Exploring organisational learning and knowledge management factors underlying innovation effectiveness

A thesis submitted for

the degree of Doctor
of
Philosophy

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April 2013

Abstract

Innovation is widely seen as a basis for competition and knowledge plays a key role in underlying its effectiveness in the present economy which is knowledge-based. The innovation process is highly complex and uncertain; it is fraught with ambiguity, risks, errors and failures. How organisations respond to these downsides is not well reflected in the literature. They are often placed in a black box and left empirically unexplored.

This researcher attempts to penetrate this box with an exploratory empirical study consisting of two research phases rooted in positivism. In Phase 1, a questionnaire survey is carried out with error management culture, organisational learning and knowledge management as antecedents of innovation effectiveness. The survey data collected are deductively analysed to test these four constructs. In Phase 2, the same data are inductively explored to determine the factors underlying innovation effectiveness.

From deduction, knowledge management is found to be the sole antecedent of innovation effectiveness, affirming the importance of knowledge to innovation. From induction, autonomy and trust are found to be key factors underlying innovation effectiveness. Their attributes in this study are collaboration, knowledge sharing and control (for autonomy) and behaviour, relationship and reciprocal faith (for trust).

The contributions from this study are – (a) an empirical confirmation on the importance of knowledge to innovation and (b) the derivation of autonomy and trust as key factors underlying its effectiveness. In addition, it contributes to research methodology with an exploratory integration of deduction and induction as complimentary modes of inference to facilitate the understanding of complex subjects like innovation. As a positivist research does not answer the causal *how* and *why* of innovation, it is recommended that future research on a similar topic moves to critical realism as a philosophical realm when an ontological dimension can be added to the epistemological exploration posited in positivism as found in this study.

ACKNOWLEDGEMENT

Thank you to my mentors for their supervision and support.
In alphabetical order, they are:

Professor John Burgoyne
Professor Ray Hackney
Professor Edward Truch

This thesis is dedicated to my mother (1915 – 2012).
She championed scholarship.

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
BPR	Business Process Reengineering
‘ECLK → IE’ process flow	'Errors → culture → learning → knowledge → innovation effectiveness' process flow
EMC	Error Management Culture
HR	Human resource
HRM	Human resource management
ICT	Information and Communication Technology
IE	Innovation Effectiveness
IT	Information Technology
KM	Knowledge Management
MNC	Multinational company
NHS	National Health Service in Britain
OL	Organisational Learning
O&M studies	Organisation and management studies
R&D	Research and development
TPS	Tetra Pak Singapore
TQM	Total Quality Management

APPENDICES

CHAPTER 1

INTRODUCTION

This chapter presents the research scope and context with an outline of the research issues. In it is also found the research framework and structure of the study.

1.1 RESEARCH BACKGROUND

Innovation has become a main component of the dynamics of organisational performance and it is viewed as fundamentally important to organisational effectiveness and competitiveness (Stehr, 2002; Hung, 2004; Adams *et al*, 2006; Hoeber and Hoeber, 2012). It is alluded that to reap the potential benefits from innovation, organisations must be effective in their approaches to innovations. Yet the literature is characterised by a multiplicity of divergent approaches and practices that is often inconsistent and puzzling to both researchers and practitioners. Innovation has been studied in different ways in relation to products, services and processes, amongst others.

This researcher looks at innovation as a process at the organisational level in relation to this definition of it - “An innovation is a new idea, which may be a recombination of old ideas, a scheme that challenges the present order, a formula, or a unique approach which is perceived as new by the individuals involved” (Van de Ven, 1986:591). His interest in the research area is rooted in his involvement with quality improvement, which is linked to incremental innovation in the literature, for twenty years at Tetra Pak.

Tetra Pak is a multinational food processing and packaging company of Swedish origin. It was founded in 1951 in Lund, Sweden and is identified with this insignia -

It is a leading food processing and packaging solutions company. It works closely with its customers and suppliers to provide safe, innovative and environmentally sound products that meet the daily needs of billions of people. Operating in more than 150 markets with well over 20,000 employees, it believes in responsible industry leadership, creating profitable growth in harmony with environmental sustainability

and good corporate citizenship. Tetra Pak has many factories for the production of packaging materials around the world. Its factory in Singapore (TPS) started its operation in the early 1980's.

This researcher was appointed its Quality Manager for twenty years from its inception in Singapore to year 2000 when he left the organisation. Quality is closely associated with innovation in the literature (Singh and Smith, 2004; Adams *et al*, 2006; Watson, 2012) and per this association, the innovation at TPS was deemed to be continuous and incremental, and not radical (Courvisanos, 2007:46).

Key to this researcher's appointment at TPS is the minimisation of operational errors. He initiated, with the support from management, a 'knows best/no blame' culture to address the minimisation of errors for these reasons – (a) an employee who does his or her job everyday knows best what he or she is doing and (b) errors are expedient experiential resources when there is a positive organisational culture in learning and knowing, rather than finger pointing and blaming when they are encountered.

This approach to errors minimisation thrived at TPS during this researcher's tenure there and its positive outcomes are reflected in Figure 1.1 and 1.2 where the amounts of rework and waste respectively were in check. The gradients of these outcomes were positively steep during the initial years of TPS's operation.

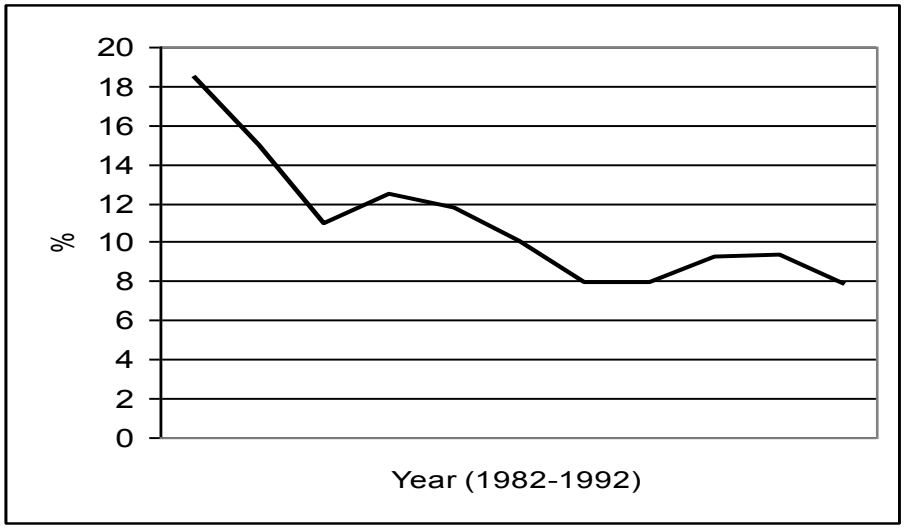


Figure 1.1 Yearly percentage of material for rework at TPS

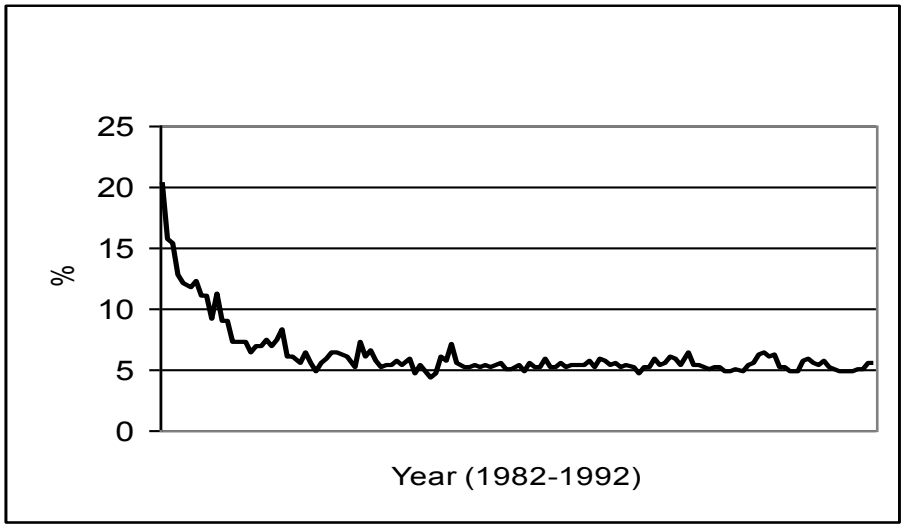


Figure 1.2 Monthly percentage of waste at TPS

The above two figures show TPS's developments from doing wrong to doing right through its 'knows best/no blame' culture where the encounters of errors were accepted as opportunities for organisational learning and knowledge management.

Bad quality is associated with faulty products, and error management principles have been argued to be in conflict with bad quality; this argument is correct because "companies cannot afford to produce faulty products" (van Dyck *et al*, 2005:1238). At TPS this argument was not a point of contention as error prevention and error management were respectively its first and second lines of defence in upholding its commitment to good quality.

TPS's managers walked "a fine line between taking errors seriously and emphasising error tolerance and between using information on errors as examples of (or lack of) performance and using errors opportunities for learning" (ibid.). This fine line of addressing errors is aligned with (a) a duality of control and learning (b) applied and recognised in areas such as Total Quality Management where there is (c) exploitation versus exploration, and (d) organisational learning per an organisation's attempt to implement an error management culture (ibid.).

The above brief introduction to TPS forms the backdrop that this study is anchored. It is central to this researcher's experiential reflection during his twenty years working there. During those years his thoughts in trying to bring TPS to the fore of good quality were mostly *ad hoc*. With this study, it is his intention to have his thinking on

quality/innovation more erudite. His exploratory study is inclined towards a more learned and knowledgeable approach demanded of a doctoral undertaking.

1.2 THE RESEARCH ISSUES

Monitoring innovation as a process is important for both the academics and practitioners. But in the literature reviewed, research on innovation as a process has disaggregated into many separate and different studies. As a result, there is an absence of a holistic framework covering the range of processual aspects required to effectively transform innovative ideas into purposeful implementations.

Adams *et al* (2006) endeavour to address this gap by reviewing the literature on the measurement of innovation and they have come forth with these seven areas of focus – inputs management, knowledge management, innovation strategy, organisational structure and culture, portfolio management, project management, and commercialisation. The first four areas are of linked significance to this study's research topic and they are elaborated further thus.

Inputs management is concerned with the resourcing of innovation and it ranges from physical resources, finance to human resources. The intensity of research and development (R&D) has been used frequently as a broad measure of inputs into the innovation process. The relationship between R&D intensity and innovation effectiveness has been empirically demonstrated in several studies but there is some ambiguity in the literature (Adams *et al*, 2006:26). An inverted-U relation between R&D intensity and innovation effectiveness is noted and it is pointed out that R&D intensity is an imperfect measure of the outcomes of innovation (ibid.). In addition, R&D cannot be regarded as an adequate proxy as it is only one of several inputs into the innovation process. The other factors are for example people, facilities, funds, and knowledge together with its management.

Knowledge management is concerned with the creation of ideas and the sharing of knowledge that underlie the innovation process. The generation of ideas is important to innovation as they are its raw materials. Researchers on innovation normally regard ideas as "plans to be implemented" (Vandenbosch *et al*, 2006:206). An innovation is the successful implementation of a creative idea, which may be expressed in the form of knowledge, practice, or a physical product (ibid.). An

innovation starts with an idea, but this original idea is frequently altered or re-invented during the innovation process according to changing contingencies and needs.

It has been proposed that 'idea management' be studied as a topic in its own right as 'ideation' is – "a capability that underpins human beings' adaptive and imaginative skills and as an essential faculty that propels everyday managerial action" (ibid.). Ideas do not observe hierarchical channels of communication Tampoe, 1993:49). Ideation has long been recognised as a critical start to product development processes (Hauser *et al*, 2006:702). A proper start with good ideation may help to resolve issues of research measurements.

Ideas have to be carefully screened at the commencement of an innovation process on their applicability. There is general agreement on the value of knowledge in facilitating innovation which can be explicit or tacit. However, the measurement of tacit knowledge is difficult and the investigation of this knowledge during the innovation process has been found to be complex. Issues relating to this complexity pertain to debates on the possibilities of sharing this knowledge, technically and socially, in organisations. It is proposed that by analysing the dimensions of relationships that precede or lead to knowledge sharing, we are better engaged in the various strategies that can improve an organisation's ability to create and share knowledge (Cross *et al*, 2001:108).

Innovation strategy has been defined as "a timed sequence of internally consistent and conditional resources allocation decisions that are designed to fulfil an organisation's objectives" (Adams *et al*, 2006:30). The activities of an innovation process must be consistent with its strategy and an organisation must make conscious decisions that align with its objectives. Innovation strategy generally describes an organisation's stance with regards to competition in terms of new product and market development plans. This techno-centric view prevails in the literature and it bypasses those innovative initiatives that are internally focused from a human resource perspective.

Knowledge is largely people-based and the cultural characteristics of different groups of people play key roles in the success and failure of knowledge management in relation to the subsequent development of competencies within organisations (Ajmal *et al*, 2009:339). Innovation process inefficiencies and ineffectiveness are less likely

to emerge when its strategy is embedded appropriately in the culture, behaviours and actions of the organisation. Such an embedment is more likely to bring to the fore underlying creative tensions for fruitful diffusion.

Organisational structure and culture are concerned with the ways employees are organised and the culture within which they work. An organisation's structure and culture have been identified to differentiate between organisations that are deemed to be innovative and those that are not. It has been found in the literature that the structural and cultural elements in an organisation's environment contribute to the levels of innovation effectiveness. There are many studies that contrast structure and culture as separate organisational entities, and not many connect the two together as a complementary union that enables innovation.

From the above elaboration, it becomes apparent that underlying innovation effectiveness is a multiplicity of factors and there is a dearth of empirical studies on these factors. From their review of the literature on the measurement of innovation management, Adams *et al* have found that there are a relatively small number of empirical studies of such measurements. "Measurement of innovation management appears to be undertaken infrequently, in *ad hoc* fashion, and relies on dated, unbalanced or under-specified models ... This suggests that a large part of the contemporary conceptualisation of the … phenomenon is overlooked in practitioners' measurement practices and consequently … opportunities for the more efficient and effective management of the innovation process are not realised" (2006:38).

