which can remove the incentive to produce results efficiently.

The ideal structural contexts surrounding an innovation project should offer procedural autonomy coupled with multiple milestones that must be reached in order for the project to continue. These milestone points represent the major interface with organisational decision-makers and perhaps coalition members. They also help maintain team members' own commitment by giving them targets to shoot for and occasions to celebrate (Kanter, 1990: 306; Amabile, 1998: 78; Amabile, 1990: 257).

### **3.7.4 Transfer and diffusion**

The following discussion regarding transfer and diffusion contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

The culmination of innovation production is transfer to those who will exploit the innovation and embed it in ongoing organisational practice. Transfer needs to be handled effectively, if new products are to be successfully commercialised or new organisational practices or techniques to be successfully diffused. Isolated in its development, the innovation must again be connected with the actors and activities that will allow it to be actually used.

Social arrangements, from organisation structures to patterns of practice, again make the principal difference, even more than the technical virtues of the innovation (Rogers 1995: 24).

### **3.7.4.1 Strategic alignment and structural linkages**

The following discussion regarding strategic alignment and structural linkages contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory.

According to Kanter (1990:307) whereas the creation and development/production of an innovation can occur with few resources, little visibility, modest coalitions, and isolated activity of relatively small teams, the use of an innovation is a different matter. If creation is an intensive process, diffusion is an extensive process. Use requires many other people, activities, patterns and structures to change to incorporate the innovation.

Thus, a first condition for effective transfer is minimal new change requirements because the innovation is aligned with strategy or direction and linked to the other parts of the structure, so that adjustments and changes have already been made in anticipation of the innovation.

It is not surprising that innovations are more successfully transferred, commercialised, or diffused where the organisation or market is already receptive to the idea and prepared for its use.

On the other hand, those innovations that begin life as random deviance, or unofficial bootlegging in a hidden corner of the organisation, or the idiosyncratic dream of a tolerated but marginal actor, have a harder time getting adopted regardless of their virtues. Other actors, other departments have already made their plans without taking the possible availability of an innovation into account. Therefore, structures and practices have already been established that would have to be rearranged. These structural constraints to diffusion or transfer may be

matched by political constraints: controversy over the innovation or refusal to use it by those uninvolved in its development. The latter is the common not invented here problem; this problem particularly plagues organisational innovations (Kanter, 1990: 307).

Some studies have found that diffusion or adoption of an innovation, once developed, is aided by formalisation and centralisation in the organisation, by a concentration of power and a set of employees accustomed to following orders. The opposite structural features, then, from those that are conducive to a free flow of many new ideas are held to be necessary for ensuring rapid acceptance of any one.

According to Kanter (1990:308) a concentrated source of power is needed to impose the innovation on the organisation or move it quickly through pre-existing formal channels whenever the innovation has not already been appropriately linked to the units to which it will be transferred. Indeed, strong central authority can be argued to be a functional alternative to strong direct links between an innovation project and those to whom its product is handed-off.

If an innovation development projects is structurally well integrated as it comes to completion, rather than segmented and isolated from the rest of the organisation, then it does not require the power of centralised authority to ensure its effective transfer.

The hand-off or diffusion process is more difficult in organisations where interdepartmental rivalries and lack of integration cause friction when anything comes from a sister unit; then only "orders" from central authority are attended to.

According to Drucker (1985: 72) effective transfer also requires a strategic decision that an innovation should get the resources allocated to it, resources necessary to exploit its potential. For product and technical process innovations, and even for some organisational innovations, the greatest financial requirements begin after the model has been developed. Thus, the nature of the strategic decision process and how top management is linked to the innovation project is another critical structural element in an innovation's success or failure.

At the transfer point, when resources to exploit the innovation are allocated, visible and well connected projects already aligned with the organisation's strategic objectives are likely to fare better. In turn, the degree of investment the project gets, as it moved into, commercialisation, routine production, or institutionalisation affects its prospects for success as an ongoing product or practice. "Thinking small" and not providing adequate investment is often identified as a reason for new venture failures.

#### **3.7.4.2 Interface structures: active agents and communication channels**

The following discussion regarding interface structures contains elements that are part of the structural subsystem and managerial subsystem of Systems Theory. Elements of the environmental system are also included in this discussion.

According to Walton (1987: 226) the transfer or diffusion issue should be conceptualised as a continuum. At one extreme there is a perfect identity between developers and ultimate users, but at the other extreme, there is little or no connection between developers and those to whom the innovation could potentially be transferred, nor is there an established

transfer process. There is high uncertainty (an information issue) and controversy (a political issue) about what the next step is to get anyone to use the innovation, who should take lead, and whether there are identifiable customers for the idea, whether anyone does or should want the innovation.

A variety of interface or bridging structures can reduce both the uncertainty and the controversy, thus making it more likely that successful transfer will occur.

One method for diffusing new ideas is to establish a group whose formal responsibility is to move new ideas into active use. Members serve as active agents of diffusion, managing the process by which the realised idea is transferred to those who can use it. Part of their mandate is to gather information to make systematic the process of getting an innovation to users.

Inside organisations, product managers can be made responsible for bridging structures. A project manager's job is to manage the successful entry of a new product into the marketplace, drawing on every function in the organisation that might contribute, from continuing work on the design to the manufacturing process to the sales effort. Or, in case of organisational or work innovations, the bridging structure might be a transition team or "parallel organisation" that concentrates on the change process as a management task in and of itself (Bean and Radford, 2002:228; Kanter, 1990:309-310).

Agents of diffusion may also exist outside the organisation. Indeed, it can be argued that external agents are even more important in diffusion than champions inside the organisation, for they add a real or imagined legitimacy to the idea (contact with consultants for instance is an



important part of diffusion of innovation). What is important is not only the cloak of respectability in which the external body clothes the innovation, but also the communication service provided.

How well organised the environment is for the transfer of ideas can account for how rapidly a particular innovation is diffused. By "organised" it is meant the ease with which those with common interests can find each other, and therefore how easily connections can be made between innovations and users. Thus, the existence of conferences, meetings, and special interest associations should all be valuable in diffusing innovations, even product innovations, which have to be brought to the attention of specific groups. Trade associations, professionals and societies, and specialist-consulting organisations are among those serving this purpose more broadly (Bean and Radford, 2002:228; Kanter, 1990:309-310).

### **3.7.4.3 The institutional environment**

The institutional environment forms part of what is called the environmental system in Systems Theory.

The last issue in transfer and diffusion is a receptive social and legal environment. The institutional environment is one of the most important factors distinguishing between nations with high levels of innovation in its industry and those with low levels of innovation. Among the specific elements making a difference are patterns of labour organisation and government policy and regulations (Ettlie, 2006:377-378; Walton, 1987: 197-200).

Nelson (in Ettlie, 2006:403-404) has done a comprehensive international study of government and innovation involving 15 countries. It is difficult

to generalise across all these countries, even when they are divided into groups such as the three used here: large, high-income countries; small, high-income countries; and low-income countries. However, there does seem to be a general trend toward a positive impact across the board on innovation from government support of education and training systems and a university system responsive to industrial needs. Fiscal, monetary and trade policies also make a difference, especially when they make exporting attractive. There is a trend toward co-operative R&D in government innovation policies, but government support of university research and laboratories varies by industry in its impact. In biology, chemistry, and pharmaceuticals, there has been a positive impact. Government support does not cost much, relatively speaking, and does spark innovation.

Hollomon and colleagues (in Kanter, 1990: 311) identified specific ways in which government policies and programmes directly affect innovation adoption patterns:

- Assessment of new and existing specific technologies.
- Direct regulation of research or development of new products and processes.
- Direct regulation of the production, marketing, and use of new or existing products.
- Programmes to encourage the development and utilisation of technology in and for the private goods and services sector.
- Government support of technology for public services for consumers.
- Policies to affect industry structure that may affect the development and use of innovation.
- Policies affecting supply and demand of human resources having an impact on technological change.

- Economic policies with unintended or indirect effect on technological innovation.
- Policies affecting international trade and investment.
- Policies intended to create shifts in consumer demand.
- Policies responding to worker demand having an impact on technological change.

According to Kanter (1990:311) whether innovations are ultimately spread and used, then, may be a matter of societal as well as industry organisation. This level of analysis is not common in innovation literature, but it demands more attention, particularly with respect to innovations that themselves have organisational consequences.

However, as organisations themselves bump against the institutional limits to innovation diffusion, then the issues become clearer. For example, if the use of technological innovations has implications for job security, then the institutional patterns of labour relations in the industry may be among the most important determinants of an organisation's ability to use such innovations.

Innovation, and the spread of innovation, is also a function of industry conditions and the support an organisation can draw from its larger community. The more dependent an organisation is on others, the more likely that it will be shaped or constraint in its internal innovation by those portions of the environment which dominate it. However, the opposite also holds. Some environments represent "fertile fields" that provide more of the surrounding conditions conducive to innovation.

According to Kanter (1990:312) "fertile fields" include these kinds of features, associated with entrepreneurship in the form of starts-ups as well as innovation in established organisations:

- Close proximity and ample communication between innovators and users.
- A more highly skilled, professionalised, cosmopolitan workforce.
- A flow of new technical ideas from Research and Development centers.
- A more complex, heterogeneous environment that encourages innovation as an uncertainty-reducing strategy.
- Channels of communication for exchange of innovation ideas.
- Competition from entrepreneurial new companies, in turn benefiting from the availability of venture capital.
- More inter-organisation interdependence and integration.
- Public encouragement of new ideas as social goods.

The ultimate set of social structural factors supporting innovation, then, comes from the nature of the environment in which an organisation operates, as well as its connections to various key units in that environment. Although an innovation model may be produced in one organisation independently and in isolation, it takes the actions of many for the innovation to diffuse.

It is appropriate to look beyond the borders of one organisation for the determinants of innovation. Indeed, some innovations can start life as a joint product of one more than one organisation, through joint ventures, co-operative research efforts, and strategic alliances. Furthermore, sometimes organisations unwittingly co-operate in innovation. For example, the failure of innovation in one organisation can be the trigger for the creation of a new organisation designed solely to develop that

same innovation. The entrepreneurial process that has led to spin-offs from larger companies that reject innovations developed and exploited successfully by start-up companies. (Kanter, 1990: 310-313).

By utilising the work of various researchers, the researcher has connected the major tasks in the innovation process to those structural arrangements and social patterns that facilitate each. Innovation consists of a set of processes carried out at micro level, by individuals and groups of individuals; and these micro processes are in turn stimulated, facilitated, and enhanced (or the opposite) by a set of macro-structural conditions. Overall, the common organisational threads behind innovation are breath of reach, flexibility of action, and above all, integration between those with pieces to contribute, whether inside or outside a single organisation.