Often when the factors underlying the process of innovation are difficult to understand and explain, they are more likely to be placed in a black box. A cycle of research normally moves from a cycle of 'description to explanation to testing', with continuing iterations of the cycle. But when the explanatory phase is left out and the research is between description and testing, a black box is used to replicate reality with no understanding and explanation of the phenomenon. Using human resource (HR) as an analogy to innovation, the challenge is to establish HR, or innovation, as a science. This means dealing with the black box that describes the strategic logic between an organisation's HR (or innovation) architect and its subsequent performance. In short, scientific evidence must be injected "into what has largely been a rhetorical debate over the role of HR in driving the performance in organisations" (Fleetwood and Hesketh, 2010:11).

This study attempts to address the above gaps found in the organisational innovation effectiveness studies as reviewed. It is tasked with the development of an appropriate research framework and model, and the use of the latter to empirically tease out the factors that underlie the innovation process.

1.3 THE RESEARCH CONTEXT

From the literature review, there has been a substantial interest in innovation and its present strong interest dates back to as far as the seminal work of Joseph Schumpeter in 1942 - *Capitalism, Socialism and Democracy*. In this work, Schumpeter had coined the term *creative destruction* and it is associated with a theory of economic innovation and business cycle. At its most basic, creative destruction describes the way in which capitalist economic development arises out of the destruction of some prior economic order. Some researchers in the literature have associated the process of innovation with creative destruction (Malerba *et al*, 1997; Hung, 2004; Brink, 2011).

"Ever since Schumpeter … one finds in the literature two conceptualisations of the process of technological change … At the cost of oversimplification, one can summarise the first conceptualisation as viewing technological change as a process of *creative destruction* … In contrast, the second conceptualisation emphasises that technological change is a process of *creative accumulation*" (Malerba *et al*, 1997:802). This study will embrace innovation as creative destruction and link creative accumulation to the accumulation of knowledge through its creation and sharing in the realm of knowledge management (KM).

Knowledge is important to innovation. Vakola has cited Peter Drucker in 1988 thus – "knowledge is the only lasting resource of competitive advantage" (2000:815). "To remain competitive – maybe even to survive – businesses will have to convert themselves into organisations of knowledgeable specialists" (Drucker, 1988: 50).

Knowledge facilitates innovation but many organisations are faced with a challenge of a knowledge gap where current knowledge is not at a sufficient level to introduce new products, services or processes (Hall and Andriani, 2002:29). This study looks into how to bridge this gap on existing knowledge and its requirements for innovation

effectiveness. This gap on knowledge will be looked into in this study per its management as in KM.

Generally it is found in the literature that there are limited successes with KM programmes in organisations (Scarbrough, 2003:504). These limited successes with KM may be due to its ambiguity as reflected in the literature. The study of knowledge is rooted in antiquity but KM as a self-conscious discipline is new (Jha and Joshi, 2007:134). When a discipline is new, it is to be expected that initial studies linked to it may not be clear-cut and unproblematic. Thus the limited success with KM studies should not deter but instead push researchers to study it even more, so that they can contribute to its pool of knowledge where there is a pull for such contributions.

Unsuccessful studies on KM are as valuable, if not more so, as its success stories. Learning is always a part of knowledge irrespective of the success/failure with KM. Failures may shed a different light on the underlying factors that are constraining an organisation's ability to apply knowledge to its KM initiatives. From an innovation perspective, KM initiatives are by themselves innovations. Whilst KM is typically presented as a medium for the innovation process – a means for creating, exchanging and integrating knowledge – it has also been viewed as an innovation in its own right (Scarbrough, 2003:504).

Thus the approach taken in this study to examine innovation effectiveness has a good parallel with KM effectiveness and an examination of them together has symbiotic and synergistic consequences. Both types of effectiveness have learning in common, and the latter pertains to reflective reviews on the stages of the innovation process, whether successful or not, the results of which should form the bases for further learning, leading to improved knowledge.

The outcomes from the stages of innovation may be expected or unexpected. The unexpected outcomes are potentially rich sources of innovation – unexpected successes, failures or outside events (Rutigliano, 1986:38). When it comes to the demands an unexpected outcome may make upon managers, Drucker had indicated this – "It demands that they alert themselves to it instead of trying not to notice it, or brush it under the rug because it is inconvenient" (ibid.).

This study will focus more on failures and errors as unexpected outcomes as it is more likely that they would be swept under the carpet in less tolerant organisational

cultures. Failures and errors, as unexpected outcomes, “present an opportunity if you are willing to subordinate your ego” as emphasised by Drucker (Rutigliano, 1986:39). There is much learning from failures/errors to gain knowledge for the fuelling of innovation. This study will explore this linkage – ‘errors → culture → learning → knowledge → innovation’.

The research on the linkage will be exploratory as the process of innovation has been described as uncertain, ambiguous and risky (Hung, 2004; Shaw *et al*, 2005). This study seeks to illustrate a general picture of an exploratory research journey to exemplify how studies on little understood phenomena can be done more effectively. It aims to show how this researcher adopts an appropriate approach and a relevant methodology in an attempt to cope with the uncertainty and ambiguity arising during the exploratory research (Mansourian, 2008:273).

A positivist approach is adopted with both deduction and induction as modes of inference in this study’s exploration of innovation effectiveness linked to errors, learning and knowledge. A study such as this, involving errors, culture, learning, knowledge and innovation simultaneously, is not found in the literature reviewed. Its underpinning is Schumpeterian, with the assertion from Drucker on the competitiveness of knowledge and knowledgeable specialists.

The purpose of this study is to investigate Drucker’s assertion with a questionnaire survey that is more global in intention. As many as possible multinational corporations, within and outside of Singapore, are contacted to participate in the survey. The unit of analysis is ‘organisation’.

1.4 SIGNIFICANCE OF THE STUDY

As indicated in the preceding section, there is yet a study in the extant literature review that put together errors, culture, learning, knowledge and innovation into one single study; there are some more straightforward studies though that involves innovation with each of the four antecedent variables. These five variables are put together in this study to embrace their complex interrelations as covered in Section 1.1 and 1.2. The research framework in this study is developed from the literature and this researcher’s working experience; and from the framework, a research model is proposed.

Having a research framework and model that are derived theoretically from the literature is important as it can help to bridge some of the gaps identified. This study is a replication of three previous studies from the literature reviewed. In the natural sciences replication is a common practice, but in the social sciences they are more uncommon (Tsang and Kwan, 1999:759). The replication in this study is carried out in relation to knowledge accumulation. A coherent body of knowledge is lacking in the social sciences and we can improve the present state of knowledge accumulation through the encouragement of more replications (Tsang and Kwan, 1999:771).

The significance of this study is in its development of the understanding of organisational innovation effectiveness. Its empirical approach is to address its more abstract concepts for a better alignment of them to the day-to-day context of managing innovation. In the absence of a better understanding of innovation, organisations may approach it with ineffective off-the-cuff and impromptu practices. Clarity on various concepts will be sought in terms of explanations in this study.

The practical significance of the study is associated with this researcher's interest in the research amalgamation of the five variables. His practical experience of working in an organisation with a no-blame culture, that promoted learning and the sharing of knowledge to improve on innovation, will add some experiential value to this study. This background will be valuable when the research outcomes can be interpreted and explained from actual experience in relation to this research question: -

Are error management culture, organisational learning and knowledge management, the determinants of innovation effectiveness?

1.5 RESEARCH FRAMEWORK

The research question in the preceding section has been identified through the literature reviewed and this researcher's experience. Answers to this question are explored in this study rooted in positivism based on two phases – deductive analysis and inductive exploratory analysis of the data collected from its questionnaire survey.

The details of the research framework are contained in these chapters of the study after this introductory chapter: -

Chapter 2 (Literature review)

The literature review is done on innovation in general and the main elements in the research question in particular. This review includes a look-out for definitions, theories, models, methods, measures and research instruments. The literature is also reviewed for insights on how the research issues identified have been studied by others. Research methods adopted by others in related fields of study are also tracked and noted for likely adoption.

Chapter 3 (Positivism – the research approach in this study)

The philosophical aspects of positivism are covered in this chapter. The connection between theory and data are looked into prior to a differentiation between deduction and induction. The understanding and use of deduction and induction as modes of inference are contained in this chapter.

Chapter 4 (Research design and hypothesis development)

The proposed research model and its research constructs are theoretically derived from the literature. The derivation of these is found in this chapter – (a) theoretical framework, conceptual model and proposed research model (b) research hypotheses (c) survey questionnaire from existing instruments in the three replicated studies. Piloting of the survey questionnaire and the main research survey are also contained in this chapter.

Chapter 5 (Deductive analysis - Phase 1)

Statistical analyses of the data collected are done with respect to sample characteristics, reliability, validity, correlation and regression. In this chapter, the regression results are deductively analysed to confirm or disconfirm the proposed research model and hypotheses.

Chapter 6 (Inductive exploratory analysis - Phase 2)

Inductive exploration of the same survey data is done with factor analysis and regression. The derived factors underlying innovation effectiveness are explored further. These factors are also gauged with an additional literature review on more contemporary related studies.

Chapter 7 (Discussions)

In-depth discussions on the factors inductively derived at are done per what are found in the additional literature review with this researcher's experience as a backdrop.

Chapter 8 (Concluding chapter)

These are summarily recollected at the beginning of the chapter – understanding of philosophical issues, besides deduction and induction. These recollections are followed by the main contributions and limitations of this study.

The two modes of inference, deduction and induction, are recalled in terms of their advantages and disadvantages. Their positivist outcomes can be explanatorily meagre and these limitations can be addressed in a recommended future research rooted in critical realism. With critical realism as a philosophy of science, a future critical realist researcher can better explain the causal links between innovation effectiveness and its underlying factors.

1.6 CONCLUSION

This chapter is an introduction to studies on innovation and its complexity. It has been studied in myriad ways in the literature leading to the view that the body of knowledge on innovation is fragmented. This study, instead of adding another fragment, works on the gaps identified in the literature by building on relevant previous studies through replication. Knowledge, a fuel for innovation as a process, can come from learning through encounters of its unexpected outcomes as the process unfolds. This study will focus on error as one of the unexpected outcomes for a research per this flow ~ errors → culture → learning → knowledge → innovation.

Instead of looking at the process of innovation as contained implicitly within a black box, this study attempts to look at its underlying factors within by opening the black box with two modes of inference – deduction and induction.

CHAPTER 2

LITERATURE REVIEW

Introduction

Prior to the review, studies on innovation are perceived as complex, multidisciplinary and multidimensional. A preliminary broad scan of innovation is done to determine (a) what innovation is, (b) its relation to organisational performance and (c) the measurement of its effectiveness as a process. From this initial scan, this researcher comes across many precursors to effective innovation and they are put together as a framework for further review of the literature to determine how the constructs for this study's proposed research model can be developed to address its research question.

The theoretical value of innovation research that has been done is problematic as its body of empirical study has extreme variance among its findings. Factors found to be important for innovation in one study are found to be less important, not important at all, or even inversely important in another study (Downs and Mohr, 1976:700). Twenty nine years from 1976 on, there still exists no attempt to construct a theoretical framework linking the different findings from this now huge literature on innovation (Castellacci *et al*, 2005:92). The existing literature on organisational innovation is very diverse and not well integrated into a coherent theoretical framework (Lam, 2004:3).

The innovation literature is a fragmented corpus, and scholars from a multiplicity of disciplinary backgrounds adopt a variety of ontological and epistemological positions to investigate, analyse and report on a phenomenon that is complex and multidimensional (Adams *et al*, 2006:22). Thus difficulties are faced when identifying a bounded body of literature in which a comprehensive discussion of innovation measurement issues might be found. The literature on innovation management encompasses widely divergent views and models (Dankbaar, 2003:xi).

2.1 WHAT IS INNOVATION?

When innovation is perceived to have come from such diverse and multiple disciplinary milieus, what is it basically? Perhaps it is more appropriate to get the basics of innovation to be contained fittingly in an orderly outline before its more intricate and complex facets are considered.

In Table 2.1 are some basics of innovation and their implications from the work of Carnall (1990). When innovation is deemed to be central to improving organisational effectiveness, it is necessary to understand why some circumstances appear to be more innovative than others. Table 2.1 provides some basic grounding and the key issues to be faced when deciding on a strategy for innovation (Carnall, 1990:66). When there is a willingness to face and understand these issues squarely, together with the ability to learn from the process of a more informed choice, an organisation will be better poised to garner more effective innovations.

Table 2.1 Basics of innovation

Innovation …	Implications
Is systematic	All factors (social, economic, political, technological, cultural, etc…) are inter-related.
Is non-linear	It experiences stops and starts, characterised by 'accidents'.
Is creative problem solving	Managers learn how to support people and facilitate teamwork.
Is situational	There is no one best way.
Requires appropriate structures	Traditional hierarchies are rigid; project teams and task cultures are more effective.
Can be stimulated	It requires major effort and involves significant learning.
Requires communities of interest	Customers can and should play a part.
Is mission-oriented	It creates impetus, high viability and 'success'.
Involves negotiation and participation	It involves conflict management.
Is itself innovation	It will never go the way of past innovations.
Is linked to information	The linkage is close.
Is personal and global	It involves and affects individuals and communities.

(*Adapted from Carnall: 1990:66*)

"Innovation is a language and like languages in general can generate endless new combinations" (Hampden-Turner, 2009:1-2). As innovation startles us, is unprecedented and unique, we begin to doubt that there is anything about it that can be generalised and passed on (ibid.).

In the 1970-80s, innovation was sought after to enhance organisation performance because it is laden with positive values (Downs and Mohr, 1976:700). But from the 1990s onward, innovation has less of a positive cast as it is then still deemed as an important driver, but not the only driver, of organisational performance. Innovation by itself is not enough to enhance competitive advantage and organisational performance. Even though a positive bias permeates the study of innovation (Van de Ven *et al*, 2000:58), such a bias is increasingly tempered by its practical realities. Innovation is a complex process, one that is identified as being of critical importance but not easily managed (Terziovski, 2002:5). This difficulty to manage it is reflected in the difficulty to define it.