Undeniably, innovation stems from individual talent and creativity. But whether or not individual skills are activated, exercised, supported, and channelled into the production of a new model that can be used, is a function of organisational and inter-organisational context. The model proposed by the researcher shows the importance of integration in the innovation process, close structural connections between potential innovators and users, between functions and departments, between the innovation project and the units or organisations that will move the model into production and use. An integrated organisational model is helpful to show that innovation extends beyond the borders of a single organisation. Innovation benefits from inter-organisational ties and organisation-environment linkages as well as from internal integration.

## **CHAPTER 4**

### **4 RESEARCH METHODOLOGY**

#### **4.1 Introduction**

In Chapter 3, the Systems Theory, coupled with ideas from the Contingency Approach, were discussed as a general framework for analysing organisations and locating the various aspects of innovation. The most important processes and factors of innovation were discussed.

The type of data obtained through the scale used was quantitative. The logic of the scale development and evaluation was guided by positivism. The data gathering procedure, measuring instrument and type of statistical analyses are also presented in this chapter.

#### **4.2 Research methodology**

A positivist approach is used in this study. Essentially, positivism is the view that the social sciences should use the same methods as the physical sciences. This means that social phenomena are considered to be objectively occurring phenomena. So for example, Human Resource Management should be more concerned with generalising than with particularising. This latter demand dictates that the social science should not concern itself with the description of unique historical events but should be primarily concerned with the generation of scientific laws. There should be a search for causal laws. Because a positivist approach is favoured for this study, a quantitative research methodology was used (Bailey, 1987: 8-9).

Probability sampling and non-probability sampling was used to collect the data. In probability sampling the probability of selection of each respondent is known. The specific sampling method used within probability sampling was random sampling. In random sampling, each person in the population has an equal probability of being chosen for the sample, and every collection of persons of the same size has an equal probability of becoming the actual sample. This is true irrespective of the similarities or differences among them, as long as they are members of the same population (Bailey, 1987: 8-9).

In non-probability sampling, the probability that a person will be chosen is not known. The obvious disadvantage of non-probability sampling is that, since the probability that a person will be chosen is not known, the researcher generally cannot claim that his/her sample is representative of the larger population. This limits the investigator's ability to generalise his/her findings beyond the specific sample studied. A non-probability sample may prove perfectly adequate if the researcher has no desire to generalise his/ her findings beyond the sample, or if the study is merely a trial run for a larger study. If the investigator plans to repeat the study at a later date he/she may initially be more interested in perfecting the questionnaire than in the sample and may find a non-probability sample adequate. It is also not a problem to use non-probability methods of data gathering when constructing a scale (Bailey, 1987: 87-93).

The specific type of non-probability data gathering method used was convenience sampling. As the name implies, it is a type of sampling where the researcher chooses the closest or most easily accessed persons/organisations as respondents. In this case the researcher asked people who have taken part in the study to refer him to others and he also contacted some of the major companies in the Gauteng province (the data gathering procedure is discussed in more detail in Section 4.3).

By using a quantitative research methodology, measurements were taken at the interval-ratio level and a variety of inferential statistical procedures were applied.

#### **4.2.1 The rationale behind scale development**

A brief discussion of the role of the latent variable in scales may help to clarify the process of a measurement model underlying a scale. The measurement model used in the development of a scale for managerial innovation was based on the assumptions of positivism.

#### **4.2.2 Understanding the latent variable**

A latent variable is the underlying phenomenon or construct that a scale is intended to reflect. A latent variable has two main features. Firstly, it is *latent* rather than manifest. Secondly, the construct is *variable* rather than constant - that is, some aspect of it, such as its strength or magnitude, changes. The latent variable is the actual phenomenon that is of interest, in this case, managerial innovation. Although the latent variable cannot be observed or quantified directly, it has a specific value under some specified set of conditions. A scale developed to measure a latent variable is intended to estimate its actual magnitude at the time and place of measurement for each person measured. This unobservable 'actual magnitude' is the true score (De Ville, 1991:14).

#### **4.2.3 Latent variable as the presumed cause of item values.**

The notion of a latent variable implies a certain relationship between the latent variable and the items. The latent variable is regarded as a cause of the item score - that is, the strength or quantity of the latent variable



(the value of its true score) is presumed to cause an item (or set of items) to take on a certain value.

An example may illustrate this point. The following are hypothetical items for assessing parents' aspirations for children's achievements:

1. My child's achievements determine my own success.
2. I will do almost anything to ensure my child's success.
3. No sacrifice is too great if it helps my child's success.
4. My child's accomplishments are more important to me than just about anything else I can think of.

If parents were given an opportunity to express how strongly they agree with each of these items, their underlying aspirations for achievement by their children should influence their responses. In other words, each item should be an indication of how strong the latent variable (aspirations for children's achievement) is. The strength or quantity of the latent variable causes the score obtained on the item for that parent, at that particular time (De Ville, 1991:15).

A causal relationship between a latent variable and a measure implies certain empirical relationships. For example, if an item value is caused by a latent variable, there should be a correlation between that value and the true score of the latent variable. Because the true score cannot be assessed directly, the correlation between the true score and the item cannot be determined. However, if there are several items that are presumably caused by the same latent variable, the relationships between the items can be examined. Thus, if one has several items like the ones above measuring parental aspirations for child achievement, one could look directly at how they correlate with one another, invoke the latent variable as the basis for the correlation among items, and use that

information to infer how highly each item correlated with the latent variable (De Ville, 1991:15).

### **4.3 Data gathering procedure**

As indicated in the problem statement in the first chapter, the research problem centres on investigating specific aspects of innovation and to do confirmatory and explanatory factor analysis on the innovation measuring instrument (scale).

The research subjects were chosen initially by means of random selection (probability sampling) and then by means of convenience sampling (non-probability sampling). The researcher used convenience sampling because of time constraints and low levels of initial response.

To select the companies that would form part of the study, The Researcher used the following procedure:

- Profile's Stock Exchange Handbook was used to identify Johannesburg Stock Exchange listed companies in the Gauteng Province. This was done in order to simplify the delivery and collection of the questionnaires containing the scale.
- Random numbers were assigned to all the companies identified and 40 companies were randomly selected to form part of study.
- The selected companies were contacted in order to establish whether they would be prepared to participate in the study. If not, a new company was selected randomly. In all cases, permission from top management or the CEO was obtained via a public relations officer or a human resources management manager.

- Questionnaires containing the scale were delivered to every selected company. The companies were requested to distribute the questionnaires to managers at middle and top management level and also to employees not involved in management. They were also requested to distribute the questionnaires among managers and workers in different sections (for example, production, finance, human resources, etc.).

Unfortunately, quite a few of the companies that initially agreed to take part in the study kept the researcher waiting for months with promises that he would get the questionnaires and then informed him that they were not interested any longer in taking part in the study. Of the questionnaires received, 102 resulted from the use of random selection.

Time constraints and non-compliance by some of the selected companies necessitated a new approach to the distribution and collection of questionnaires. Various acquaintances employed in JSE listed companies were asked to distribute the questionnaires within their companies. The researcher also contacted some of the more well-known and larger companies in Gauteng. This was also done after first receiving permission from the companies concerned. The same instructions were given to companies selected in this manner. Of the questionnaires received, 309 were obtained through the use of convenience sampling.

In total, a number of 411 questionnaires were received back.

#### **4.4 Measuring instrument**

A semantic differential scale was used for this study. The semantic differential scale's measurement takes place at the interval-ratio level.

With this scale, one unit's difference means the same wherever it occurs in the scale and the value is absolute. The level at which the researcher wants to work determines the choice of the statistical tests that are used (Smit, 1985: 209).

The reasons for deciding to use the semantic differential scale were the following:

- The semantic differential scale can be used with sufficient reliability and validity; and
- a wide variety of statistical tests can be used with this scale.

The scale was developed by means of the following steps, which took place in a previous study (Boonzaaier, 2001):

- 1. Determine clearly what it is to be measured.** Various theoretical models as well as research on all aspects of innovation was used to determine what must be measured. This scale is well grounded in substantive theories relating to innovation.
- 2. Generate an item pool.** A large pool of possible items was assembled. All items were carefully scrutinised in order to ensure that the scale's purpose is reflected. The different aspects of organisational innovation that was covered are:  
(a) qualities of individuals that influence creativity; (b) qualities of the environment that influence creativity; and (c) the structural, collective, and social conditions for innovation in organisations.
- 3. Select items to be included in the scale.** The scale for managerial innovation was composed by selecting 88 items from the item pool.

4. **Determine the format for measurement.** A semantic differential scale was used. Each item had 7 response categories ranging from 1 (strongly disagree) to 7 (strongly agree).
  
5. **Administer items to a development sample.** The sample size and composition have already been discussed under the data gathering procedure section.
  
6. **Evaluate the items.** After an initial pool of items had been developed, scrutinised, and administered to a sample, the performance of the individual items was evaluated in order to identify the appropriate ones that would constitute the scale. For a scale to be acceptable, it should be reliable and valid. (correlation and reliability analyses were used in this process).

#### 4.5 Statistical analyses

The Statistical Package for the Social Sciences (SPSS) and SAS was used to capture and analyse the data. The choice of SPSS and SAS as the preferred software to analyse the data was guided by practical considerations. The SPSS and SAS statistical packages are widely used and accepted within the economic, business, and social sciences. The SPSS and SAS packages were sufficient for the types of tests that were used.

The data obtained were analysed by using the following:

- Frequency analysis on biographical data;
- Factor analysis;
- Analysis of Variance.

Frequency analysis was used to give a profile of the respondents who took part in the study.

Factor analysis was used for explanatory and confirmatory purposes. It was used to establish whether there are clear factors underlying the items within the scale. The analysis of variance (ANOVA) test was used to determine whether there were any significant differences between the age groups, gender, educational level, industrial classification, seniority in organisation, and length of service in terms of innovative behaviour.

All the above statistical tests are discussed in more detail in Chapter 5.

#### **4.6 Validity**

The different forms of validation criteria are discussed in Chapter 5 to establish which validity criteria are applicable for the scale.

## CHAPTER 5

### 5 EVALUATION OF THE DATA

#### 5.1 Introduction

In Chapter 4, the research methodology that guided the research design was discussed. The data gathering procedure, measuring instrument and statistical tests used in this study were examined briefly.

In this chapter, the biographical data of the respondents is presented, as well as the various statistical tests used to evaluate the data.

#### 5.2 Biographical data

The following biographical data were obtained: age, gender, highest level of education completed, standard industrial classification for all economic activities as defined by the Central Statistical Service, length of service and seniority in the organisation concerned.

Particulars of the specific biographical variables are depicted in tables 2 to 7.

**Table 2: Age of respondents**

	Age in years	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-25	29	6.6	7.2	7.2
	26-30	77	18.7	19.2	26.4
	31-35	113	27.6	8.1	54.5
	36-40	94	22.9	23.5	78
	41-45	50	12.1	12.4	90.4

	≥46	39	12.3	12.4	84.6
	Total	402	97.8	100.0	
Missing	System	9	2.2		
Total		411	100.0		

More than half of the respondents were between the ages of 30 and 40. Very few respondents were in the age group of 20 to 25 years.

**Table 3: Gender of respondents**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	213	51.8	52.7	52.7
	Female	191	46.5	47.3	100.0
	Total	404	98.3	100.0	
Missing	System	7	1.7		
Total		411	100.0		

The distribution of males and females in the study was almost even.

**Table 4: Highest level of education of respondents**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Gr 8-12	6	1.5	1.5	1.5
	Tech. cert.	113	27.5	28.0	29.5
	Tech. dipl.	38	9.2	9.4	38.9
	Bachelor	102	24.8	25.2	64.1
	Honours	88	21.4	21.8	85.9
	Masters dipl.	7	1.7	1.7	87.6
	Masters degr.	43	10.5	10.6	98.3
	Dr. laureates	2	.5	.5	98.8
	Dr. degr.	5	1.2	1.2	100.0
	Total	404	98.3	100.0	
Missing	System	7	1.7		
Total		411	100.0		



As set out in Table 4, most of the respondents have some type of further education qualification. The majority of the respondents, who have further qualifications, have a technicon certificate, a bachelor's degree or an honours degree. Very few of the respondents had a doctorate degree.

**Table 5: Industrial classification of organisations where the respondents are employed**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agriculture, hunting, forestry & fishing	11	2.7	2.7	2.7
	Mining & quarrying	20	4.9	4.9	7.5
	Manufacturing	44	10.7	10.7	18.2
	Community, social & personal services, and local government	29	7.1	7.1	7.1
	Construction & engineering	18	4.4	4.4	29.7
	Retail, catering & accommodation services	24	5.8	5.8	35.5
	Transport, storage & communication	25	6.1	6.1	41.6
	Finance, insurance, real estate & business services	240	58.4	58.4	100
	Total	411	100.0	100.0	

According to Table 5, the majority of the respondents are employed in the finance, insurance, real estate and business services. This has created a situation where the sample is quite skewed. The situation was remedied by weighing the data in terms of the actual employment by industrial category figures in the Gauteng province (as supplied by the Labour Force Survey of March 2005), to make sure that the raw data and the

data of the Labour Survey stand in the correct relation to each other. The weighted data was used for the statistical analysis.

**Table 6: Length of service in years**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-5	151	36.7	37.7	37.7
	6-10	121	29.5	30.2	67.9
	11-15	64	15.4	15.9	83.8
	16-20	41	10	10.1	93.9
	≥21	24	5.4	6.1	100
	Total	401	97.6	100.0	
Missing	System	10	2.4		
Total		411	100.0		

The categories (indicated as groupings of 5 years) higher than 21 were combined since each of the categories above 21 contained few respondents. The respondent with the longest service in years was 42 years. The majority of the respondents had less than 10 years service at their present workplace. Since no information was obtained about previous work experience, it would be pure speculation to try to correlate length of service with seniority in organisations. For instance, it might be that the respondents with fewer than 5 or 10 years of service were employed at other organisations before joining the organisation where they are currently employed at the time the study was conducted.

**Table 7: Seniority in organisation**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Senior management.	106	25.8	27.2	27.2
	Middle management	163	39.7	41.8	69.0
	Non management	121	29.4	31.0	100.0
	Total	390	94.9	100.0	
Missing	System	21	5.1		
Total		411	100.0		

Table 7, indicate that most of the respondents are at middle management level.

### 5.3 Factor Analysis

Before the factor analysis was done, some of the questions in the questionnaire were reverse-scored. When items were generated, statements that related equally to the construct being measured (innovation) were identified; some were positive and others negative. Most of the items in the scale were scored in a positive direction. Thus a high score on an item indicates a high level of managerial innovation and a low score indicates a low level of managerial innovation.

The items that related to the construct in a negative direction were reverse-scored to ensure that all the items relate to the construct in a positive direction. The reason for this is that the researcher wanted high scores on the scale to be a reflection of a high level of innovation, and a low value to reflect a low level of innovation. For example, Item 26 in the scale states that 'A lot of crisis management takes place within the company'. If a respondent indicated that he/she strongly agreed (value 7) with the statement, it actually reflected negatively on the company in

terms of innovation. Innovative companies are more pro-active than companies that are not successful in terms of innovation. By reversing the score, 7 (strongly agree) become 1 (strongly disagree) and thus reflect a low score for this item in terms of managerial innovation. It could be argued that the scores for items that relate negatively to the construct being measured should be ranked in a descending order. The problem with such a process is that it may confuse the respondent. According to De Vellis (1991: 82), by reverse-scoring such items, more positive correlations can be created. This is important since one seeks a set of scale items that is highly intercorrelated. The items that were reverse-scored were the following: Items 26, 27, 44-47, 59-62, 77, and 84. The reverse scoring was done manually. The database was accessed and the above mentioned items for each respondent were changed as follows: If the score on an item was 7 it was changed to 1, 6 to 2 and 5 to 3 and *vice versa*.

After the above items had been reverse-scored, the data were submitted to factor analysis.

Consult Appendix A for the complete scale of managerial innovation as it was handed to the respondents.

The following items were excluded after the initial factor analysis; v22; v42; v51; v55; rv64; rv65; rv79. These items were excluded since they scored low and did not contribute much to the individual factors of which they were part of.

Factor analysis was done again on the remaining items after the above mentioned were excluded.

Five factors were identified. The five factors with the items that are part of it are as follows:

**Factor 1 (Leadership and culture)**

7. When we recruit new workers we seek people who are self-motivated.
8. The organisation has a special recruitment program that seeks to recruit people who have special cognitive abilities in their particular fields.
14. It is important that the person we recruit have some experience in his/her specific field
16. We seek to employ workers who are persistent in doing their jobs.
18. It is important that our workers identify with the company.
20. We seek to employ workers who are intrinsically motivated.
23. Workers who deliver creative work are sure to be recognised.
24. Workers who deliver creative work are sure to be rewarded.
26. The workers work most of the time under extreme pressure.
28. Management serves as a good role model to workers.
29. Management is enthusiastic about the company.
30. The members of management have good communication skills.

31. Management protects workers from outside distractions and interference when completing their tasks.
32. Management matches tasks to workers skills and interests.
33. Management sets a clear direction without managing too tightly.
35. Management has created an atmosphere where ideas can be freely stated and evaluated.
36. The organisation values innovation.
37. The organisation tolerates failure of new ideas.
41. There is pressure on workers to perform better than other organisations in their related fields.
45. There exists open communication between the different departments and business sections.
47. With regard to communication, we have an open door policy meaning that all levels can have access to anyone to ask questions.
48. There is an emphasis on immediate face-to-face verbal (not written) communication.
49. There is a strong realisation among management of the interdependence between different departments or business sections.

50. There is a strong realisation among workers of the interdependence between different departments or business sections.
53. The company makes frequent use of integrative team mechanisms at middle levels of management.
58. There exist close interpersonal contacts via interpersonal communication channels in the company between different departments.
59. The company has a cosmopolitan rather than a local orientation.
68. The organisation allocates specific resources (money, staff, materials and space) for innovation to make it easier for potential innovators within the company to find resources.
70. The company leaders have pride in the company.
71. The company leaders are supportive of innovation.
73. Company leaders are committed to the company.
74. Experts in the company have a great deal of contact with experts in other fields.
75. There is formal communication links between experts in the company and users of products of the company.
82. The success of project teams is measured by results achieved rather than adherence to a predetermined course of action.

83. Management makes sure that when innovations are transferred to the rest of the organisation, that the organisation is already receptive to the idea and prepared for its use.
84. Management makes sure that when innovations are transferred to the market, that the market is already receptive to the idea and prepared for its use.
85. When new ideas/products need to be transferred to its users, management establishes a group whose formal responsibility is to move the new idea/product into active use.

**Factor 2 (employee acquisition and development)**

9. The organisation has a special recruitment program that seeks to recruit people who are experts in their areas.
10. The organisation has a special recruitment program that seeks to recruit people who are risk orientated.
11. The organisation has a special recruitment program that seeks to recruit people who have good social skills.
12. The organisation has a special recruitment program that seeks to recruit people who have a high level of general intelligence.
13. The organisation has a special recruitment program that seeks to recruit people who are leaders within their fields.
15. When we recruit a new worker we seek somebody who is a good team player.



17. We seek workers who can work independently.
21. Workers have freedom in deciding how to accomplish a given task.
27. Workers have freedom of operational autonomy-freedom in the day to day conduct of their own work.
34. Managers have sufficient access to the necessary resources, including facilities, equipment, information, funds and people.
38. It is easy for people to collaborate across levels and divisions.
60. Ideas can flow freely through the different departments in the company.
61. The company makes use of extensive cross-functional consultation.
62. Jobs are defined broadly in the company.
63. Job definitions permit jobs to overlap different task domains.
66. Job assignments that are given to workers are broad in scope.
67. Job assignments that are given to workers leaves the means unspecified, up to the doer.
69. The organisation has loosely committed resources (money, staff, materials and space) at local levels to make it easier for potential innovators to find resources.

76. The organisation makes use of differentiated innovation units, separated from ongoing operations in both a physical and an organisational sense.

78. The organisation makes sure that there is a continuity of personnel within a team who is involved with an innovation project.

80. Project teams work unencumbered by formal plans.

**Factor 3 (variables that facilitate problem solving and aid in innovation)**

19. We make use of programmes that teach individuals the necessary skills for creative thinking.

39. Management has sufficient time to explore different perspectives when a new problem arises.

40. Workers have sufficient time to explore different perspectives when a new problem arises.

46. There is frequent mobility (lateral career moves) in the company.

52. There exists mobility across jobs in our organisation.

54. The company makes frequent use of integrative team mechanisms at upper levels of management.

**Factor 4 (variables that impact negatively on innovation)**

25. A lot of crisis management takes place within the company.

43. The managers are reluctant to change their way of doing things.
44. The workers are reluctant to change their way of doing things.
56. Communication between the different departments is difficult.
57. Communication between the different departments is formal.
72. Senior company leaders do not give the necessary support to new ideas.

**Factor 5 (variables external to the organisation that influence innovation)**

77. When a team is involved in the development of a new innovation they are buffered against outside interference (i.e. they are protected from the day-to-day functioning of the company).
81. Project teams work unencumbered from committees, board approvals, and other bureaucratic delays.
86. Management makes use of external agents to transfer a given product to its intended users (i.e. consultants and user groups).
87. Labour organisations do not have an influence on the transfer of an innovation to its intended market.
88. There is no mechanism (i.e. conferences, meetings and special interest groups) to transfer new ideas/products to its intended users.