2.1.1 Definitions of innovation

A definition on innovation from Van de Ven (1986) is introduced in Chapter 1 and there are many more that abound in the literature. The following is a tabulation of a spread of what some of these definitions are from a comparative perspective; it includes the one from Van de Ven as found in the first chapter.

Authors	Definitions of innovation
Downs and Mohr (1976)	The adoption of means or ends that is new to the adopting unit (p. 701).
Van de Ven (1986)	An innovation is a new idea, which may be a recombination of old ideas, a scheme that challenges the present order, a formula, or a unique approach which is perceived as new by the individuals involved (p. 591).
Damanpour *et al* (1989)	The adoption of an idea or behaviour – whether pertaining to a device, system, process, policy, programme, product, or service – that is new to the adopting organisation (p. 588).
Amabile *et al* (1996)	Innovation is the successful implementation of creative ideas within an organisation (p. 1155).
Wolpert (2002)	Innovation means pursuing radical new business opportunities, exploiting new or potentially disruptive technologies, and introducing change into the core concept of your business (p. 78).

Four of the above five definitions are focused on something new and novel with regard to the relevant unit of adoption; but it is not newness *per se*, and therefore subjective (Walker *et al*, 2002:203). The definition from Van de Ven is one of the few in the literature that is clearer on what is meant by 'new'. From his definition, if an idea is seen "as new to the people involved, it is an 'innovation' even though it may appear to others to be an 'imitation' of something that exists elsewhere" (Van de Ven, 1986:591-2).

The myriad definitions of innovation are linked to a host of innovation types such as these, amongst others - process-based (Davenport, 1993), technical and administrative (Van de Ven, 1986; Damanpour et al, 1989; Ravichandran, 2000), total, expansionary, evolutionary and incremental (Walker et al, 2002), knowledge-based (Drucker, 2002), disruptive, radical, complex and continuous incremental (Tidd, 2001), radical, incremental and integrated (Terziovski, 2002), value-based (Kim and Mauborgne, 1997), products and services (Miles, 2000), strategic

(Govindarajan and Gupta, 2001; Synder and Duarte, 2003), and networking (Harvard Business Review, 2002).

The innovation journey is unpredictable and theory may never reach a precision to tell managers exactly what to do and how an innovation will turn out to be (Van de Ven *et al*, 2000:xviii). Also the diversity of innovation determinants studied has led to instability and confusion. “The instability of the determinants from case to case frustrates theory-building efforts” (Downs and Mohr, 1976:701).

To alleviate the above instability and confusion, Downs and Mohr suggest a rejection of the notion that a unitary theory of innovation exists. Their suggestion of empirically distinguishable innovation types with associated models would help to accommodate theories which may include dissimilar variables, or they may contain the same explanatory variables while positing dissimilar interrelationships among them and different effects upon the dependent variable (ibid.). Perhaps this lack of a unitary theory underlies the spate of innovation definitions found aplenty in the literature.

More recent studies on innovation have it studied as a process. A process is an identifiable flow of interrelated events moving over time towards some goal (French and Bell, 1995:4). It shows how things get done in organisations to arrive at results. An event is a specified happening or action resulting from the enactment of one or more mechanisms (Wynn and Williams, 2012:792).

In this study innovation is approached as process-based; and it is defined from a processual perspective as ‘a process of changing for the better from the lessons and knowledge gainfully acquired per the unfolding of events in a change’. This definition is chosen for this study to be in tandem with its research topic; also the word ‘better’ is included to reflect on the word ‘effectiveness’ contained in the topic.

In an organisation and management (O&M) study, an innovation process is a temporal sequence of events that occur as people interact with each other to develop and implement their innovation ideas within an institutional context (Van de Ven and Poole, 2000:32). As a process, innovation is cut into shorter stages where control is monitored by asserting on clear boundaries (in time, resources and results) for each stage and on formal decision making at the end of each stage (Dankbaar, 2003:xvi). Each stage may involve intermediate processes that accrue to the overall innovation process.

When viewed as a process, the effectiveness of innovation can be better assessed in real time with respect to process expectations. Such expectations "deal with making progress in developing the innovation and solving problems as they are encountered" (Van de Ven and Chu, 2000:58). When problems are resolved this way, innovation effectiveness progresses in steps and stages. Effectiveness is the degree to which people assess the innovation process to be achieving their expectations (Van de Ven and Angel, 2000:13).

The effectiveness of the processes involved in the resolution per each step, and stage, can enable or hinder the overall outcome of an innovation. Thus the intermediate effectiveness of innovation is important as intermediate outcomes reflect dissimilar aspects of an organisation's performance, both financial and non-financial (Lee and Choi, 2003:182). When it comes to the measurements of innovation performance, there are contemporary empirical studies in the literature that operationalize measures linked to various aspects of innovation management.

But these studies lack consensus on the nature of innovation management for gaps to be identified and studies to be synthesised for knowledge accumulation (Adams *et al*, 2006:24). In the introductory chapter, contemporary studies on innovation have been traced to Joseph Schumpeter's work in 1942 - *Capitalism, Socialism and Democracy.*

2.2 A SCHUMPETERIAN OVERVIEW ON INNOVATION

"The success of everything depends upon intuition, the capacity of seeing things in a way which afterwards proves to be true, even though it cannot be established at the moment, and of grasping the essential fact, discarding the unessential, even though one cannot give account of the principles by which this is done" (Schumpeter, 1934:85).

The above citation from Schumpeter is the legacy he had left behind for us to reflect on when innovation is the subject of attention and contention. It emphasises the combination of intuition and skills, an intertwined capacity for acquiring a new idea and brings it to fruition (Brink, 2011:109).

A resurgence of interest in the Joseph Schumpeter's theory came about at the beginning of the 1980s with the seminal contributions in evolutionary and neo-Schumpeterian approaches in the field of economics. They focus on "the central role of innovation for the process of economic development" (Castellacci, 2005:91). Following these works is a rapid expansion of innovation studies bringing new insights which further attract researchers and policy makers. When new products, services, processes, organisations, and markets replace the existing for the better, they are in Schumpeter's words – 'creative destructions' (Lam, 2004:3).

Tzeng, in reviewing contemporary innovation literature from a Schumpeterian perspective, has cited Peter Drucker as saying that Schumpeter will shape the thinking on economics for the 20th, and into the 21st, century (2009:373). In his review, Tzeng has used legibility as a criterion to survey innovation studies linked to Schumpeter. By legibility he meant – the core ideas and contributions of each study are recognisable and integrated with the Schumpeterian tradition (ibid.). His review juxtaposes the economic, sociological and cultural perspectives of innovation to provide a bigger picture of it, under these three schools respectively – capability school, corporate entrepreneurship school and cultural school.

These three schools are not only limited to Schumpeterian stream; incorporated into this stream are other streams e.g. knowledge management (based on Polanyi's theory on tacit and explicit knowledge) and complexity adaptive systems (based on the natural sciences to better understand the nonlinear and dynamic relationships between innovative agents and their environments). For this study, these three schools will be referred to correspondingly as the Schumpeterian economic, social and cultural schools of innovation.

2.2.1 The Schumpeterian economic school of innovation

Here innovation, as an institutional capability, is characterised by technological change and the decision to innovate or not is done through evaluation. Within this school, the dynamic capabilities of an organisation are focused and they include its routines, relationships and other affiliations inside and outside of its boundary. Such capabilities are defined as "the organisation's ability to integrate, build, and reconfigure internal and external competences" (Tzeng, 2009:375).

The inherent logic of this school is the evaluation of costs and benefits. This evaluation is a matter of routine and the relationships among members are instruction-based. Routines govern the activities and behaviours of the members in terms of 'organisational memory', 'truce' and 'targets of control' (Tzeng, 2009:377). From a routine-based perspective, the members become an element that may be placed, moved and controlled by instructions.

Innovation from the economic school evolves in a path-dependent way that follows routines. They may meet with the reverse salient which are "components in the system that have fallen behind or out of phase with the others" (Hughes, 1987:73). Such encounters may affect the progress of a technical change. When the reverse salient is addressed with changes that allow movement forward as a progressive manoeuvre, the encounter is one of "competence enhancing change" (Tzeng, 2009:378). But when the reverse salient cannot be tackled and a new technology emerges and replaces the old one, a "competence destroying change" is said to have taken place.

2.2.2 The Schumpeterian social school of innovation

As named, the focus of this school is social and the 'grassroots impetuses' that underlie innovation are presented here as a pattern of corporate activities involving the engagements of many agents. "Innovators that 'run in packs' will be more successful than those who go at it alone" (Van de Ven, 2002:2). The agents may include an organisation's staff, customers and suppliers. In an innovative organisation, the innovation process "overlaps within and across departments" (Tzeng, 2009:379).

The way agents interact in the social school of innovation is one that moves towards networking in a community where loyalty is portrayed through the identity of membership in the community. Here innovation is something that happens in human relationships (Tzeng, 2009:380-81). These relationships are manifested by authentic voices that enable innovation to reveal itself in action as the innovation process takes after an uncertain progression. "The whole process is highly suspenseful because no one knows how it will unfold. Thus in the middle of innovation, everything can look like a failure" (ibid.).

2.2.3 The Schumpeterian cultural school of innovation

Here the emphasis is on high-tech innovation as a deep craft, associated with "a shared culture of beliefs, a shared culture of practice" (Arthur, 2001:7-11). True technical innovation cannot be created out of books; it takes on craftsmanship (ibid).

Deep craft is – (a) a set of skills and sensibilities that are not reducible to a science, (b) an intergenerational heritage in that it is shared through time, (c) renewed and reinforced in each era in accordance with its particular circumstances and (d) driven by vision and it "is motivated by purposes that go beyond simple materialism" (Graham and Shuldiner, 2001:xiv).

Vision is at the core of deep craft as innovative organisations envision in transcending the path dependence of technology (Tzeng, 2009:381). It is argued that high-tech innovation of the cultural school in the new economy is "old-world attention to craftsmanship" (ibid.).

Deep craft is built on intergenerational relationships and affective identification. Innovation does not come "from intrinsic properties of the knowledge itself … (but) from the personal commitment required of a revolutionary" (Berger and Luckman, 1967:144). A deep craft innovation comes from a deep sense of temporality; craftsmen comprehend the past, present and future simultaneously. Mintzberg describes this temporality thus – (a) craftsmen fuse the past with the future in the present, (b) they are aware of sitting between past experiences and future prospects, (c) memory and expectation merge in the province of attention, (d) they cast the past into the future through the present, (e) their present products may be a break with the past but they will still enters the genealogical series to become an inheritance (1987:66).

Such an innovation is emergent – "the craftsmen's unconsciousness reel over consciousness and melts away the linearity of time" (Tzeng, 2009:383). Graham and Shuldiner found that at Corning, innovation tends to be an accidental by-product rather than "the deliberate outcome of the directed research and a linear development" (2001:259). Innovation occurs when serendipity strikes.

2.2.4 The three Schumpeterian schools - building block ideas for innovation

The Schumpeterian economic, social and cultural schools of innovation can be used as platforms where basic ideas can be drawn upon to build one's thoughts and approaches to seed a research on innovation. In Table 2.2 is a summary of the building blocks from the three schools per the above discourses.

Table 2.2 Schumpeterian building block ideas for innovation

Building blocks	Schumpeterian schools		
	Economic	Social	Cultural
Nature of innovation	Innovation as institutional capability	Innovation as grass-root impetuses	Innovation as a deep craft
Inherent logic of innovation	Evaluation	Engagement	Envision
Relationships among members	Instruction-based relationship	Identity-based relationship	Intergenerational relationship
Focal concern	Affiliated institutions	Authentic voices	Affective identification
Apprehension of time	Path dependencies	Improvisation	Sense of temporality

Even though the perspectives of the three schools are looked into separately, they are not separate as such. There are overlaps amongst them and they are linked to Schumpeter as an inspirational source who broke away from conventional economic theories. In this sense Schumpeter is himself an innovator.

2.2.5 Schumpeter was an innovator

Joseph Schumpeter destroys to create with his thinking. When Tzeng (2009) can interpret his thinking 69 years on into three schools, it appears that Schumpeter is a deep craftsman in the cultural school of innovation. He is deemed to be an innovator when he is able to think out of the conventional economic box with these gifted capacities which span the subsequent, from one to the next – reasoning, reflection, imagination, deliberation, sense-making, intellect, belief and ability to break away from conventional wisdom.

Conventional economists, who favour equilibrium models and treat changes as exogenous, are challenged by Schumpeter who adopts a disequilibrium perspective

and treats economic change as evolutionary and technology as endogenous (Tzeng, 2009:387). “In dealing with capitalism we are dealing with an evolutionary process” (Schumpeter, 1942:82). The economic school of innovation has descended from this process, focusing on the technological prowess of innovation.

Free markets are made up of quantifiable aggregates of supply and demand, but the entrepreneurs should not be overlooked. To Schumpeter, an entrepreneur is “the bearer of the mechanism of change” (1934:61) and the outcome of this change is “filled cooperatively” (1991a:261). The social school of innovation descends from here, underlined by cooperation searching for and researching the social relations of innovation.

Conventional economists should also not overlook the role culture plays in innovations. In empirical economic models, entities studied are individualist, homogenous and they assume no memory. In comparison, “Schumpeter regarded innovation as a collective product, culturally coded, historically constructed” (Tzeng, 2009:388). The cultural school of innovation is built to study the “superstructure of innovation” (ibid.). Schumpeter is cited to have believed in these that underlie innovation – “traditions, beliefs … honour and beauty” (Schumpeter, 1991b:359).

One of the goals of this study is to broaden the current perspectives of contemporary studies on innovation. This goal is to bring together into being a study that is more rounded in its economic, social and cultural considerations of innovation. This attempt at aggregation is not to be equated with a sum of the three schools of innovation. Rather it pertains to a synergistic synthesis of them to obtain a more holistic aggregation that is beyond the sum of the parts. Such a synthesis is important to innovation as it “cannot be decomposed into infinitesimal steps” (Schumpeter, 1991a:138).

Another goal of this study is to synthesise contemporary innovation studies in the literature to come forth with a more holistic humanistic and social notion of innovation. Since the 1990s, some leading scholars have moved from a hard, economic perspective to a soft, cultural perception of innovation (Tzeng, 2009:389) e.g. from a call on the institutionalisation of innovation (Jelinek, 1979) to sense-making in innovation (Jelinek and Litterer, 1995). Jelinek is the same author that is behind the move on innovation from the institutional to the sense-making perspectives.

The Schumpeterian school that aligns more in parallel with this researcher's inclination is the social school. The summary in Table 2.2 will be used by this researcher as a preparatory step for his review of the literature relevant to his innovation areas of research interest that is linked to his working experience related to this field.

At the start of Section 2.2 it is indicated that other streams of innovation have been added to the review of the above Schumpeterian stream. Likewise more relevant streams will be added when the review of the literature moves deeper into the softer aspects of innovation, especially the social and cultural dimensions of innovation in the knowledge-based economy.

2.3 INNOVATION IN THE KNOWLEDGE-BASED ECONOMY

"Knowledge-based innovations differ from all others in the time they take, in their casualty rates, and in their predictability, as well as in the challenges they pose to entrepreneurs" (Drucker, 2002:100). Innovative knowledge is the most advanced type of knowledge that will greatly influence the dynamics within an industry (ibid.).

This type of knowledge enables a firm to lead its industry, and its competitors, to greatly differentiate itself from the others (Zack, 1999:133). Innovative knowledge frequently enables a firm to determine the rules of the game itself (ibid.). "The most obvious link between knowledge management and enhanced economic performance is in the area of innovation" (Demarest, 1997:381). All studies of innovation in the last twenty years have reached a similar conclusion: innovation starts with the construction of a new kind of knowledge within an organisation (ibid.). There is a symbiotic relation between innovation and knowledge, and there is synergy to be realised from such a relation.

"Continuous innovation has to be part of the work, the task and the responsibility of knowledge workers" (Drucker, 1999:84). Effective organisations consistently create, disseminate and embody new knowledge at the organisational level. These knowledge activities define the knowledge-creating company, whose main business is continuous innovation Truch (2001:25). But how will the effectiveness of this innovation be managed?

In the introductory chapter, it is indicated that there is a relatively small number of empirical studies on innovation - measurement of innovation management appears to be undertaken infrequently and opportunities for the more efficient and effective management of the innovation process are not realised.

The above dearth on empirical innovation management studies is reported in 2006 (Adams et al, 2006). Six years on in 2012, there is still a deliberation in the literature on how innovation management should be measured. The management dimensions, and their number, to determine innovation varies from authors to authors (Bulbul, 2012:169). A likely reason for this impasse in its monitoring and measurement is because innovation management is dependent on specific context (Ortt and van der Duin, 2008:522).

To this end, this researcher does not pursue the determination of innovation management but rather the antecedents to the effectiveness of innovation as a process per those shown in Figure 2.1. Here innovation effectiveness is focused as an intermediary to organisational performance as raised in Section 2.1. With innovation placed as an intermediary to organisational performance, a quick scan of the literature reveal that there are many antecedents in the literature related to innovation effectiveness and they are captured in the framework of Figure 2.1.

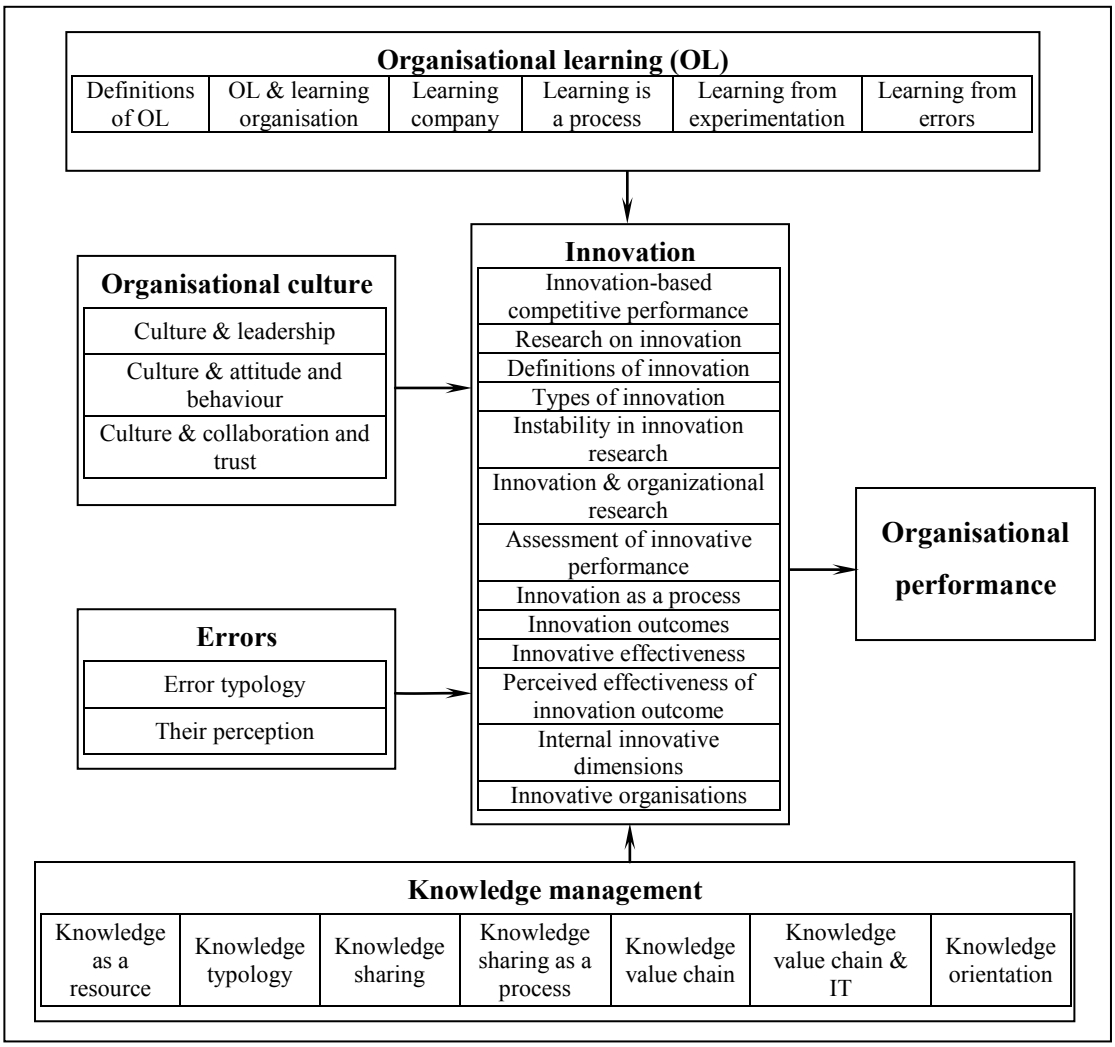


Figure 2.1: Framework on the antecedents to innovation

These antecedents in the above figure are arrayed to include these key concepts found within the scope of this study as stipulated in Section 1.3 – error, learning, knowledge and innovation. They are reviewed as building blocks for the development of this study's research constructs. In the midst of their review in the literature, other related concepts may come into being and they are also looked into. Figure 2.1 is basically this study's theoretical framework.

Innovation is not a stand-alone notion and it does not stand by itself. It affects the other concepts in Figure 2.1 and is in turn affected by them. The performance of an innovative organisation is embedded in an interlaced tapestry of complex, multi-dimensional and multi-disciplinary threads. By itself innovation is not enough for

competitive advantage; its integration with the other concepts is needed to bring about competitive advantages and desired performances in organisations.

2.3.1 Innovation by itself does not accrue to organisational performance

Innovations are assumed to bring competitive advantages to organisations. However a large number of businesses have adopted innovations without success (Baer and Frese, 2003:46). One possible explanation is the desired critical innovation contingencies may not be in place for organisations that are unsuccessful with it.

One of these contingencies is a lack of understanding of what innovation basically entails as reflected in Table 2.1. Behind these tabulated basics are other contingencies core to innovation – structure (organisational and social), human agency, culture and climate. When all these contingencies are taken into considerations, embracing innovation best practices are best not bought 'off the shelf' as there is no one size that fits all.

The identification and suitability determination of the contingencies with respect to an organisation's innovative context are critical. This identification and determination step is more important to specifying conditions that are important to those innovation packages from the shelf e.g. Business Process Reengineering, Total Quality Management (TQM), Just-in-time, Lean Production or Simultaneous Engineering.

2.3.2 Innovation – structure and human agency

In the knowledge-based economy are complex organisational systems where these two types of factors intertwine and shape emergent new possibilities (Ahrweiler et al, 2011:59) – (a) institutional frameworks of organisations (structures) and (b) self-organising interaction patterns and strategies of the individual actors (human agents). The relative primacy of structure and human agency are both important for innovation (ibid.).

Structure refers to "the innumerable social facts over which the individual, qua individual, does not have much control and which he or she cannot escape" (Mysolf, 2003:1). Race, class, sex, institutions, organisational hierarchy, group, geographical locality, roles and rules are all parts of structure. Agency refers to "the fact that we make culture, history and policy though not under conditions of our own choosing"

(Mysolf, 2003:3). Human behaviour is embedded in, and emerges through, social interactions. Social actions are volitional, purposeful, and meaningful although some social facts constraint life choices. Actors reflect rather respond by reflex (ibid.).

Agency and structure encompass the tension between social reproduction (stability) and transformation (change). On the world stage of life, we often find ourselves situated in upsetting spectacles; however, even though the stage of life has been set, as actors (though structures make us sashay and vex) we always have some choice as to how to play out the scene (Mysolf, 2003:8). When it comes to innovation, tension between agency and structure can be stretched from incremental to radical proportions.

From an organisational perspective, structure in an organisation refers to its social structure and it is "a portmanteau term to refer to configurations of causal mechanisms, rules, resources, relations, powers, positions and practices" (Fleetwood, 2005:201). Organisation structures allow management to (a) organise and deploy resources, (b) define job activities, responsibilities and accountabilities, (c) design decision making and information flows, (d) establish power make-up (Carnall, 1990:12). Structure influences the identity and image of an organisation and its employees' attitudes towards it. The way in which an organisation is 'structured' will exert a strong influence on the way people behave (Bessant, 2003:38).

Structure is an important construct for manoeuvring organisation improvement interventions such as innovation. If an organisation is highly bureaucratic with a top-down control structure, then innovation will be affected as there may be limited initiative and creativity. But on the other hand, if the top-down structure is highly autonomous, an organisation's innovative performance may have to be managed differently.

The literature on innovation is divided on the need for autonomy and the need for control especially in the knowledge economy where employees are increasingly recognised as knowledge workers. There is a tension between autonomy and control in relation to both innovation management and the knowledge economy. It is argued that knowledge workers occupy strategic positions of power in the knowledge economy, but the direct economic importance of knowledge may lead to more direct control and indeed manipulation of knowledge workers (Dankbaar, 2003:xii-xvii).

Autonomy enhances innovation as the latter develops better in organisation structures that are characterised by (a) loosely defined tasks and responsibilities, (b) horizontal rather than vertical communication and (c) considerable latitude for knowledge workers to guide and direct their own work (ibid.). However it is possible to introduce control into innovations when they are regarded as processes. Processual control elements can incorporated into an innovation process when it can be broken up into shorter phases for formal decision making at the end of each phase.

When it comes to agency, it has been translated into action as found in some of literature reviewed. Problems of action and structure underpin key issues in innovation process research (Hung, 2004:1479). Research into innovation processes can take either of these positions – (a) a voluntaristic (action) view that is focused on the capacity of risk-taking actors often exercising creative and destructive action in an age of disruption or (b) a deterministic (structure) position within the institutional context of structures in which the agents are socially shaped (ibid.).

For innovation, the action-structure dichotomy provides important insights, "but it does not tell the whole story" as innovation exists in both the voluntaristic and deterministic realities; any adequate theoretical understanding of innovation must include both aspects (Hung, 2004:1480). Here innovation implies both technological revolution and technological evolution; and its research model must move reasonably beyond a 'stage-to-stage' notion of innovation as a process, to a dynamic, continuous conception of change over time (ibid.).

Thus the innovation model to be developed must re-integrate the schism between action and structure positions to reflect their reciprocal association. With this re-integration, research (normally a lengthy innovation process that goes on in the black box between the agential actions and the outcomes from such actions) can now be assessed at various stages of "the process by which innovation emerge, develop and grow" (Hung, 2004:1481).

2.3.3 Innovation as a process

An innovation process is an identified temporal flow of related events when the interactions of people with others move towards some goals. In trying to explain how

organisations go about their innovation undertakings, researchers have often made use of process models consisting of several stages.

Some take the process to be sequential and linear in configuration, together with a stage gate approach to explain how ideas progress from one stage to the next. This view of innovation has been criticised as being too simplistic and not representing reality (Bernstein and Singh, 2008:368). Rather it is proposed that innovation be looked upon as "a complex process with multiple, cumulative and conjunctive progression of convergent, parallel and divergent activities" (ibid.).

Also innovation has been perceived as an uncertain process that relies on "improvisation, real-time experience and flexibility" (ibid.). From this perspective, innovation follows an unsure road through fast-moving changes, and the response is more geared towards uncertainty than certainty, iterative than linear, and experience-based than planned. In the literature, the number of stages for an innovation process has been found to range from thirteen to five (ibid.). But a four-stage model is the most common (Bernstein and Singh, 2008:368) with this sequential flow in thinking – (a) idea generation, (b) innovation support, (c) innovation development, and (d) innovation implementation.

An innovation process is one through which new ideas, objects and practices are created, developed or reinvented. (Walker *et al*, 2002:202). Understanding process dynamics can lead to these (Ravichandran, 2000:252) – (a) how innovations develop over time from concept to implemented realities, (b) which process leads to successful and which to unsuccessful outcomes, and (c) what extent can knowledge be generalised from one situation to another.