89. Government policy and regulations do not have an influence on the transfer of an innovation to its intended market.

### **5.3.1 Reliability analysis**

Reliability analyses were conducted on the data obtained to determine the reliability of such data. Reliability analysis allows one to study the properties of measurement scales and the items of which they are made up. The reliability procedure calculates a number of commonly used measures of scale reliability and also provides information about the relationship between individual items in a scale. In general, the concept of reliability refers to how accurate, on average; the estimate of the true score is in a population of objects to be measured (De Vellis 1991: 94).

The assumptions on which reliability analysis are based is the following:

- Observations should be independent, and errors should be uncorrelated between items.
- Each pair of items should have a bivariate normal distribution.
- Scales should be additive, so that each item is linearly related to the total score (De Vellis 1991: 95).

The items in the managerial innovation scale conform to these assumptions. All the respondents completed the questionnaire containing the scale independent from each other; pairs of the scale have tested positively for a bivariate normal distribution, and the scale is measuring at the interval-ratio level that conforms to the criteria of addition.

Certain data considerations must also be taken into account. The data can be dichotomous, ordinal or interval, but it should be coded

numerically. The data in the scale for managerial innovation were at the interval-ratio level and were coded numerically.

The method for reliability assessment used in this study is the Alpha (Cronbach) test for reliability. This is a model of internal consistency based on the average inter-item correlation. The Pearson's correlation coefficients, a method that uses the average inter-item correlation, was used. Thus Alpha (Cronbach) was the most suitable method for reliability to use.

The reliability coefficient, alpha, which is obtained through reliability analysis, is one the scale's most important indicators of quality. Item problems such as poor variability, negative correlations among items, low item-scale correlations, and weak inter-item correlations will tend to reduce alpha. Therefore, after selecting the items, rejecting the low scoring items (below 0.55) and retaining the high scoring items (above 0.55), using alpha is a way of evaluating how successful the selection process has been.

The Alpha Cronbach scores for the different factors are given in Table 8.

**Table 8: Alpha Cronbach Scores**

Cronbach Coefficient Alpha	
Variables	Alpha
<b>FACTOR 1</b>	
Raw	0.966291
Standardised	0.966485
<b>FACTOR 2</b>	
Raw	0.911164
Standardised	0.910662
<b>FACTOR 3</b>	

Raw	0.815051
Standardised	0.816001
<b>FACTOR 4</b>	
Raw	0.770615
Standardised	0.769873
<b>FACTOR 5</b>	
Raw	0.607247
Standardised	0.602973

Alpha Cronbach scores above 0.9 are regarded as very high, and scores above 0.75 is regarded as high, with scores above 0.55 being regarded as acceptable. Thus Factor 1 and 2 have very high scores, Factor 3 and 4 high scores, and Factor 5 has an acceptable score. It can thus be said that the identified factors of the scale conform to the criteria for reliability.

## 5.4 ANOVA

### 5.4.1 Background

Subjects for the study were obtained by means of random and non-random sampling from economically active individuals in the Gauteng Province. The data obtained from the measuring instrument were subjected to factor analysis. Through this analysis five major influential and determining factors that influence innovation were identified, defined and computed. These derived *factors*, together with the biographical data (hereafter called *variables*), were then analysed in order to determine which variables could generally be attributed to which factors. Here it should be noted that the five variables, although generally analysed in isolation, were combined to give four additional 'composite' variables. Thus, in total nine variables were analysed.

The procedure generally known as the ANalysis Of VAriance (ANOVA) was used to perform the comparative analysis.

Throughout the analyses a significance ( $\alpha$ ) level of 0.05 was assumed.

#### **5.4.2 Discussion on Pre-processing and ANOVA**

There are two major assumptions that data need to satisfy for the analyst to be able to perform ANOVA. Firstly, the treatments (or groups of *variables* in this case) need to be independent. This is assumed to be the case by the research design of this study.

Secondly, the underlying distribution of each treatment (i.e. *factor*) needs to be normal. To determine the validity of this assumption, a range of tests pertaining to the location, range and distribution of the factors were performed prior to ANOVA.

The main outcomes of these preliminary analyses were the following:

- None of the factors come from a population with zero mean
- None of the factors were from normally distributed populations

As a result, the factors had to be transformed to represent characteristics of a normal distribution.

After the transformation, the ANOVA analyses were performed. In ANOVA, the means (i.e. the average factor values) of different groups of data (in this study groups are made out of different categories in the biographical data, e.g. all respondents who fall in age group 1 (20 – 25 years) categorise into one group). Thus the ANOVA procedure was repeated five times, once for every factor.

ANOVA performs a test for the following null- and alternative hypotheses:

$H_0$ : all means are equal

$H_1$ : at least one pair of means differ

The outcome of ANOVA can be to either accept or reject the null hypothesis.

Then, if the ANOVA procedure shows that the null-hypothesis of all means equal should be rejected, the next step is to identify which means differ (or in this case, which group (-s) of individuals differ from the rest and which exhibit similar means for the specific factor being analysed). The multiple comparison procedure employed in this study is known as the Sheffé Post Hoc comparison test. This test allows for pair wise comparison of the means used in the original ANOVA null hypothesis.

The tables in the following section provide a summary of the results obtained in the ANOVA and Sheffé tests for each of the 5 variables and 4 combined variables

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## 5.5 SUMMARIES OF ANOVA RESULTS AND INTERPRETATIONS THEREOF FOR VARIABLES VIEWED IN ISOLATION

**Table 9: ANOVA results for Variable 1: Age**

		F1: Leadership & culture			F2: Employee acquisition & development			F3: Problem solving & innovation facilitation			F4: Variables that impact negatively on innovation			F5: External influences on innovation		
Age group (years)	N	Mean	Std Dev	Scheffe Groups <sup>1</sup>	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups
20 – 25 (1)	27	4.14	0.78	B	4.12	0.70	B	3.61	0.93	A	3.68	0.76	A	4.01	0.45	A
26 – 30 (2)	70	4.16	1.04	B	4.08	1.03	B	3.74	1.09	A B	3.73	1.05	A	3.88	0.63	A
31 – 35 (3)	108	4.83	0.84	A	4.65	0.78	A	4.00	1.05	A B	3.85	0.99	A	3.58	0.74	A
36 – 40 (4)	88	4.88	0.99	A	4.54	0.88	A B	4.09	1.08	A B	3.66	1.13	A	3.70	0.88	A
41 – 45 (5)	48	4.92	1.08	A	4.41	0.97	A B	4.06	1.13	A B	3.85	1.30	A	3.65	1.07	A
>= 46 (6)	38	4.90	0.78	A	4.64	0.66	A B	4.33	0.95	A	3.98	0.96	A	3.78	0.92	A
p*		0.0157			0.0025			0.1262			0.5392			0.2644		

The results in Table 9 indicate that, of the five factors, age seems to play a significant role in F1 and F2 (i.e. leadership and culture as well as employee acquisition and development). For these factors average achievement seems to increase with age. With regard to the other three factors age does not seem to impact on achievement significantly.

<sup>1</sup> Means with common characteristics do not differ significantly (Sheffé multiple comparisons) and are indicated with the same symbol e.g. A. Although the test performed just tests for significant difference, the means associated with A are generally that those of B, which are generally higher than those of C. Note that there are instances where clear distinction cannot be made between certain groups within a variable (e.g. when Sheffé grouping is A B).

\* Significance level of 5 % was assumed for the null hypothesis of equal means



**Table 10: ANOVA results for Variable 2: Gender**

		F1: Leadership & culture			F2: Employee acquisition & development			F3: Problem solving & innovation facilitation			F4: Variables that impact negatively on innovation			F5: External influences on innovation		
Gender	N	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups
Male (1)	203	4.90	0.93	A	4.53	0.88	A	3.99	1.01	A	3.86	1.11	A	3.53	0.89	A
Female (2)	176	4.44	0.99	B	4.36	0.89	B	3.98	1.13	A	3.70	0.99	A	3.94	0.65	B
p		0.8334			0.9994			0.9286			0.0509			0.0985		

Table 10 indicates that, although in three of the factors distinction could be made between higher and lower achievements, in none of the cases the difference could be deemed statistically significant. As a result it seems that in general gender does not impact significantly on innovation.



**Table 11: ANOVA results for Variable 3: Education**

		F1: Leadership & culture			F2: Employee acquisition and development			F3: Problem solving and innovation facilitation			F4: Variables that impact negatively on innovation			F5: External influences on innovation		
Highest level of education	N	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups
Gr. 8-12 (1)	6	6.05	0.66	A	5.12	0.66	A	5.33	0.61	A	3.17	1.38	A	3.56	0.58	A
Technicon certificate (2)	103	4.363	0.97	B	4.24	0.0	B	4.01	1.12	B	3.81	0.95	A	3.99	0.54	A
Technicon diploma (3)	34	4.50	1.12	B	4.30	1.10	B	3.90	1.20	B	3.95	0.96	A	3.71	0.95	A
Bachelor degree (4)	96	4.69	0.87	B	4.40	0.89	A B	3.91	0.94	B	3.77	1.05	A	3.53	0.77	A
Honours degree (5)	84	5.06	0.86	B	4.78	0.75	A B	4.07	1.06	B	3.72	1.13	A	3.83	0.91	A
Masters diploma, masters degree, doctorate laureates, doctorate degree (6)	56	4.75	1.01	B	4.46	0.80	A B	3.84	1.07	B	3.82	1.19	A	3.43	0.92	A
P		0.0001			0.0034			0.1191			0.6488			0.1088		

The impact that highest level of education has on innovation was found to differ significantly between the levels for two factors, namely F1: Leadership and culture and F2: employee acquisition and development, as can be seen in Table 3. Although these factors seemed to improve with age, they seem to decline as the level of education increases. The effect education have on innovation is surprising since it is contrary to the literature.