When viewed as a process, the effectiveness of innovation can be better assessed in real time with respect to processual expectations. Such expectations deal with making progress in developing an innovation and solving problems as they emerged and are encountered along the way (Van de Ven and Chu, 2000:58). When problems are solved this way, innovation effectiveness advances in progressive steps.

Effectiveness is the degree to which people judge the innovation process to be achieving their expectations (Van de Ven and Angel, 2000:13). The effectiveness of the processes involved in the resolution of the problems per each step can enable or hinder the overall outcome of an innovation. This has been discussed earlier in

relation to intermediate outcome effectiveness of innovation and behind this effectiveness are located an organisation's human resource.

2.3.4 Innovation and human resource management

"Certainly, people are a central aspect in any innovation effort" (Van de van, 2000:15). In today's economy, the "ability to build human capital and manage knowledge is vital for success in almost any organisation" (Cabrera and Cabrera, 2005:720). Human capital refers to the skills and abilities of individuals or the stock of knowledge within organisations (ibid.).

Most innovations are too complex for one individual to accomplish alone. Collective human resource is needed; and they need to be recruited, organised, managed and directed for innovation. Thus the link between innovation and human resource management (HRM) is persuasively strong.

HRM is defined as all management decisions and activities that affect the nature of the relationship between the organisation and its employees – the human resources (Leede and Looise, 2005:109). This is a breakdown of a number of the policies and practices important to effective HRM – e.g. (a) staffing of the organisation by managing the in-, through- and outflow of personnel, (b) design of organisations and tasks, (c) measurement of performance and the reward of employees, and (d) channels for communication and participation in work and decision-making.

From the above four components of HRM, innovation appears to have a close fit with all of them. Most of the literature on innovation, and its management, have given considerable attention to HRM issues (Leede and Looise, 2005:108). These are some of the HRM issues from the perspective of innovation – (a) development of a skilful and creative workforce, (b) building of high performance teams, (c) leadership roles in innovation processes, and (d) motivation and recognition of innovative contributions.

Much attention has been focussed on HRM from the literature on innovation. But on the other hand, less attention is given to innovation in HRM literature until recent times and interest in this direction appears to be fast-growing (ibid.).

The focus on people as the creators and facilitators of innovation must be balanced by equivalent attention to them as inhibitors of innovation too. Much of the literature on the management of innovation has "ignored the research by cognitive psychologists and social psychologists about the limited capacity of human beings to handle complexity and maintain attention" (Van de Ven and Angle, 2000:15). Generally people tend (a) to adapt unconsciously to gradually changing norms, (b) to conform to group and organisational patterns and (c) to limit their focus on repetitive actions (ibid.).

A question to HRM in addressing the innate nature of employees should pertain to this – "How do individuals become attached to and invest effort in the development of innovative ideas, when people and their organisations seem mostly designed to focus on, harvest, and protect existing practices and ideas rather than to pave new directions?" (Van de Ven and Angle, 2000:15). This question is linked to innovation issues, as weeds taking roots and causing damage in the cultural terrain of organisations.

2.3.5 Innovation and organisational culture

Organisation culture encases how people in a company are likely to act in given situations, both inside and outside the organisation (Carnall, 1990:168). This encasement is focused on beliefs, behaviour, standards of performance and ethics (ibid.). Innovation has a close association with changing an organisation's culture (Harvey and Brown, 2001:67) and culture is a crucial leverage point for intervening in the system to cause significant improvements (French and Bell, 1995:5).

Culture is the product of continuing social learning and it reflects more on what has worked in the past (Cummings and Worley, 2001:503) and changing it may be a difficult and long term process. With its impacts on an organisation's performance and effectiveness, culture has been used as an explanatory concept on why an organisation could succeed or fail as a business. "What happens in organisations is fairly easy to observe; for example, leadership failures, arrogance based on past success …; but in the effort to understand why such things happen, culture as a concept comes into its own" (Schein, 2004:xi).

A culture that supports high employee involvement can have a positive impact on organisational performance. But the strength of an organisation's culture can be both

an advantage and a disadvantage. It can foster or hinder innovation. A strong culture, found to be inappropriate in a fast changing environment, can be a liability as changing an organisation's culture is challenging. Culture has been looked at from different levels – nationally, regionally, organisationally and socially; and because society (as a whole with organisations within it) is continually changing, there is not a static culture that is universally relevant for all times and all situations (Ajmal *et al*, 2009:346). In the most general terms, culture refers to the way of life of a group of people, and Geert Hofstede is cited as defining culture as "an intangible collective of characteristics that distinguishes one group, organisation, or nation from another" (Ajmal *et al*, 2009:343).

In the earlier part of this sub-section, culture is denoted as the product of long-term social learning. It is associated with learned solutions to problems. Such learning can be engaged in two types of learning situations – (a) positive problem-solving situations that produce outcomes in terms of whether the attempted solution work or not, and (b) anxiety-avoidance situations that produce outcomes in terms of whether the attempted solution does or does not avoid anxiety (Schein, 1984:8).

Per the first type of learning, the individuals involved will try out various solutions to determine the ones that work for the long term. But for the second type of learning, once a lesson is gained on removing an anxiety, it stops there without any concern if it is a solution for the long haul and the anxiety may be re-encountered repeatedly. Those that belong to the first type are creative and have a balanced sense of psychological safety to take risks; those of the second type are not creative and are risk averse.

2.3.6 Innovation, creativity, risk aversion and psychological safety

"It is unlikely that any psychological construct could claim a more central position than creativity, in the study of innovation" (Angle, 2000:149-50). Creativity involves a process that is extended in time and characterised by (a) originality, (b) adaptiveness and (c) realisation (ibid.).

When it comes to innovation and creativity, action theorists argue that individual creativity (and by extension organisational innovations) are examples of man and woman's free will and capacity to rise above and beyond the reach of what are known (Hage and Meeker, 1988:99). Creative individuals do not attempt to predict or

produce a specific new product or service which is being invented, but rather to affect innovation rates and creativity rates (ibid.).

Creativity has been associated with a risk orientation; it is a consequential factor of psychological safety (Angle, 2000:152). Creative talent is important to innovation but it takes more than creativity to sustain high rates of innovation. An organisation needs to create a nurturing culture with the right conditions so that people would want to and can be creative and innovative. These conditions pertain to a risk-taking and nurturing culture that supports risks in relation to psychological safety.

Sustainable organisations are designed for desirable future states of its stakeholders and it includes managing risks while promoting innovation (Funk, 2003: 65-66). There is consensus that successful innovation requires (a) risk-taking, experimentation, and failure (Sitkin, 1996:568) and (b) a failure tolerant culture shored up by psychological safety that is positive aligned with sustainable organisations. Psychological safety is an employee's sense of "being able to show and employ one's self without fear of negative consequences to self-image, status or career" (Baer and Frese, 2003:50). It enhances an employee's creative potential for a higher performance.

An error tolerant culture is important to employees who will feel safe in taking interpersonal risks, are encouraged to propose new ideas and openly discuss problems (Baer and Frese, 2003:46). Such a culture contributes positively to innovations which are high risked in terms of errors, failures and mistakes. Generically not all organisations have such a culture as it is context specific.

2.3.7 Innovation and context

Context is a set of circumstances in which phenomena (e.g. events, processes or entities) are situated (Griffin, 2007:860). Context typically exists at a level of analysis above a phenomenon under investigation e.g. contexts such as organisations constitute the ground in which processes of lower level entities such as individuals and teams are enacted (ibid.). It is the setting, or institutional environment, within which innovative ideas are developed and transacted among its agents (Van de Ven and Angle, 2000:17).

An organisational discourse has not much meaning outside its context. To understand the significance of a discourse, we must theorise about both the

discourse's possibilities and the circumstances of its constitution (Sillince, 2007:363). Innovation does not exist in a vacuum and an organisation's structures, actors and practices are a reflection of the amount of support or direction that will influence its process.

Besides the management of its internal micro contextual perspective, an organisation must also be concerned with the macro infrastructure needed to implement or commercialise an innovation. For most innovations, this infrastructure includes institutional norms, knowledge, financing and competent human resource.

Brachos *et al* argue that a context characterise by a combination of trust, motivation, learning orientation, social interaction and top management support positively affect the level of innovation in organisations. This is so as such a combination fosters the effectiveness of knowledge transfer needed for innovation; knowledge is a vital prerequisite to the innovation process (2007:37). It is an organisation's competitive resource when it is used effectively from a resource perspective.

2.3.8 Innovation and resource-based view of competitiveness

Competitive advantage can be accrued to an organisation when it has resources and capabilities that are valuable, rare, imperfectly imitable, and not substitutable (Barney *et al*, 2001:625).

Resources are defined as those tangible and intangible assets that are tied semi-permanently to the firm. They have been distinguished between property-based and knowledge-based resources. The latter resources often take the form of particular skills which are technical and collaborative. They are of greater usage during uncertain times which are changing and unpredictable, allowing organisations to respond and adapt to challenges and are "closely connected to the ability to innovate" (Hadjimanolis, 2000:264)

C*apabilities* are characteristics of the firm and managerial skills establishing organisational routines leading to competitive advantage. Of direct relevance to innovation are dynamic capabilities which are an organisation's ability to integrate, build, and reconfigured competences that are internal and external to an organisation's fast-changing environments. Innovation capabilities, a subset of

dynamic organisational capabilities, are defined as the comprehensive set of characteristics of an organisation that enable and foster innovations (ibid.).

Central to the innovation process is the integration of two or more resources; a single resource is rarely the solitary success factor when the interaction of complementary resources contributes to the creation of new unique and inimitable assets (Hadjimanolis, 2000:265).

Based on dynamic capabilities, mechanisms are considered for their enactments along a path which is dependent on an approach in accordance with these norms of the resource-based view perception (ibid.): -

- Uniqueness
- Complementarity or resources
- Inimitability
- Temporality of resource accumulation
- Interaction of resource clusters
- Learning aspects

The path dependence of learning is critical to the effectiveness of innovation which is frequently fraught with unexpected outcomes. Lessons from having experienced these outcomes are arrived at through an iteration of “doing, learning, doing, learning … some more doing and learning” (Marsh and Stock, 2003:138). Learning, especially organisational learning, helps to launch innovations reinforced with a resource-based view foundation.

2.4 ORGANISATIONAL LEARNING

Innovation pertains to a non-routine, important, and discontinuous organisational change that embodies a new idea that is inconsistent with the current concept of an organisation’s operation (Mexias and Glynn, 1993:78). Approached thus, an innovative organisation is - “One that is intelligent and creative. Capable of learning effectively and creating new knowledge” (Lam, 2004:12). From this perspective, comprehending the role of cognition and organisational learning that foster or inhibit innovation becomes crucially important (ibid.).

The terms ‘cognition’ and ‘cognitive’ refer to the notion that people develop mental models, belief systems and knowledge structures that they use to perceive, construct and make sense of their worlds and to make decisions about what actions to take (ibid.). Per the cognitive perspective, the research focus on innovation has changed from organisational structures and systems to the processes of organisational learning and knowledge creation.

“Innovation can be understood as a process of learning and knowledge creation through which new problems are defined and new knowledge is developed to solve them. Central to theories of organisational learning and knowledge creation is the question of how organisations translate individual insights and knowledge into collective knowledge and organisational capability” (Lam, 2004:14).

2.4.1 What is organisational learning?

Organisational learning (OL) is accepted as a central, rather than a fringe organisational variable, with its competitive worth widely recognised per its emphasis on dynamic, changing relationships (Andrews and Delahaye, 2000:797-798). Definitions of OL found in the literature include: encoding and modifying routines, acquiring knowledge useful to the organisation, increasing the organisational capacity to take productive action, and the detection and correction of errors (Moingeon and Edmondson, 1996:18).

OL has and is still receiving growing attention as a source of competitiveness. An organisation is competitive when its employees can learn faster than its competitors. The ‘individual-team-organisation’ learning continuum connects and converges to organisational learning. Individuals and teams are the basic and fundamental units of learning respectively. Like innovation, the OL literature is fragmented, consisting of multiple constructs; it is quite frequent to find OL being looked at in relation to these – (a) encounters of errors as unexpected outcomes and their correction, (b) learning throughout an organisation and (c) management of knowledge useful to an organisation.

Besides its multiplicity, OL has also been confused with learning organisation. Although these terms have sometimes been used interchangeably in the literature, there is a distinct difference in the two concepts. OL and learning organisation can best be explained as a ‘process’ versus ‘product’ argument (Schwandt and

Marquardt, 2000:26). The former is a process, and the latter a product. The concept of change is inherent in the concept of learning; any change in behaviour implies that learning is taking place or has taken place. Learning that occurs during the process of change can be referred to as the learning process (Crow and Crow, 1963:1).

OL practitioners have been referred to as 'organolearners' (Jha and Joshi, 2007:138). Learning in organisations runs the whole gamut: from individuals → teams → whole organisations. Individual learning leads to personal knowledge, and organisational learning leads to collective knowledge (ibid.). Collective knowledge is the accumulated knowledge of the organisation stored in its rules, procedures, routines and shared norms guiding problem-solving activities and patterns of interaction among its employees (Lam, 2004:14).

Collective knowledge is characterised by these (ibid.) – (a) it resembles the 'memory' or 'collective mind' of an organisation, (b) it can be a 'stock', stored as hard data, or it can be in a state of 'flow', emerging from social interactions, (c) it exists between rather than within individuals, (d) it can be more or less than the sum of the individuals' knowledge, depending on the mechanisms underlying the translation and transformation of it from individual knowledge.

All learning in an organisation takes place in its social context and it is the "nature and boundaries of the context that make a difference to learning outcomes" (ibid.). Much of the OL literature highlights the importance of social interaction, context and shared cognitive schemes for learning and knowledge creation. This is based on Polanyi's (1966) assertion that human knowledge is subjective and tacit which cannot be easily codified and shared independently of the knowing person.