**Table 12: ANOVA results for Variable 4: Industry**

		F1: Leadership & culture			F2: Employee acquisition and development			F3: Problem solving and innovation facilitation			F4: Variables that impact negatively on innovation			F5: External influences on innovation		
Industry	N	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups
Agriculture, hunting, forestry and fishing (1)	10	5.21	0.59	A B C	4.66	0.24	A B	4.28	1.02	A B	3.17	0.48	B C	3.9	1.01	A
Mining and quarrying (2)	19	4.52	0.75	C D	4.24	0.57	B C	3.90	0.66	B C	3.71	0.95	A B C	4.17	0.85	A
Manufacturing (3)	43	4.93	0.80	A B C	4.42	0.93	A B C	4.07	1.11	B C	4.32	0.80	A	3.01	1.02	B
Local government, community, social and personal services (4)	29	3.80	1.03	D	3.69	0.81	C	3.10	0.64	C	3.47	1.00	A B C	3.41	0.72	A B
Construction and engineering (5)	17	5.65	0.67	A B	4.97	0.64	A B	3.43	0.87	B C	2.66	1.40	C	4.07	0.57	A
Retail, catering and accommodation services (6)	24	5.63	0.47	A	5.29	0.52	A	5.20	0.73	A	3.63	1.14	A B C	3.81	1.19	A B
Transport, storage and communication (7)	23	4.82	0.65	A C	4.64	0.66	A B C	3.95	0.97	B C	3.73	1.18	C	3.46	0.61	A B
Financing, insurance, real estate and business services (8)	10	4.56	0.98	C D	4.41	0.90	B C	3.99	1.06	B C	3.87	1.01	A B	3.85	0.64	A B
p		< 0.0001			< 0.0001			< 0.0001			< 0.0001			< 0.0001		

Table 12 indicates that for all five factors there seem to be a very significant difference in average achievement when individuals from different industries are compared.

For F1 (leadership and culture) individuals in the retail, catering and accommodation industry tested highest. A number of individuals in other industry sectors also exhibited quite strong ability in this innovation factor, although their specific industry also had individuals with lesser ability in the fields of leadership and culture. These were:

- Agriculture, hunting, forestry and fishing
- Manufacturing
- Construction and engineering
- Transport, storage and communication

Local government, community, social and personal services tested the lowest in this factor.

For F2 (employee acquisition and development) individuals in the catering and accommodation industry again tested highest. The same holds for F1, where a number of individuals in the Agriculture, hunting, forestry and fishing; Manufacturing; Construction and engineering as well as Transport, storage and communication industries were also quite strong in the field of employee acquisition and development. Once again local government, community, social and personal services tested lowest in this factor.

As was the case for F1 and F2, individuals in the catering and accommodation industry again tested highest for F3 (problem solving and innovation facilitation). However, in this instance the only other

industry group that tested high for this factor was agriculture, hunting, forestry and fishing. Again local government, community, social and personal services tested lowest in this factor.

For F4 (variables that impact negatively on innovation) the manufacturing industry tested highest. Other industries that had individuals with quite high scores in this factor were:

- Mining and quarrying
- Local government, community, social and personal services
- Retail, catering and accommodation services
- Financing, insurance, real estate and business services

The industries scoring lowest for this factor were construction and engineering as well as transport, storage and communication

Lastly, for F5 (external influences on innovation) three top scoring industries were identified. These were:

- Agriculture, hunting, forestry and fishing
- Mining and quarrying
- Construction and engineering

The lowest scoring industry was manufacturing.

**Table 13: ANOVA results for Variable 5: Length of service**

		F1: Leadership & culture			F2: Employee acquisition and development			F3: Problem solving and innovation facilitation			F4: : Variables that impact negatively on innovation			F5: External influences on innovation		
Length of service (years)	N	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups
1 – 5 (1)	144	4.61	0.94	B C	4.51	0.89	A B	3.98	1.06	B	3.88	0.99	A B	3.75	0.70	A B C
6 – 10 (2)	115	4.42	0.99	C	4.22	0.88	B	3.67	0.97	A B	3.74	0.95	A B	3.681	0.77	B C
11 – 15 (3)	57	4.98	0.92	A B	4.49	0.93	A B	4.20	1.05	A	3.67	1.10	A B	3.41	1.03	C
16 – 20 (4)	39	5.06	1.02	A B	4.69	0.85	A B	4.35	1.16	A	3.50	1.47	B	4.10	0.86	A
> 20 (5)	24	5.17	0.83	A	4.75	0.62	A	4.43	1.06	A	4.18	0.94	A	3.89	0.79	A B
P		0.2754			0.1214			0.6011			0.4950			0.0027		

As can be seen from Table 13, length of service only impacts significantly on F5 (external influences on innovation). The results suggest that individuals who has been in service for between 16 and 20 years scored the highest for this factor. Individuals with more than 20 years' service also scored quite high in this factor, although not quite as high as their 16 to 20 years counterparts. Individuals in the category 1 to 5 years experience, although scattered around the range of achievements, also contained some high scoring individuals. The lowest scoring category for F5 was individuals with 11 to 15 years experience.

As far as the other factors are concerned, individuals with longer length of service generally scored higher than those with shorter service length, although the difference in achievement per factor did not test to be significant.



## 5.6 ANOVA results for combined variables

A number of tests were also conducted to determine the combined effect of certain identified variables. These are discussed in the tables on the following pages.

**Table 14: ANOVA results for combination of Variables 1 and 2: Age and Gender**

Variable and group			F1: Leadership & culture			F2: Employee acquisition and development			F3: Problem solving and innovation facilitation			F4: Variables that impact negatively on innovation			F5: External influences on innovation		
V1	V2	N	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups
1	1	8	3.94	0.61	B	3.90	0.46	A	3.35	0.83	A	3.75	0.89	A	3.77	0.40	A
1	2	19	4.23	0.85	A B	4.21	0.77	A	3.72	0.97	A	3.65	0.72	A	4.11	0.44	A
2	1	22	4.43	1.17	A B	4.16	1.10	A	4.02	1.12	A	3.45	0.75	A	3.77	0.73	A
2	2	48	4.04	0.97	A B	4.05	1.01	A	3.60	1.06	A	3.85	1.15	A	3.93	0.58	A
3	1	60	4.85	0.86	A B	4.67	0.78	A	3.79	0.97	A	4.07	1.02	A	3.39	0.75	A
3	2	48	4.80	0.81	B	4.63	0.79	A	4.26	1.09	A	3.57	0.88	A	3.82	0.66	A
4	1	58	4.97	0.97	A B	4.54	0.95	A	4.07	1.04	A	3.80	1.16	A	3.59	0.97	A
4	2	30	4.73	1.02	A B	4.56	0.76	A	4.12	1.18	A	3.38	1.03	A	3.91	0.64	A
5	1	33	5.23	0.83	A	4.52	0.95	A	4.07	1.02	A	3.89	1.42	A	3.52	1.10	A
5	2	15	4.25	1.27	A B	4.18	1.02	A	4.03	1.38	A	3.78	1.01	A	3.93	0.98	A
6	1	22	5.23	0.47	A	4.81	0.48	A	4.41	0.86	A	3.85	1.02	A	3.50	0.97	A
6	2	16	4.47	0.92	A B	4.41	0.81	A	4.22	1.08	A	4.16	0.89	A	4.16	0.70	A
P			0.0101			0.2183			0.0021			0.2605			0.4207		



A significant difference in average achievement was observed for F1 (leadership and culture) when the research participants are grouped based on both age and gender.

In general males of any age group tested equal to or higher than their female counterparts for F1, but the difference in achievement due to gender was not significant. Also apparent from the results is that generally the scores for F1 seemed to increase with age.

**Table 15: ANOVA results for combination of Variables 1 and 5: Age and Length of service**

			F1: Leadership & culture			F2: Employee acquisition and development			F3: Problem solving and innovation facilitation			F4: Variables that impact negatively on innovation			F5: External influences on innovation		
V1	V5	N	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups
1	1	23	4.21	0.77	A	4.22	0.67	A	3.70	0.88	A	3.76	0.76	A	3.96	0.46	A
1	2	4	3.72	0.80	A	3.54	0.63	A	3.08	1.14	A	3.21	0.60	A	4.29	0.28	A
2	1	37	4.42	1.02	A	4.29	1.06	A	4.03	1.13	A	3.82	1.06	A	3.82	0.69	A
2	2	33	3.87	1.00	A	3.85	0.95	A	3.40	0.95	A	3.63	1.04	A	3.94	0.55	A
3	1	46	4.87	0.74	A	4.75	0.67	A	4.05	0.94	A	4.06	0.98	A	3.61	0.77	A
3	2	43	4.77	0.82	A	4.49	0.75	A	3.71	0.95	A	3.87	1.02	A	3.63	0.65	A
3	3	19	4.84	1.10	A	4.78	1.05	A	4.54	1.29	A	3.29	0.75	A	3.38	0.86	A
4	1	25	4.79	1.08	A	4.73	1.01	A	3.99	1.28	A	3.79	1.05	A	3.81	0.66	A
4	2	21	4.65	0.91	A	4.44	0.80	A	3.92	1.02	A	3.65	0.78	A	3.62	1.02	A
4	3	24	5.18	0.83	A	4.53	0.87	A	3.99	0.81	A	3.63	1.32	A	3.34	0.95	A
4	4	18	4.90	1.11	A	4.44	0.83	A	4.56	1.14	A	3.54	1.38	A	4.11	0.74	A
5	1	7	4.20	1.31	A	4.07	1.13	A	3.69	1.15	A	3.67	1.13	A	3.60	0.67	A
5	2	9	4.43	1.14	A	3.94	0.92	A	3.81	1.01	A	4.11	0.91	A	3.17	0.95	A
5	3	11	4.87	0.86	A	3.95	0.83	A	4.08	1.13	A	4.33	1.00	A	3.41	1.52	A
5	4	16	5.31	0.95	A	4.92	0.81	A	4.02	1.14	A	3.28	1.65	A	3.88	0.92	A
5	5	5	5.71	0.69	A	5.10	0.62	A	5.10	1.11	A	4.43	1.00	A	4.40	0.61	A



			F1: Leadership & culture			F2: Employee acquisition and development			F3: Problem solving and innovation facilitation			F4: Variables that impact negatively on innovation			F5: External influences on innovation		
V1	V5	N	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups
6	1	6	4.91	0.57	A	4.64	0.49	A	4.42	1.18	A	3.86	1.26	A	3.41	0.97	A
6	2	5	4.76	0.94	A	4.52	0.96	A	4.23	0.58	A	3.57	0.64	A	3.07	0.95	A
6	3	3	4.53	0.59	A	4.43	0.29	A	4.22	0.35	A	3.94	0.42	A	4.11	0.35	A
6	4	5	4.85	1.00	A	4.82	1.00	A	4.67	1.22	A	4.03	1.34	A	4.80	0.80	A
6	5	19	5.02	0.82	A	4.66	0.61	A	4.25	1.00	A	4.11	0.94	A	3.75	0.79	A
P			0.5829			0.4203			0.4335			0.6671			0.4875		

The results of the tests for difference in achievement when the research participants are grouped according to age and length of service do not indicate that there is any significant difference in average achievement between the groups. However, the higher scores, although not significantly higher, often tend to be for individuals over 41 years of age – especially with respect to F1 and F2. This is coherent with the results of the analysis given in Table 14.



**Table 16: ANOVA results for combination of Variables 2 and 4: Gender and Industry**

			F1: Leadership & culture			F2: Employee acquisition and development			F3: Problem solving and innovation facilitation			F4: Variables that impact negatively on innovation			F5: External influences on innovation		
V2	V5	N	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups
1	1	10	5.21	0.59	A B	4.68	0.24	A B C	4.28	1.02	A B C	3.17	0.48	A	3.90	1.01	A
1	2	15	4.57	0.70	A B C	4.25	0.44	A B C	3.99	0.55	A B C	3.86	0.98	A	4.29	0.90	A
1	3	43	4.93	0.80	A B C	4.42	0.93	A B C	4.07	1.11	A B C	4.32	0.80	A	3.01	1.02	A
1	4	13	3.47	0.69	C	3.38	0.68	C	3.03	0.84	C	4.14	0.99	A	3.21	0.85	A
1	5	17	5.65	0.67	A	4.97	0.64	A B	3.43	0.87	B C	2.66	1.40	A	4.07	0.57	A
1	6	15	5.76	0.16	A	5.43	0.55	A	5.16	0.65	A B	3.64	1.03	A	3.47	1.01	A
1	7	17	4.89	0.50	A B C	4.69	0.73	A B C	3.87	0.77	A B C	3.88	1.34	A	3.25	0.57	A
1	8	73	4.82	0.98	A B C	4.52	0.88	A B C	4.00	0.96	A B C	3.96	1.05	A	3.65	0.68	A
2	2	4	4.35	1.01	A B C	4.21	1.01	A B C	3.58	1.00	B C	3.17	0.62	A	3.71	0.48	A
2	4	16	4.07	1.20	B C	3.94	0.84	B C	3.16	0.45	C	2.92	0.61	A	3.57	0.57	A
2	6	9	5.40	0.71	A B	5.06	0.41	A B	5.28	0.88	A	3.61	1.38	A	4.37	1.31	A
2	7	6	4.63	1.00	A B C	4.50	0.41	A B C	4.17	1.48	A B C	3.31	0.32	A	4.06	0.14	A
2	8	141	4.42	0.95	A B C	4.36	0.91	A B C	3.99	1.11	A B C	3.82	0.99	A	3.95	0.60	A
P			0.0634		A B	0.1170			0.7398			0.0113			0.1431		

The only factor where a significant difference in achievement was observed when the groups were based on gender and industry, was F4 (variables that impact negatively on innovation).

**Table 17: ANOVA results for combination of Variables 2 and 5 (Gender and Length of service)**

			F1: Leadership & culture			F2: Personal acquisition and development			F3: Problem solving and innovation facilitation			F4: Variables that impact negatively on innovation			F5: External influences on innovation		
V2	V5	N	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups	Mean	Std Dev	Scheffe Groups
1	1	66	4.81	0.88	A	4.65	0.83	A	3.94	1.01	A	4.06	0.99	66	3.57	0.82	A
1	2	56	4.65	0.99	A	4.32	0.92	A	3.81	1.01	A	3.71	0.97	56	3.47	0.87	A
1	3	38	5.09	0.87	A	4.41	0.94	A	4.07	0.94	A	3.83	1.15	38	3.18	0.95	A
1	4	24	5.11	1.09	A	4.68	0.95	A	4.03	1.16	A	3.47	1.60	24	3.88	0.90	A
1	5	19	5.33	0.47	A	4.83	0.53	A	4.53	0.86	A	4.18	0.97	19	3.87	0.88	A
2	1	78	4.43	0.95	A	4.39	0.93	A	4.01	1.11	A	3.72	0.98	78	3.90	0.53	A
2	2	59	4.21	0.95	A	4.13	0.84	A	3.54	0.92	A	3.78	0.94	59	3.88	0.61	A
2	3	19	4.74	1.00	A	4.67	0.93	A	4.47	1.21	A	3.33	0.94	19	3.86	1.04	A
2	4	15	4.97	0.95	A	4.69	0.71	A	4.87	0.98	A	3.54	1.30	15	4.46	0.67	A
2	5	5	4.55	1.53	A	4.41	0.90	A	4.07	1.71	A	4.20	0.92	5	3.97	0.32	A
P			0.2559			0.1193			0.8423			0.0618			0.2465		

For the test of difference in mean performance on the five factors influencing innovation, there does not seem to be any significant differences in achievement when groups are based on gender and length of service. This result is coherent with the finding that there is no significant difference in achievement for any of the factors when compared according to gender in Table 10 as well as no difference for F1 to F4 when compared according to length of service only. However, in the analysis for length of service in Table 13, there was a significant difference in achievement for F5 (external influences on innovation). This significant difference does not seem so apparent in this analysis – probably because the subdivision of the time of service-intervals into gender-intervals had a smoothing effect, so that no definite distinction could be made between groups.

## **5.7 Validity**

Whereas reliability is concerned with how much a variable influences a set of items, validity refers to whether the variable is the underlying cause of item co-variation. To the extent that a scale is reliable, variation in scale scores can be attributed to the true score of some phenomenon that exerts a causal influence on all the items. However, determining that a scale is reliable does not guarantee that the latent variable shared by the items is, in fact, the variable of interest to the scale developer. The adequacy of a scale as a measure of a specific variable is an issue relating to validity.

Validity is inferred from the manner in which a scale was constructed, its ability to predict specific events, or its relationship to measures of other constructs. There are essentially three types of validity that correspond to these operations: content validity, criterion related validity and construct validity (De Vellis, 1991: 43-45).

### **5.7.1 Construct validity**

A procedure for validating a new measure is to substitute it for an older measure in the test of a theory: The new measure is validated if the test of the theory yields the same results with the new measure as with the old measure (De Vellis, 1991: 45).

### **5.7.2 Criterion validity**

This refers to a technique for assessing the validity of a new measure or scale by comparing the score on the new measure with the score on an old measure thought to be valid, and thus chosen to the criterion (De Vellis, 1991: 45).

### **5.7.3 Content validity**

Content validity concerns item sampling adequacy - that is, the extent to which a specific set of items reflects a content domain. Content validity is easiest to evaluate when the domain is well-defined (De Vellis, 1991:46).

The type of validation that is applicable to the innovation scale is content validity. The theorists and researchers whose work the researcher used to develop the construction of the innovation scale are all acknowledged and well respected within their fields. These are: Amabile (1998; 1990; 1984; 1982), Burnside (1990), Delbecq and Mills (1985), Drucker (1985), Duncan and Holbek, (1973), Galbraith (1982), Gluckman and Liyanage, (2006), Harvard Business Essentials Series (2003), Hennessey & Grossman (1986) Kanter (1990; 1983), Kimberly (1981) Kimberly and Evanisko (1979), King and Anderson (2002), Koestner, Ryan, Bernieri, & Holt (1984), McGraw & McCullers, (1979), Quinn (1985), Rogers (1995), Van den Ven (1986), Walton (1987), Zaltman (1973).

It is the researcher's belief that the innovation scale is an accurate and true reflection of the domain of innovation (De Vellis, 1991: 45-46).

Neither construct validity nor criterion validity is applicable to the scale of managerial innovation, since the researcher did not substitute the scale for an older measure of managerial innovation or compare the score of the scale for managerial innovation with the score of an older scale that measures managerial innovation, due to the fact that the researcher could not find any scale devised to measure the complete process of managerial innovation.

## CHAPTER 6

### 6 RESULTS AND RECOMMENDATIONS

#### 6.1 Overview

Innovation is a term that is widely used and organisational development and business management literature emphasises how important it is for companies to be innovative if they want to survive current turbulent economic conditions. Management can be seen as the most important role players in the process of innovation. They must create the right conditions for innovation to take place, and must manage the whole process of innovation adequately. The new role that is envisaged for Human Resource practitioners is that of active partners in the design and execution of strategy. Innovation is one of the strategies that are being used by organisations in these turbulent economic times in which we live. Human Resource Management can play a crucial role in making innovative behaviour a reality.

In order to obtain a broader perspective of innovation, the study paid attention to the different definitions of innovation as well as the relationship between innovation, creativity and change (see Chapter 2). Furthermore, the study examined the characteristics of innovation, different types of innovations, types of innovation decisions and the sources of innovation.

Systems Theory was used as the theoretical underpinning of the study. Systems Theory allows one to view organisations in their totality and emphasises the interaction and interdependence between the various subsystems of an organisation. Furthermore it also draws the attention to the fact that the organisation do not operate in a vacuum but rather that one must pay attention to the environment in

which the organisation finds itself and how the organisational system interacts with the environment.

The work of various researchers was used to discuss organisational innovation. It was shown that individual creativity and organisational innovation are closely interwoven systems. Innovation consists of a set of processes carried out at the micro-level, by individuals and groups of individuals. These micro-processes are in turn stimulated, facilitated and enhanced - or the opposite- by a set of macro-structural conditions (see Chapter 3).

In Chapter 4 the research methodology was discussed. A quantitative methodology was used that falls under the positivist approach to research.

Chapter 5 dealt with the evaluation of the questionnaire used. By making use of factor analysis five factors were identified. The five factors identified were as follows:

- Factor 1 – Leadership and culture
- Factor 2 – Employee acquisition and development
- Factor 3 – Problem solving and innovation facilitation
- Factor 4 – Variables that impact negatively on innovation
- Factor 5 – External influences on innovation

The Alpha Cronbach test for reliability was used in this study. The Alpha Cronbach scores for the different factors were as follows:

Factor 1 = 0.966, Factor 2 = 0.91, Factor 3 = 0.816, Factor 4 = 0.77, and Factor 5 = 0.602.

Alpha Cronbach scores above 0.9 are regarded as very high, and scores above 0.75 is regarded as high, with scores above 0.55 being regarded as acceptable. Thus Factor 1 and 2 have very high scores, Factor 3 and 4 high scores, and Factor 5 have an acceptable score. It



can thus be said that the identified factors of the scale conform to the criteria for reliability.

Furthermore, the scale also conforms to the criteria for content validity. The scale includes the major tasks that are involved in the innovation process (at the macro level) as well as the processes at the micro-level as discussed in chapter 3. Innovation stems from individual talent and creativity, but whether or not individual skills are activated, exercised, supported and channelled into the production of a new model that can be used, is a function of the organisational and inter-organisational context.

The procedure generally known as the ANalysis Of VAriance (ANOVA) was used to perform comparative analysis on the biographical variables.

ANOVA were used with age, gender, educational level, length of service, industry and the five identified factors.