OL, as a process, is a representation of the dynamic human processes required to increase the cognitive capacity of a total organisation (Schwandt and Marquardt, 2000:26). "Inquiry into OL must concern itself not with static entities called organisations, but with an active process of organising which is, at its root, a cognitive enterprise" (Argyris and Schon, 1978:16). This cognitive enterprise's OL is underpinned by three levels of learning – single-, double- and triple-loop learning.

2.4.2 The three levels of organisational learning

As OL is concerned with dynamic entities, its process is better associated with an organismic view, the metaphor of which is the living organism. Employees can then be seen as organisms always seeking greater self-sufficiency (Knowles, 1984:24). The adequate personality embodies positive percept of self, together with a rich, varied and available perceptive field of experience (Pittenger and Gooding, 1971:107).

In 1978 Argyris and Schon had looked upon organisational learning as the detection and correction of errors. Chris Argyris has explicated that - "our theory was on learning as the detection and correction of error" (Crossan, 2003b:40). Jointly both writers had come forth with these three types of organisational learning: single-, double- and triple-loop learning.

Single-loop learning takes place when the error detected and corrected permits the organisation to carry on with its present policies or achieve its present objectives (Argyris and Schon, 1978:2-3). *Double-loop* learning occurs when error is detected and corrected in ways that involve the modification of an organisation's underlying norms, policies, and objectives. Both single- and double-loop learning are not 'one-shot' learning events but continuous such as the learning that is required for innovation (Argyris and Schon, 1978:26). When an organisation continuously learns from previous context for learning, it goes into *triple-loop* learning or deutero-learning (ibid.).

Single- and double-loop learning have respectively been referred to as lower- and higher-learning by Fiol and Lyles (1985), or respectively adaptive and generative learning by Senge (1990). Triple-loop learning is for increased organisational effectiveness with respect to "learning how to learn" (Schon, 1975:2). These three forms of learning are perceived to have terminological ambiguities leading to differences in current conceptualisations (Visser, 2007:659). Their conceptual differences have lead to confusion which impedes a proper theoretical understanding of higher-level learning processes (ibid.).

By higher-level learning, Visser is referring to triple-loop learning or deutero-learning. But when scholars are not too clear on what double-loop learning entails, it may not be in the order of things to talk about deutero-learning. Argyris was asked these questions during an interview in 2003 with Crossan (2003b:46) – (a) Have scholars

used his book in the way he expected, and (b) Are there messages that have been lost that he would like to emphasise, or others that have been overemphasised or poorly understood?

The book referred to is this one that Argyris had co-authored with Schon in 1978 ~ *Organisational learning: a theory of action perspective*. To the above questions posed, Argyris responded thus – "In the poorly understood category, I'd put the lack of research on double-loop learning. The largest amount of work that has been done is on single-loop or routine issues. I think that limits social science as a discipline and as a contributor to a better world. The notion that I think has been misunderstood is that somehow there is a difference between individual learning and organisational learning" (Crossan, 2003b:46).

Per the interview in question, Peter Senge has added – "Although 25 years have passed since the book was published, it still may be ahead of this time" (Crossan, 2003a:38). Also Mark Easterby-Smith and Marjorie Lyles did a brief overview on the book and they highlighted the selective nature of the book's impact on the academic community. They suggested that the book's originality "is what limited its appeal to the mainstream academic community (ibid.).

Easterby-Smith and Lyles have elaborated further – "Ideas such as the emphasis on practice, on making direct interventions into the world one is studying, and on relying on subjective experience of the authors, run counter to the training and values of most management scholars, especially those trained within the positivist and empiricist traditions" (ibid.). On this point, Argyris is reported to have indicated that the tendency of the academics to focus on internal and external validity with little regard for implementable validity has meant that theory has generated far more than practice can absorb (ibid.).

"To bridge the gap between organisational learning theory and practice, we need to focus not only on implementable validity but also, as Argyris notes, in the interview, on usability" (Crossan, 2003a:39). Argyris had added that "implementable validity should be producible by a scholar or by a practitioner – it must be applicable to everyday life conditions and again, the scholar and the practitioner should be able to use it" (ibid.).

2.4.3 Learning from experience

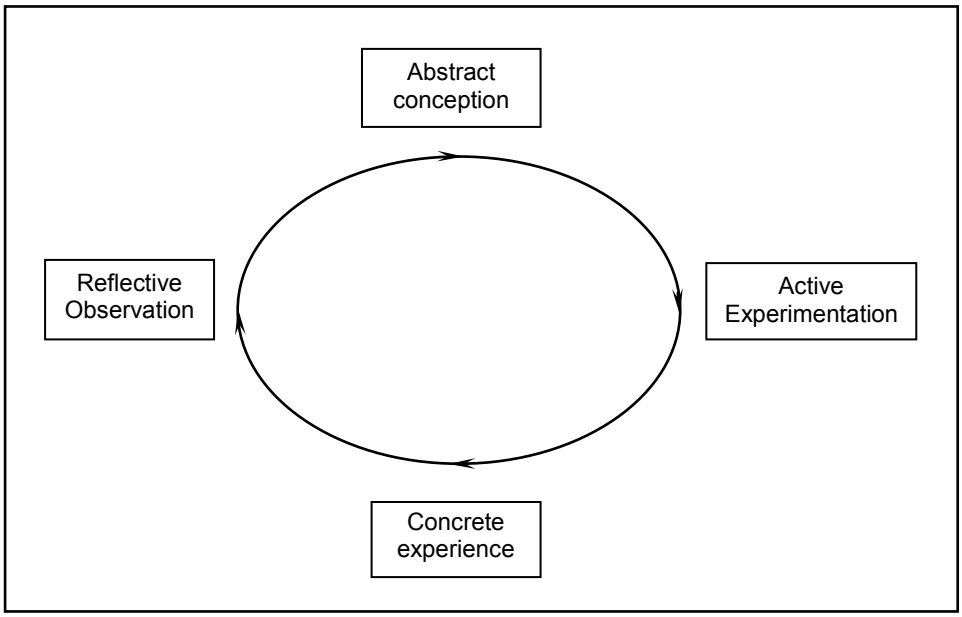
"If learning comes through experience, it follows that the more one can plan guided experiences, the more one will learn" (DiBella *et al*, 1996:45).

Experiential learning is essential to innovation which is inherently risky and "trial-and-error learning is a highly uncertain undertaking – naive at first, mistakes encountered, more knowing later" (Van de Ven *et al*, 2000:15). Many organisations do not learn from their errors regarding innovation, and are baffled repeating the same errors and feeling the same old frustrations (Davila *et al*, 2006:210). When more new errors are made, these organisations become even more baffled and exasperatingly frustrated.

Learning has been indicated to enhance a company's speed, innovativeness and adaptability (Amidon, 2003:307). However "working, learning and innovating are closely related forms of human activity that are conventionally thought to conflict with each other" (Brown and Duguid, 1991:40). Learning and change go hand in hand and as innovation is all about change; learning is an intrinsic part of innovation (Davila *et al*, 2006:211). But this association is not that straight forward because it is generally viewed that (a) work practice is conservative and resistant to change, (b) learning is distinct from working and problematic in the face of change and (c) innovation is the disruptive but necessary imposition of change on the other two (Brown and Duguid, 1991:40).

To see that working, learning, and innovating are interrelated, compatible, complementary and not conflicting forces, Brown and Duguid have stressed the need for a distinct conceptual shift. It is argued in this study that the shift must include a move from just learning to OL. With a positive attitude underlying this shift - working, OL, and innovating are better poised for a convergence towards innovation effectiveness.

Bessant too has emphasised the importance of OL to innovation – "Learning is the engine that creates innovations … via the learning cycle" (2003:185). He cites David Kolb's experiential learning cycle as shown in Figure 2.2.



(Source: Bessant, 2003:184)

Figure 2.2 Kolb's experiential learning model

Davila *et al* have referred to an organisation with significant learning disabilities that hampered its innovation (2006:210). Their advice to such an organisation is - "you cannot improve any part of innovation – not the framework, strategy, processes, organisation metrics, or incentives – and expect to see good results unless you make sure that your organisation knows how to learn and change" (2006:211). The point of entry per the four components of the Kolb learning cycle is not important; but completing the cycle matters as incomplete cycles do not enable learning (Bessant, 2003:184).

Errors can be pointedly tagged to the arrow connecting 'active experimentation' and 'concrete experience' in Figure 2.2 for subsequent reflection and conceptualisation in terms of positive experiential learning. This is quite unlike that of negative error cultures where errors may be concealed and there will be little experential learning from them (Rybowiak *et al*, 1999:528).

When it comes to innovation, this seems almost to have a death wish – "we ignore what's important … the role of failure" (Peters, 1991:12-21). Innovation is a daunting process and organisations should cheer failures and preach "failure-as-a-part-of-life" (ibid.). A tenet of OL is that without detecting and correcting errors in "what we know"

and “how we learn”, an organisation’s knowledge can deteriorate, become obsolete, and result in bad decision making (Fahey and Prusak, 1998:265).

2.5 ERRORS

If to err is human, can errors be humanly and naturally accepted by organisations as experiential resources for growth? Does an organisation need to have a certain culture that accepts errors as generative resources through learning from innovation?

2.5.1 What are errors?

“Errors are not easily defined … (they) are unintended deviations from goals, standards, a code of behaviour, the truth or from some true value” (van Dyck *et al*, 2005:1229). Due to the unintentional nature of the deviations that characterises errors, (a) they typically lead to aversive feelings that one should have known better, and (b) they are differentiated from violations which are more intentional.

In the literature, the term error has been used interchangeably with those of mistake and failure. The Shorter Oxford English Dictionary (2002) has the meanings of the three terms as these: -

Term	Meaning
Error	Something done incorrectly because of ignorance or inadvertence*.
Mistake	A misconception about the meaning of something; a thing incorrectly done or thought; an error of judgement*.
Failure	An instance of failing to effect one’s purpose. A person or thing that which turns out unsuccessful.

(** both the meanings of error and mistake can lead to good outcomes if they are positively corrected for redress*)

The above meanings have this in common - they are linked to unexpected outcomes. But they can be good outcomes when an organisation’s culture is positive in its reactions towards them.

The meanings of error and mistake are close to each other, but not failure. Errors and mistakes can be thought of as preceding failures. Just as Farson and Keyes

(2002a:71) have viewed mistakes as “signposts on the road to success”, errors and mistakes can be thought of as signposts to failures.

All the three terms have an association with knowledge thus: -
• Error – ignorance or inadvertence implies a lack of knowledge.
• Mistake – misconception implies not a lack of knowledge, but a misinterpretation.
• Failure – no lack of knowledge, but the outcome of its application is unsuccessful.

As the terms are not differentiated in some of the literature reviewed, their meanings above and implied associations with knowledge are adopted in this study. Collectively they are referred to as errors, unless when specific terms are used in citations made, irrespective if they are linked to the negative or positive consequences of errors.

Examples of errors relevant to this study include these (van Dyck *et al*, 2005:1231) – (a) misplacing a finished product, (b) ordering wrong supplies so that a product could not be finished timely, (c) errors in planning and budgeting a project, and (d) error of not sharing a piece of important information. These examples are associated with everyday organisational life. In this study errors of safety will not be focused even though it is always safety first.

2.5.2 Negative and positive consequences of errors

It is commonplace for organisations to be confronted with errors and “errors can result in negative consequences … as well as positive ones (e.g. learning, innovation)” (van Dyck *et al*, 2005:1228).

The negative consequences of errors tend to be more noticeable and recognisable and have been of high interest to scholars and laypeople (ibid.). These consequences have been researched more than that of the potential positive effects of errors. This line of research has supported the concept of error prevention, that is “the attempt to block erroneous actions whenever possible” (ibid.).

On the other hand the potential long-term positive consequences of errors, such as learning and innovation as indicated above, are less focused “although people readily agree that they can learn from errors” (ibid.). In the long haul, organisations that accept and understand these positive consequences with effective approaches are

likely to be profitably competitive because they (a) learn from error, (b) are more ready to experiment, and (c) are more likely to innovate (ibid.).

One way to restrain the negative consequences of errors and to stimulate the positive ones is through their premeditated and meditative management.

2.5.3 Error management and error prevention

The approach to error management accepts that human errors *per se* can never be completely prevented and this leads to the question of what is to be done after an error has occurred in an organisation. This approach differentiates between incidents of errors and their subsequent consequences. It does not shy away from errors but rather focus on how to deal with the encounters of them and the management their consequences.

Van Dyck *et al* have associated error management with the management of stress. Stress management does not aim to change the stressors but rather how to change employees' reactions to stressors in order to alleviate their negative consequences (2005:1228). With such an association, error management does not attempt to purge errors completely but rather to deal them and their consequences per these in focus (ibid.) – (a) detected errors are quickly reported, (b) negative error consequences are effectively managed and minimised, and (c) positive learning occurs as a result.

Although their work is on error management, van Dyck *et al* are of this belief – "organisations should use both error prevention and error management approaches so that … negative error consequences are effectively handled" (2005:1229). They emphasise that organisations must not rely on error prevention only as it has its limits and "because total elimination of errors is impossible" (ibid.).

On its own error prevention (a) cannot deal adequately with the ubiquitous nature of errors, (b) will not be able to predict what specific error will occur (or when), (c) reduces the opportunities to learn from errors, and (d) minimises the possibility to benefit from potential long-term positive consequences of errors. Compare to error management, error prevention shuns negative error consequences by evading errors altogether.

Although their work is focused on error management, van Dyck *et al* do not wish to suggest that error prevention is unimportant per this line of argument (2005:1238) – error prevention is required as a first line of defence to ensure safe flows of high quality products and services. Whilst more firms use error prevention strategies on a first line basis, (a) only a few attempts to use error management principles as an explicit second line of defence to address negative error consequences, (b) error prevention is broadly used in a non-conscious way, and (c) an error management culture (EMC) requires more explicit efforts to address errors more effectively (ibid.).

Errors are beneficial to innovation when there is a positive tolerance for them. But this tolerance amounts to little unless errors are looked upon as a generative resource from an experience of them. For innovation to be effective, a proper perception of errors and their acceptance is important as a negative error perception entails little risk taking but a high degree of planning and little action. A positive error perception is linked to behaviours that are more action-oriented, innovative and experimental.