There are very few studies that investigate the relationship between age and innovation, gender and innovation, educational level and innovation, length of service and innovation, and industry type and innovation, as was done in this study. Thus not all of the results of this study can be compared with other data. Where it is possible the results of this study is related to existing data. The following research articles also investigated the relationship between age and innovation, gender and innovation, educational level and innovation, length of service and innovation, and industry type and innovation: Awamleh (1994), Bantel and Jackson (1989), Finegold (2006), Harhoff (1999), Reuvers, Marloes, Van Engen, Vinkenburg and Wilson-Evered (2008), and The Harvard Business Essentials (2003).

A discussion of the results and the above mentioned studies is presented in 6.2.

## **6.2 Results of the study.**

The results of the study were as follows:

### **6.2.1 Age and innovative behaviour.**

Age seems to play a significant role in Factor 1 and Factor 2 (i.e. leadership and culture as well as employee acquisition and development). For these factors average achievement in terms of innovation seems to increase with age. With regard to the other three factors age does not seem to impact on achievement significantly. This differs from Awamleh (1994:59) and The Harvard Business Essentials (2003:81) that assert that there is not a definitive relationship between age and innovation.

A study by Bantel and Jackson (1989) also differs from the results of this study. Bantel and Jackson (1989:114) have found that innovation is negatively correlated with average age. According to Bantel and Jackson (1989) there are several reasons to expect younger managers to bring better cognitive resources to decision-making tasks. First, some cognitive abilities seem to diminish with age, including learning ability, reasoning, and memory. Second, younger managers are likely to have received their education more recently than older managers, so their technical knowledge should be superior. Third, younger managers have been found to have more favourable attitudes toward risk-taking.

Awamleh's (1994) study was done in Jordan and the study The Harvard Business Essentials (2003) refer to, was done in America. The study of Bantel and Jackson (1989) was done in the American

banking sector. The differences in locality – and in the study of Bantel and Jackson (1989) the fact that the study only included the banking sector - can of course play a role in the differences in results. It might be that cultural differences – which influence the way business gets conducted – could be used to explain part of the differences. Another factor that can explain the part of the differences might be the legal framework in which businesses operate. Of course, to determine whether the difference in the findings of this study and that of Awamleh (1994), The Harvard Business Essentials (2003) and Bantel and Jackson (1989) can be attributed to the above mentioned is outside the scope of this study.

### **6.2.2 Gender and innovative behaviour.**

The results of this study indicate that there is no significant relationship between gender and innovation. This differs from Awamleh (1994:59) who states that there is a weak positive relationship between gender and innovation. According to this study, men are more innovative than women. It could be that the differences between the study of Awamleh (1994) and this study be explained by investigating the role that different cultures (Awamleh's study was done in Jordan) can have on the innovative behaviour of men and women. Not all cultures allow the same degree of freedom for women to take part in the economy and cultures also differ in the way in which they allow women entry to more senior positions in organisations. As stated by Reuvers, Marloes, Van Engen, Vinkenburg and Wilson-Evered (2008:235), people in higher positions are better placed to display innovative behaviour.

A study by Reuvers, Marloes, Van Engen, Vinkenburg and Wilson-Evered (2008:235) has found that there is a difference in the innovative behaviour of men and woman. Their findings indicate that men are moderately more innovative than women are. Their study

only involved the medical sector in Australia. Reuvers, Marloes, Van Engen, Vinkenburg and Wilson-Evered (2008:235) suggests that this might be because the upper levels of management in the medical field in Australia are dominated by men and generally people in higher positions are better placed to display innovative behaviour. It will be problematic to compare the results of this study with the results from the study of Reuvers, Marloes, Van Engen, Vinkenburg and Wilson-Evered (2008) since they involved only the medical field in their study whereas this study was conducted across all the economic sectors.

### **6.2.3 Education level and innovative behaviour.**

The results of this study indicate that there is a positive relationship between level of education and innovation for Factors 3, 4 and 5. It was found to differ significantly between the levels for two factors, namely Factor 1: leadership and culture, and Factor 2: employee acquisition and development. They seem to decline as the level of education increases. The effect education has on innovation when compared to Factor 1 and 2 are surprising since it is contrary to the literature on innovation and education.

Awamleh (1994:59) has found that although there is a weak relationship between level of education and innovation, that innovative behaviour seems to increase as the level of education increases.

Bantel and Jackson (1989:114) have also found that innovation is positively correlated with average education level.

A study by Harhoff (1999) explored the relationship between specific forms of education and the individual manager's ability to successfully drive innovation. The study by Harhoff (1999:159) has found that

there is overall a positive relationship between innovation and educational level.

A study by Finegold (2006) has investigated educational and training systems in different countries and the effect it has on innovation. Finegold (2006) also took the effect of the countries business cultures into consideration. The study of Finegold (2006:391-410) has found that it is important when analysing the relationship between educational level and innovation to take into consideration the nature of the educational and training system in the country in which the study takes place, as well as the business culture in that specific country. Taking this into consideration can also help explain the differences of the studies of Awamleh (1994), Harhoff (1999), Bantel and Jackson (1989:114) and the study by the researcher.

#### **6.2.4 Industry and innovative behaviour.**

The results of this study indicate that for all five factors there seem to be a very significant difference in average achievement when individuals from different industries are compared.

For Factor 1 (leadership and culture) individuals in the Retail, Catering and Accommodation industry tested the highest. A number of individuals in other industry sectors also exhibited quite strong ability in this innovation factor, although their specific industry also had individuals with lesser ability in the fields of leadership and culture. These were:

- Agriculture, hunting, forestry and fishing
- Manufacturing
- Construction and engineering
- Transport, storage and communication

Local government, community, social and personal services tested the lowest in this factor. This might be contributed to the fact that local government, community, social and personal services are public organisations and thus do not experience the same pressures as private companies to survive and therefore do not need to be as innovative. To establish this assumption will necessitate a separate study to confirm or refute the possible reason given by the researcher of this study.

For Factor 2 (employee acquisition and development) individuals in the Catering and Accommodation industry again tested highest. Individuals in the Agriculture, Hunting, Forestry and Fishing; Manufacturing; Construction and Engineering as well as Transport, Storage and Communication industries were also quite strong in the field of employee acquisition and development. Once again Local Government, Community, Social and Personal services tested lowest in this factor. The researcher of this study again feel that it might be contributed to the fact that local government, community, social and personal services are public organisations and thus do not experience the same pressures as private companies to survive and therefore do not need to be as innovative. However, to establish this, a separate study is needed to confirm or refute the possible reason given by the researcher.

As was the case for Factor 1 and Factor 2, individuals in the Catering and Accommodation Industry again tested highest for Factor 3 (problem solving and innovation facilitation). However, in this instance the only other industry group that tested high for this factor was Agriculture, Hunting, Forestry and Fishing. Again Local government, Community, Social and Personal Services tested lowest in this factor. The researcher of this study again feel that it might be contributed to the fact that local government, community, social and personal services are public organisations and thus do not experience the same

pressures as private companies to survive and therefore do not need to be as innovative. However, to establish this a separate study is needed to confirm or refute the possible reason given by the researcher.

For Factor 4 (knowledge of variables that impact negatively on innovation) the Manufacturing Industry tested highest. Other industries that had individuals with quite high scores in this factor were

- Mining and Quarrying
- Local Government, Community, Social and Personal Services
- Retail, Catering and Accommodation Services
- Financing, Insurance, Real Estate and Business Services

The industries scoring lowest for this factor were Construction and Engineering as well as Transport, Storage and Communication. This is surprising, as one would expect organisations in the Construction and Engineering industry to be aware of variables that impact negatively on innovation since organisations in this sector are faced with industry related innovations quite often. The same goes for organisations in the Transport, Storage and Communication industry. It could be that the managers and workers that completed the questionnaire were in positions in their respective organisations that do not deal with innovations in their industry, specifically referring to those who will deal with the financial aspects of their companies. However, this is pure speculation and the information is not available from this study to test this assumption.

Lastly, for Factor 5 (external influences on innovation) three top scoring industries were identified. These were

- Agriculture, Hunting, Forestry and Fishing

- Mining and Quarrying
- Construction and Engineering

The lowest scoring industry was Manufacturing. This is surprising, as one would expect organisations in the Manufacturing industry to be aware of the external influences on innovation, since organisations in this sector are faced with institutional requirements such as government policy and regulations and the impact of labour unions. The researcher can only speculate that the respondents of organisations in the manufacturing sector were not involved in dealing with the external influences on innovation within the positions they occupied in their respective organisations and would thus not be as knowledgeable about it.

These results could not be compared to results of other studies as none could be found that relates industry type to innovation.

#### **6.2.5 Length of service and innovative behaviour.**

The results of this study indicate that there is not a significant relationship between length of service and innovation. This differs from the results of the study of Awamleh (1994:59) who found a weak and negative relationship (innovative behaviour decreases as length of service increases) between length of service and innovation. A study by Bantel and Jackson (1999:114) has also found a negative relationship between innovation and the length of service. In their study they included only managers, whereas in this study people from management as well as non-management positions were included. According to Bantel and Jackson (1999:114) the negative relationship between length of service and innovation can be explained by taking into consideration that the managers who are with a company for a long time may have more psychological commitment to the organisational status quo and to organisational values. Consequently



change, which is an inherent part of innovation, may be resisted. In addition, long tenure within the same organisation may result in insulation and a narrowing of one's perspective.

#### **6.2.6 ANOVA results for combined variables.**

These results could not be compared to other research results in this regard as none could be found to compare it to.

In this study a significant difference in average achievement was observed for Factor 1 (leadership and culture) when the research participants are grouped based on both age and gender.

In general males of any age group tested equal to or higher than their female counterparts for Factor 1. Also apparent from the results is that generally the scores for Factor 1 seemed to increase with age.

For Factor 2, 3, 4, and 5 there is no significant difference in achievement when participants are grouped according to age and gender.

The results of the tests for difference in achievement when the research participants are grouped according to age and length of service do not indicate that there is any significant difference in average achievement between the groups.

For the test of difference in mean performance on the five factors influencing innovation, there does not seem to be any significant differences in achievement when groups are based on gender and length of service.

## **6.3 Recommendations**

### **6.3.1 Policy recommendations**

At present there is a lot of emphasis in South Africa on the transformation of society. This transformation is not only related to national matters such as the education system, but also to the transformation of the composition of companies in terms of accommodating previously disadvantaged groups. This is generally referred to as the equity principle that organisations must adhere to. It is mandatory from the year 2000 for organisations to supply the Department of Labour with information on how set targets will be achieved. Policies are created to specify how this process must take place. Policies relating to equity employment have to take a variety of factors into consideration. One of these factors is the need for companies to be innovative.