2.5.4 Error tolerance

In the literature, errors tolerance has been considered in terms of the success-failure paradox. With success and failure considered simultaneously, it may be difficult to hold together these two ideas that seem to be at odds with each other but that, considered together, lead to new possibilities (Starkey, 1996:7).

"The less we chase success and flee from failure, the more likely we are to genuinely succeed" (Farson and Keyes, 2002b: book cover). These authors view innovations as paradoxical when organisations can win from failures. Success may breed a complacency that may blind organisations to the need for change. It has limited information value as it means that we should carry on doing what we have been doing (Hogan and Warrenfeltz, 2003:77). But failure challenges our understanding and this may lead to a re-conceptualisation of events. We learn more from failures than successes; "the reorganisation of mental models depends on failures" (ibid).

The 'success-failure' paradox may herald a string of dualities of which rewarding performance and punishing non-performance is one. Organisations may be asked on how they balance 'reward-punishment' and 'still be tolerant of errors' (van Dyck *et al*, 2005:1238). In addition they may be asked if it is not so that frequent errors are

symptomatic of low degrees of performance. “The answer to this question is difficult because errors and lack of performance are probably related” (ibid.).

When organisations unwittingly promote ‘error free’, ‘zero tolerance for failure’ and ‘right the first time’ policies to emphasise their commitments, such policies can create a culture averse to innovation (Lee, 2001:29). An error averse organisation will have its share of defence routines which become normative over time leading to a range of unwanted consequences like the repetition of errors (Grieves *et al*, 2006:97). Such routines may become mechanisms for psychological survival and “in themselves cause an impediment to the flow of learning in the organisation, so that achieving interconnectedness between all systems (the primacy of the whole) is impossible” (Gray and Williams, 2011:439).

Innovation has the unavoidable risk of being wrong and as it carries the risk of failure, many employees avoid them. But this avoidance may change when error tolerance is tagged to a good sense of psychological safety enhanced by an organisational openness about mistakes (Levina, 2000:35). Errors are an important issue in work psychology (Rybowiak *et al*, 1999:528) and attitudes towards errors determine a company’s organisational culture.

2.5.5 Errors and organisation culture

Besides its deliberation in Section 2.3.5, culture is the belief systems, norms, rituals social practices and customs that generate meaning and social cohesion. It implies that there is a system of shared norms and values embedded in a set of common organisational practices (van Dyck *et al*, 2005:1229). But culture also serves to divide and oppress (Houston, 2010:81). Moingeon and Edmondson have cited organisation culture as a kind of learning (1996:23). They emphasised that the learning and the way in which it takes place are determined in large measure by culture (1996:40); and much of the culture of the modern workplace is about collective knowledge (1996:62).

When it comes to EMC, it is argued that (a) homogenous cultural dimensions are assumed not to exist in large organisations, (b) the homogeneity of EMC has to be shown empirically, (c) preference should be given to medium or smaller sized organisations when doing organisational culture research as the likelihood of a

homogenous culture to exist in such organisations is higher when compared to large organisations.

A strong EMC, conceptualised to include norms and common organisational practices (e.g. communicating about errors, detecting, analysing, and correcting them quickly), is pivotal to the reduction of negative and the promotion of positive error consequences (van Dyck *et al*, 2005:1228). Even though culture includes both norms and practices, organisational members tend to assess the more visible aspects of culture than its hidden norms (van Dyck *et al*, 2005:1229). The focus then is on shared practices and procedures when it comes to EMC.

To van Dyck *et al*, a strong EMC translates into a strong organisational performance via practices that decrease negative error consequences and simultaneously increase the positive ones. These practices pertain to – communicating about errors, sharing error knowledge, helping in error situations, quick error detection and damage control, analysing errors, coordinating error handling and effective error management.

From the above emphasis on culture, if an organisation is positive towards errors as experiential resources, there is much learning and knowledge to be gained. When the association between errors and knowledge is brought together by learning, an organisation is likely to have a positive culture towards errors. One key area to be focused in this study is the management of errors as a component of an organisation's culture. This is done in relation to how errors are perceived in general and innovation in particular.

2.5.6 Innovation, errors and learning

Innovations are intrinsically uncertain and the likelihood of error encounters is innate. A positive culture towards the management of errors may stimulate innovation because (a) innovativeness can be enhanced when people are confident that they will not be blamed or ridiculed when errors occur, (b) accepting errors is a natural part of work, (c) communicating about errors encourages employees to explore and experiment, (d) errors may motivate employees to develop a better understanding of situations that caused them, (e) further exploration and experimentation may be increased after an error has occurred, (f) employees tend not to show initiative when punishment is expected for their errors linked to proactive actions, (g) better initiative

and experimentation may follow from a better EMC, and (h) communication about errors, their detection and handling make it possible to improve organisational performances (van Dyck *et al*, 2005:1230).

Increasingly, the study of errors is becoming a part of organisation studies. A close examination of the events leading up to errors will identify opportunities which might have been used to forestall the errors. The lack of prior intervention is clearly "ineffectual" behaviour (Carnall, 1990:192) as we can learn more from our failures than our successes as indicated earlier. Our understanding of organisational effectiveness can be enriched by examining the causes of errors. "Learning takes place when people are encouraged to learn from errors, when they think about errors meta-cognitively (e.g. planning, monitoring and evaluating one's actions), and when the negative emotional impact of errors is reduced" (van Dyck *et al*, 2005:1229).

Studies on errors can contribute to a positive organisational climate for learning from errors. There may be seen an apparent paradox between 'destructive failing' and 'constructive learning', when the positive subtleties between the two, covered so far, are not realistically considered because they are not expected to be considered thus. "It is precisely because the unexpected jolts us out of our preconceived notions, our assumptions, our certainties, that it is such a fertile source of innovation" (Drucker, 1985:45). When errors are considered a part of the unexpected, they are a fertile source of innovation.

The paradoxical 'destructive-constructive' tension can be defused with error management that simultaneously embraces both control and learning. Organisations can benefit from such an embrace. The control perspective of error management implies quick error detection and damage minimisation, and the learning perspective uses errors as learning opportunities which encourage exploration and experimentation (van Dyck *et al*, 2005:1229). Error management moderates the inherent conflict in allocating resources between both perspectives.

Management may not exactly hail errors even though they can profit from them. The lessons from errors are potentially resource-rich as almost every false step can be regarded as an opportunity to new possibilities not leading to dead ends. Even though errors are seldom seen as symptoms of opportunity, "failures, unlike successes cannot be rejected and rarely go unnoticed" (Drucker, 1985:41). Learning from errors is not undesirable and it is difficult to dispute this (Cannon and

Edmondson, 2001:165). But on the other hand, errors without learning are opportunities missed.

2.5.7 Errors as 'means' not 'ends'

"Failure should not be pursued for its own sake. It is a means to an end, not the end itself. If the goal is learning, then unanticipated failure is the unavoidable by-product of the risks inherent in addressing problems" (Sitkin, 1996:554).

However, not all errors end in learning as not all organisations have cultures that are positive towards lessons from errors. Even if there are such positive organisational cultures, the learning capacities of their employees towards errors may be issues at the individual level. "While companies are beginning to accept the value of failure in the abstract – at the level of corporate policies, processes and practices - it's an entirely different matter at the personal level. Everyone hates to fail" (Farson & Keyes, 2002a:65).

A deliberation on the mismatch in lessons from errors at the organisational and individual levels can help to alleviate the disparity. Do people deny their errors by burying the evidence and cover their back? Or do they say, I did it like this and it didn't work, but this is what I learned from it? (Pedler *et al*, 1997:150-151). Many individuals find it problematical to talk about errors. An individual may think along this line – (a) when you make one you feel awful about it, it gets left with you, (b) it is not right to talk about it and have a chance to redeem the error through learning and the knowledge that things will be different next time (ibid.).

However, Pedler *et al* believe that all this can be changed by talking about errors in a constructive way by adopting a non-punitive, but not soft, leadership style to move us all that little bit along the road (ibid.). Objectively, errors are to be proactively avoided in the first place as in error prevention. Only learning from unavoidable errors are more positively regarded and supported to the extent that errors that are effective at fostering learning will be referred to as "intelligent failure" (Sitkin, 1996:554).

Besides error avoidance, a distinction is made between excusable and inexcusable errors. This distinction can be beneficial to error management because it - (a) allows the building of a non-punitive environment for errors, (b) encourages thoughtfully pursued projects that, should they fail, will yield productive errors and (c) fosters non-

judgemental promotion of productive errors that is the basis for learning (Farson and Keyes, 2002a:66). By revealing what doesn't work, an error coming from a carefully designed and executed project provides insight into what will finally work (ibid).

Errors can be positively regarded as competitive experiential resources. Learning and knowing about them at the organisational level are important new mind-sets to cultivate as learning – (a) is the creation of useful meaning, individual or shared and (b) generates knowledge which serves to reduce uncertainty (Starkey, 1996:1).

From the resource-based view, errors and the lessons from them are unique resource assets that are organisation and context specific. What can these specificities be are looked into next with respects to some organisations as found in the literature.

2.5.8 Some organisations and their orientations to error management culture

If an organisation attempts to change its culture in relation to error, it needs to look into its error orientation at the individual and organisation levels. "An organisation's error culture is determined by its members' orientation towards errors" (Rybowiak *et al*, 1999:544).

Over time this orientation will help to nurture an organisation's error culture which eventually can become recognisable and unique to those within the organisation and those outside of it. Besides TPS, these are examples of organisations with recognisable/unique error cultures rooted in their error orientations (van Dyck *et al*, 2005:1238) –

(a) *BMW* – has in this mission statement that employees should not look for the guilty party in an error situation but solve the problem.

(b) *3M* – known for its constructive and innovative orientation, learns from errors.

(c) *Southwest Airlines* – proposes that failure is a natural result of the competitive process.

To get to where they are with their notable error cultures, *BMW*, *3M* and *Southwest Airlines* must have each undergone a nurturing process per a path dotted with various error orientations, akin to milestones on a journey strewn with errors. What

follows is an account of a particular organisation's attempt to embrace an EMC. It is the *National Health Service* (NHS) in Britain.

The flow of knowledge in organisations requires one to look at their whole organisational learning systems, including those associated with errors. For example at NHS, mistakes that have the unintended outcome of harming others are known as 'adverse incidents'. Adverse incidents, in the context of OL, often emphasise what has gone awry and this provides what has been referred to as a 'master frame' for learning from adverse incidents. This frame essentially sets the scene and tone by which any learning associated with adverse incidents will be accorded a value that "resonates with negative connotations to learning, and contributes to an overall negative learning culture" (ibid.).

To turn around this negative culture, those at NHS involved with OL need to withdraw from such a world that is associated with deficits, failures, errors and blaming. This withdrawal is counterbalanced with an embrace of the identification of the positive aspects of learning from the adverse events, a reframing from the negative to the positive. Per such a reframing, employees are encouraged to generate knowledge from a positive standpoint for the growth of the new frame to its full potential. Individuals are guided to learn holistically to promote the positive facets of all events, adverse or otherwise, in an attempt to eradicate the effect of a blame learning culture that seeks someone to blame.

The new reframed positive learning at NHS allows the acceptability of errors when there is ownership and readiness to learn from them. With this new culture, previous hidden or tacit knowledge linked to adverse incidents at NHS is now made more transparent and accessible. This change of practice is geared towards a preventive recurrence of errors. A strong message is sent throughout NHS that its employees have the opportunity to show how they are improving at their work through the medium of continuous learning. The stigma formerly attached to adverse incidents is in the process of being eliminated.

NHS's experience has reframed only just a part of its overall learning system "that is often not even considered to hold valuable stocks of knowledge relating to innovation or improvement on practice" (Gray and Williams, 2011:448). NHS staff is motivated further to work towards the achievement of "solving the problem within, rather than a solution imposed from outside or above … arguably this would capture innovation

and improvements borne out of learning from personal experience and used for the benefit of the organisation" (ibid.). The transformative learning at NHS has made use of a mechanism by which real learning from adverse events is done holistically. The creation of a learning environment, with leverage points to overcome barriers, is important in sustaining a deep approach towards individual and organisational learning at NHS.

Learning and knowledge are intertwined by way of OL at all hierarchical levels in organisations. An organisation's knowledge can be prevented from becoming obsolete when they can be regenerated through learning from errors to sustain knowledge in order to sustain innovation and competitiveness. But as knowledge management is just a buzzword to some people, it is looked into next.

2.6 KNOWLEDGE MANAGEMENT

"All knowledge and habit once acquired becomes firmly rooted in ourselves … and sinks into the strata of the sub-consciousness" (Schumpeter, 1934:84). "The value of intellect increases markedly as one moves up the scale from cognitive knowledge to self-motivated creativity" (Quinn *et al*, 1996:72).

The present economy has been described as knowledge-based, not because of knowledge *per se* but by the way knowledge is acquired and managed by organisations with their employees as knowledge workers. Knowledge management (KM) is a strong label for the present economy.

2.6.1 What is knowledge management?

The management of knowledge from error lessons that will be focused in this study can help diffuse some of the KM buzz. When errors can be managed together with the lessons from them, it is argued by association that the ensuing knowledge can be managed too as knowledge challenges in relation to innovation.

"The major goal of KM is to enhance innovation and in a bid to achieve this goal, organisations are investigating heavily in the development of organisational KM systems aimed at supporting knowledge work and enhancing organisational learning"

(Meso and Smith, 2000:226). But pursuing KM for its own sake amounts to not much – just like knowing how to use a tool, but for what purpose to what end?

From their various citations on how knowledge management is defined, Vera and Crossan have this indicated – "We recognise in these definitions a strong prescriptive element, where KM is understood as 'managed learning' and is assumed to have a positive impact on performance" (2003:124).

At this juncture part of the definition of KM embraced for this study, derived from Vera and Crossan's indication, is "managed learning that has a positive impact on performance". Such a definition component fits in well with the literature reviewed thus far per – KM is relevant to the management of OL of errors from innovations which in turn will positively enhance the furtherance of them and other innovations.