As stated in Chapter 1, innovation is a necessity for organisations if they want to survive in a competitive global market. Innovation is a complex and dynamic process, as illustrated in Chapters 2 and 3 and also in the items that constitutes the scale for innovation. If policies regarding equity employment do not take into consideration the complex and dynamic nature of innovation, it can be detrimental to the well-being of organisations and ultimately the country itself. Thus, policies relating to the equity principle have to be informed by research - such as explained in this thesis - on innovation. Organisations will have to inform themselves on the processes important within innovation. It is particularly important when appointing employees. As was discussed in Chapter 3, it is important for organisations to appoint people with the right skills and personality traits. Without creative workers, it is difficult for an organisation to be innovative, even if the structural conditions for innovation are in place.

### **6.3.2 Recommendations for practice**

Many organisations implement programmes to be more competitive in the marketplace. Where organisations implement programmes that are aimed at improving their innovative capacity, research such as explained in this thesis can be of help.

From the perspective of this thesis, such a programme should focus on the specific individual characteristics of individuals, work structures, organisational culture, and an awareness of the external influences on innovation.

### **6.3.3 Recommendations for further research**

Although the biographical variables were related to the different factors of innovation, more detailed information on some of the biographical variables is needed to be able to make more detailed and complete analyses of their relationship with innovation. In this regard specifically two variables come to mind: More detailed information is needed on the educational level and length of service. One will be able to make more meaningful interpretations of the data if it is known in what field a person's qualifications lie. It would then be possible to see whether there is a significant difference for instance between those who have a degree in an engineering field, the natural sciences, the social sciences and the economic and management sciences.

More detailed information is needed on the variable: length of service. The present data refer to the length of service at the organisation where the respondent is presently employed. Information about all the work experience of an individual as well as the type of work experience is needed to make a more complete analysis of the relationship

between length of service (work experience) and innovation. These are the aspects that can be explored in more detail.

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**Appendix A**

The questionnaire in its original form as it was handed to the respondents in the study.

**Instructions.**

Each statement is rated on a scale from 1 (disagree) to 7 (agree). Circle the number, which you feel indicate your impression of the statement. If you totally agree with a statement circle 7, if you agree to a lesser extent circle 5 or 6, if you are not sure about the statement circle 4 and vice versa for statements which you disagree with.

1. Age ..... years

2. Gender	Male	
	Female	

3. Highest level of education completed		
	Gr 8-12 (std 6-10)	
	Technicon certificate	
	Technicon diploma	
	Bachelor degree	
	Honours degree	
	Masters diploma	
	Masters degree	
	Doctorate laureates	
	Doctorate degree	
Other.....		

4. Industry .....

5. Length of service ..... years

6. Seniority in organisation	senior management	
	middle management	



non management positions	
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7. When we recruit new workers we seek people who are self-motivated.	1	2	3	4	5	6	7
8. The organisation has a special recruitment program that seeks to recruit people who have special cognitive abilities in their particular fields.	1	2	3	4	5	6	7
9. The organisation has a special recruitment program that seeks to recruit people who are experts in their areas.	1	2	3	4	5	6	7
10. The organisation has a special recruitment program that seeks to recruit people who are risk orientated.	1	2	3	4	5	6	7
11. The organisation has a special recruitment program that seeks to recruit people who have good social skills.	1	2	3	4	5	6	7
12. The organisation has a special recruitment program that seeks to recruit people who have a high level of general intelligence.	1	2	3	4	5	6	7
13. The organisation has a special recruitment program that seeks to recruit people who are leaders within their fields.	1	2	3	4	5	6	7
14. It is important that the person we recruit have some experience in his/her specific field	1	2	3	4	5	6	7
15. When we recruit a new worker we seek somebody who is a good team player.	1	2	3	4	5	6	7
16. We seek to employ workers who are persistent in doing their jobs.	1	2	3	4	5	6	7
17. We seek workers who can work independently.	1	2	3	4	5	6	7
18. It is important that our workers identify with the company.	1	2	3	4	5	6	7
19. We make use of programmes that teach individuals the necessary skills for creative thinking.	1	2	3	4	5	6	7



20. We seek to employ workers who are intrinsically motivated.	1	2	3	4	5	6	7
21. Workers have freedom in deciding how to accomplish a given task.	1	2	3	4	5	6	7
22. Management lay out clear guidelines to workers on how to achieve their tasks.	1	2	3	4	5	6	7
23. Workers who deliver creative work are sure to be recognised.	1	2	3	4	5	6	7
24. Workers who deliver creative work are sure to be rewarded.	1	2	3	4	5	6	7
25. A lot off crisis management takes place within the company.	1	2	3	4	5	6	7
26. The workers work most of the time under extreme pressure.	1	2	3	4	5	6	7
27. Workers have freedom of operational autonomy-freedom in the day to day conduct of their own work.	1	2	3	4	5	6	7
28. Management serves as a good role model to workers.	1	2	3	4	5	6	7
29. Management is enthusiastic about the company.	1	2	3	4	5	6	7
30. The members of management have good communication skills.	1	2	3	4	5	6	7
31. Management protects workers from outside distractions and interference when completing their tasks.	1	2	3	4	5	6	7
32. Management matches tasks to workers skills and interests.	1	2	3	4	5	6	7
33. Management sets a clear direction without managing too tightly.	1	2	3	4	5	6	7
34. Managers have sufficient access to the necessary resources, including facilities, equipment, information, funds and people.	1	2	3	4	5	6	7
35. Management has created an atmosphere where ideas can be freely stated and evaluated.	1	2	3	4	5	6	7
36. The organization values innovation.	1	2	3	4	5	6	7



37. The organization tolerates failure of new ideas.	1	2	3	4	5	6	7
38. It is easy for people to collaborate across levels and divisions.	1	2	3	4	5	6	7
39. Management has sufficient time to explore different perspectives when a new problem arises.	1	2	3	4	5	6	7
40. Workers have sufficient time to explore different perspectives when a new problem arises.	1	2	3	4	5	6	7
41. There is pressure on workers to perform better than other organisations in their related fields.	1	2	3	4	5	6	7
42. Workers are supplied with specific guidelines on how to achieve their tasks.	1	2	3	4	5	6	7
43. The managers are reluctant to change their way of doing things.	1	2	3	4	5	6	7
44. The workers are reluctant to change their way of doing things.	1	2	3	4	5	6	7
45. There exists open communication between the different departments and business sections.	1	2	3	4	5	6	7
46. There is frequent mobility (lateral career moves) in the company.	1	2	3	4	5	6	7
47. With regard to communication, we have an open door policy meaning that all levels can have access to anyone to ask questions.	1	2	3	4	5	6	7
48. There is an emphasis on immediate face-to-face verbal (not written) communication.	1	2	3	4	5	6	7
49. There is a strong realisation among management of the interdependence between different departments or business sections.	1	2	3	4	5	6	7
50. There is a strong realisation among workers of the interdependence between different departments or business sections.	1	2	3	4	5	6	7



51. The organisation uses an open physical arrangement in its office layout.	1	2	3	4	5	6	7
52. There exists mobility across jobs in our organisation.	1	2	3	4	5	6	7
53. The company makes frequent use of integrative team mechanisms at middle levels of management.	1	2	3	4	5	6	7
54. The company makes frequent use of integrative team mechanisms at upper levels of management.	1	2	3	4	5	6	7
55. Extra-organisational ties with users of the company's products are formalised (ie.user groups ect.).	1	2	3	4	5	6	7
56. Communication between the different departments is difficult.	1	2	3	4	5	6	7
57. Communication between the different departments is formal.	1	2	3	4	5	6	7
58. There exist close interpersonal contacts via interpersonal communication channels in the company between different departments.	1	2	3	4	5	6	7
59. The company has a cosmopolitan rather than a local orientation.	1	2	3	4	5	6	7
60. Ideas can flow freely through the different departments in the company.	1	2	3	4	5	6	7
61. The company makes use of extensive cross-functional consultation.	1	2	3	4	5	6	7
62. Jobs are defined broadly in the company.	1	2	3	4	5	6	7
63. Job definitions permit jobs to overlap different task domains.	1	2	3	4	5	6	7
64. Job definitions are formalised with duties finely specified.	1	2	3	4	5	6	7
65. Job definitions are formalised with duties finely codified.	1	2	3	4	5	6	7



66. Job assignments that are given to workers are broad in scope.	1	2	3	4	5	6	7
67. Job assignments that are given to workers leaves the means unspecified, up to the doer.	1	2	3	4	5	6	7
68. The organization allocates specific resources (money, staff, materials and space) for innovation to make it easier for potential innovators within the company to find resources.	1	2	3	4	5	6	7
69. The organization has loosely committed resources (money, staff, materials and space) at local levels to make it easier for potential innovators to find resources.	1	2	3	4	5	6	7
70. The company leaders have pride in the company.	1	2	3	4	5	6	7
71. The company leaders are supportive of innovation.	1	2	3	4	5	6	7
72. Senior company leaders do not give the necessary support to new ideas.	1	2	3	4	5	6	7
73. Company leaders are committed to the company.	1	2	3	4	5	6	7
74. Experts in the company have a great deal of contact with experts in other fields.	1	2	3	4	5	6	7
75. There are formal communication links between experts in the company and users of products of the company.	1	2	3	4	5	6	7
76. The organization makes use of differentiated innovation units, separated from ongoing operations in both a physical and an organisational sense.	1	2	3	4	5	6	7
77. When a team is involved in the development of a new innovation they are buffered against outside interference (i.e. they are protected from the day-to-day functioning of the company).	1	2	3	4	5	6	7
78. The organisation makes sure that there is a continuity of							



personnel within a team who is involved with an innovation project.	1	2	3	4	5	6	7
79. People who are involved in new product design have to report to management all the time.	1	2	3	4	5	6	7
80. Project teams work unencumbered by formal plans.	1	2	3	4	5	6	7
81. Project teams work unencumbered from committees, board approvals, and other bureaucratic delays.	1	2	3	4	5	6	7
82. The success of project teams is measured by results achieved rather than adherence to a predetermined course of action.	1	2	3	4	5	6	7
83. Management makes sure that when innovations are transferred to the rest of the organization, that the organization is already receptive to the idea and prepared for its use.	1	2	3	4	5	6	7
84. Management makes sure that when innovations are transferred to the market, that the market is already receptive to the idea and prepared for its use.	1	2	3	4	5	6	7
85. When new ideas/products need to be transferred to its users, management establishes a group whose formal responsibility is to move the new idea/product into active use.	1	2	3	4	5	6	7
86. Management makes use of external agents to transfer a given product to its intended users (i.e. consultants and user groups).	1	2	3	4	5	6	7
87. Labour organisations do not have an influence on the transfer of an innovation to its intended market.	1	2	3	4	5	6	7
88. There is no mechanism (i.e. conferences, meetings and special interest groups) to transfer new ideas/products to its intended users.	1	2	3	4	5	6	7
89. Government policy and regulations do not have an influence on the transfer of an innovation to its intended market.	1	2	3	4	5	6	7