KM studies are linked to organisational effectiveness and performance on a multidisciplinary platform. This study, besides being one on innovation, can also be considered as one on knowledge challenges as knowledge is a common thread that can bind errors, OL, innovation and performance together wholesomely.

The present economy is global in its reach and a multinational company (MNC) is seen as "a set of networked repositories of knowledge and capabilities … (and) the need to understand the processes of global knowledge transfer is especially important because there is some evidence to suggest that many MNCs fail to tap the knowledge or leverage the learning that occurs" (Taylor and Osland, 2003:213). Knowledge is always important to the management of any business performance be it local or global. But the attention on KM here is not on its importance alone but how globalisation has propelled KM to the forefront of competitiveness.

KM has been recognised as one of the most challenging ways for organisations to succeed in the present knowledge-based economy. Two of the challenges pertain to these – (a) the baby boomers in their 50s and 60s are approaching the retirement age; their cumulative experience and knowledge of their generation threaten to retire with them and (b) with the rapid advances in information technology (IT), knowledge streams into organisations flow fast, often leaving the human decision-makers behind although IT presents opportunities for improvements on the other hand.

Many companies think that to operate effectively in today's economy, it is necessary to become a knowledge-based organisation but few really understand what that means or how to carry out the changes needed to bring about operational effectiveness. The most common misunderstanding is the thinking that the more an organisation's products and services have knowledge at their core, the more the organisation is knowledge-based (Zack, 2003:67). Such a characterisation of a knowledge-based organisation, based on products and services, can lead to some conceptual distortion.

Products and services are what are perceivable to the customers and these perceptions are at the tip of the customer-supplier iceberg. But what enables the production of products/services lies below the icy apex, "hidden within the so-called invisible assets of an organisation – its knowledge about what it does, how it does it, and why (ibid.). Knowledge is one such invisible asset and it must be managed well.

2.6.2 Managing knowledge

Managing knowledge is not new but the literature has been unable to agree on a definition or even on the key concepts behind KM. "The vagueness and ambiguity in defining KM seems to be that the word 'knowledge' means different things to different people" (Hlupic *et al*, 2002:92).

It is difficult to design successful knowledge management interventions because knowledge is a slippery subject. It is not easy to agree what it means and even harder to agree on its management; knowledge can be explicit or tacit. Explicit knowledge pertains to knowledge that can be codified, and since it is easier to share and communicate such knowledge most organisations have captured this knowledge systematically, making it accessible to all employees (Meso and Smith, 2000:225).

On the other hand, tacit knowledge resides within individual and is more difficult to express in words for communication and sharing. It consists of mental models, beliefs and persuasions of individuals, and they are taken for granted if they are ingrained in the individuals.

Employees have a wealth of tacit knowledge deeply rooted in their actions, and their commitments to "a particular technology, a product market, or the activities of a work group" (ibid.). As it is difficult to communicate/share such tacit knowledge, it is often

lost when employees possessing it leave their organisations. But tacit knowledge has also been seen as the knowledge embedded in an organisation's culture and it is less likely to leave with employees that quit or retire.

Explicit and tacit knowledge come in many forms, "some of which we are not able to assimilate because of our own assumptions about what knowledge is, and how it is systematised" (Demarest, 1997:375). Despite the inability in assimilating some forms of knowledge, practically and pragmatically the essential nature of knowledge is presumed to work "for whatever purpose it was developed and used" (ibid.).

For example when it comes to commercial knowledge – (a) good valuable knowledge is knowledge that works, (b) its truth value is incidental to its ability to generate desirable commercial performances, (c) its goal is not truth, but effective performance, (d) it is not 'what is right' but 'what works', and (e) it is even more valuable with 'what works better', where better is defined in competitive and financial contexts (ibid.).

Besides the differentiation of explicit and tacit knowledge, attention has been given to distinguish the different kinds of knowledge and its taxonomy. Knowledge is embodied in people and is built into products and services. Organisational knowledge, being more collective than individual, is embedded in an organisation – structurally, socially, culturally, politically and contextually. It is intangible and is difficult to apprehend from time to time.

One classification of knowledge is shown in Table 2.3 where it is divided into data, information and knowledge.

Table 2.3 Distinction between data, information and knowledge

Term	Meaning
Data	They are numbers representing an observable object or event.
Information	They are human significance associated with an observable object or event.
Knowledge	They pertain to the theoretical or practical understanding of a subject.

(*Source: Knight and Silk, 1990:22*)

Besides their meaning in Table 2.3, data are assumed to be raw facts with internal organisation. When structured and put into context, they take on meaning as

information and when the human mind acts on the information, they become knowledge.

In addition to Table 2.3, an alternative classification of knowledge is found in Table 2.4.

Table 2.4 Differentiation of know-what, -why, -how, -who

Term	Meaning
Know-what	It refers to knowledge as 'facts'.
Know-why	It refers to knowledge about principles and laws in nature, in the human mind and in society.
Know-how	It refers to skills, such as the capability to do something.
Know-who	It involves information about who knows what and who knows what to do; the social capability to co-operate and communicate with different kinds of people and experts.

(*Source: Lundvall and Nielsen, 2007:210-11*)

The classification in Table 2.4 is closer to everyday language than that in Table 2.3. In the former classification, information is a part of knowledge, rather as something distinctively different from knowledge.

But Lundvall and Nielsen have defined information as "knowledge that has been transformed into codes so that it can be saved in a computer and sent through electronic media" (2007:211). Such a definition enables one to think of knowledge from an IT perspective.

2.6.3 The role of information technology in knowledge management

IT has been touted as providing many benefits to organisations that use it well e.g. increase product quality, improve workflow, enhance response to customers' needs, and better communication within an organisation and between it and its customers/suppliers (Gordon and Tarafdar, 2007:271).

It is the convergence of computing and telecommunication technologies made possible by modern microelectronics (Knight and Silk, 1990:8). Beyond microelectronics, IT supports and enables KM processes, knowledge creation, its codification, retrieval, and transfer, in addition to learning. To facilitate the global research of such learning and knowledge, MNCs have resorted to the utilisation of IT;

but these utilisations are not that straight forward as there are national, cultural, environmental, and organisational issues to contend with.

The role of IT in organisations has progressed from the execution of back-office transaction processing to enabling front-line strategic level decision making (Bardhan *et al*, 2008:147). Its rapid growth into areas like wireless communication, mobile commerce, inter-organisational systems, and social networking sites has enabled organisations to develop new types of disruptive business models that transcend organisational boundaries (ibid.). With these new possibilities recognised as benefits that IT can provide, there is also the fear that in a globalised and unstable world, IT may end up with rigidity when organisations are locked into outdated and ineffective business models (ibid.).

A challenge organisations are confronted with is in using IT to be innovative while remaining flexible in the face of an unpredictable future. IT can encourage and support innovation through employees' collaboration and search for needed information and knowledge. But it can also stifle creativity and innovation by its standardisation, automation and institutionalisation of work processes and flows. Organisations have to understand how to build IT competencies necessary for the promotion and benefits of innovation (Gordon and Tarafdar, 2007:271-2). The role of IT in the innovation process and its potential contribution has remains largely unstudied.

The wider use of IT as information and communication technology (ICT) has enhanced the sharing of knowledge per its transformation from the tacit to explicit dimensions. ICT also speeds up change through these mechanisms – (a) innovation within ICT is high and its diffusion to all sectors of the economy imposes change on these sectors, (b) as a tool ICT has sped up innovations in sectors that employ it, and (c) easier and less costly communication fuels the globalisation of the world economy with knowledge as a strategic resource.

2.6.4 Knowledge from a resource-based view perspective

The resource-based view perspective has been touched upon in Section 2.3.8 and it is superimposed here on knowledge as a strategic resource which is defined as one that is rare, intangible, valuable, imperfectly imitable and non-substitutable (Meso and Smith, 2000:224-5). The resource-based view operates under two assumptions

– (a) the *ex-ante* conditions to competition exist and (b) the *ex-post* conditions to competition can be maintained (ibid.).

Per the above definition on a strategic resource, is knowledge such a resource within the context of the resource-based view when it is used effectively innermost an organisation's KM system? The answer to this question is germane in enabling the organisation to establish whether it is strategically prudent to place and share its knowledge via its KM system. If such a placement reduces the intangibility of tacit knowledge which is competitively significant, than it may not be wise for the organisation to do so as it would render the knowledge to be non-strategic, easily acquired or replicated by competitors.

On the other hand, if the placement can leverage the strategic worth of its knowledge, than it is advisable for an organisation to consider such a positioning. The deployment of knowledge within a group-ware package is one for consideration as it enhances collaborative team work, between geographically dispersed employees in a globalised world.

The placement of knowledge within a KM system must be considered from a socio-technical perspective per a resource-based view on competitive advantage. From a more encompassing perspective, there is more to a KM system than mere technology. Per this more inclusive perspective, the KM system is a complex combination of technology infrastructure, organisational infrastructure, corporate culture, knowledge and people (Meso and Smith, 2000:229). "While IT can be considered as a value-adding technological infrastructure, KM can be viewed as a socio-technical system of tacit and explicit business policies and practices. These are enabled by the strategic integration of IT tools, business processes, and intellectual, human and social capital" (ibid.).

A socio-technical system refers to the technologies, roles, knowledge and skills of organisational team members as resources for projects. The way they relate to each other within the context of the organisation's structure defines the organisation infrastructure which in turn – (a) defines the organisation's management style and philosophy, (b) determines how employees are organised into formal and informal teams, (c) describes how these teams interact, formally and informally, (d) uncovers the goals of the teams, and (e) reveals how the team goals relate to the overall corporate strategy (Meso and Smith, 2000:230).

Organisational infrastructure is intangible and unique; no two such infrastructures are the same and a well-developed and established organisational infrastructure is, from a resource-based view, one poised for sustainable competitive advantage. This advantage is not derived from an organisation's hierarchy but the dynamic interaction of the employees as individuals and team members. It may be possible to imitate another organisation's hierarchy but not the interactions of the other's human resource in their exploration and exploitation of knowledge as a strategic asset through its sharing.

2.6.5 The exploration and exploitation of knowledge and its management

"Jim March's framework of exploration and exploitation has drawn substantial interest from scholars studying phenomena such as organisational learning, knowledge management, innovation, organisational design, and strategic alliances" (Lavie *et al*, 2010:109).

In his seminal work on exploration and exploitation in organisational learning, Jim March (1991) acknowledges the essential difference between two gestalts of organisational behaviour. March has broadly included these under exploration – search, variation, risk-taking, experimentation, flexibility, discovery and innovation (1991:71). Under exploitation, he has considered these – refinement, choice, production, efficiency, selection, implementation and execution (ibid.).

"Whereas exploration engages individuals and organisations in search, experimentation, and variation, exploitation enhances productivity and efficiency through choice, execution and variance reduction. Both types of activities are essential for organisational learning and prosperity but entail inherent contradictions that need to be managed" (Lavie, *et al*, 2010:110).

Earlier, researchers focused on a narrower aspect of this exploration-exploitation framework to accentuate the qualities of new knowledge versus refinement of existing knowledge. But recently, this framework has been looked into more broadly to portray a wide span of phenomena that encompasses various expressions of (a) diversity and experimentation and (b) specialisation and experience (ibid.).

With the extended scope of the framework, questions have surfaced thus (ibid.) – (a) should researchers adopt the narrower knowledge-based perspective or the broader interpretation of the framework? (b) can exploration and exploitation coexist in organisations? (c) are they endeavours that are complimentary or contradictory? (d) are they the opposing ends of a continuum of behaviours or as discrete options? (e) should organisations specialise in one or the other, or a balance between the two? (f) will such a balance enable or constrain organisational performance? (g) how can organisations facilitate exploration and exploitation? and (h) under what conditions can organisations benefit from this framework?

Knowledge exploration is defined as the pursuit of new competencies and knowledge exploitation as the use and further development of existing competencies. Similarly, knowledge exploration has been defined as learning activities that lead to the addition of new resources and knowledge exploitation as learning activities involving the use of resources the firm already has (Liu, 2006:145). With the growing interest in organisational learning and related concepts of knowledge exploration and knowledge exploration in relation to competitive advantage, it is found from various studies that a balanced framework between the two is primary for organisational survival; “excessive dominance by one or the other will be dysfunctional” (Liu, 2006:144).

Organisations that are not balanced in their exploration and exploitation of knowledge are prone to poor organisational performances. Facit, a Swedish organisation, was once a global leader in the production of mechanical calculators before the arrival of electronic computers. But because of slow or incompetent knowledge exploration, Facit is overtaken by its competitors; excessive exploitation of knowledge by Facit has prevented it from retaining its leadership position in calculators. On the other hand, organisations may be negatively ensnared into excessive exploration when they are exposed to environments characterised by high rates of change and innovation especially when they move into unrelated diversification (Liu, 2006:144-5).

Organisation performance is considered a function of both exploration and exploitation. Exploration without exploitation may lead an organisation to many innovations without economic rents; and exploitation without exploration may lead an organisation to a dearth of opportunities to stay competitively afloat. When it comes to learning and knowledge seeking, it is quite commonly suggested in the literature (Liu, 2006; Kane and Alavi, 2007; Lavie *et al*, 2010) that a combination of both is the

middle path for organisations to take. The simultaneous existence of exploratory and exploitative knowledge sharing is a dynamic capability embedded in organisational routines and processes that can influence organisational performance for the better.

2.6.6 Knowledge sharing

Knowledge sharing is defined as the exchange of skills, know-how and information across an organisation (Im, 2006:12). It takes place when there is an association between the level of the individual employees (as knowledge workers) and the strategy level in the organisation where knowledge is exploited and explored to reach its economic, competitive value (Hendriks, 1999:91). Such sharing is dependent on the motivation of these knowledge workers to share or not to share their knowledge with others.

Knowledge sharing has been associated with Nonaka and Takeuchi's theory on knowledge creation based on the four processes depicted in Table 2.5 where tacit and explicit knowledge are shared (1995:62).

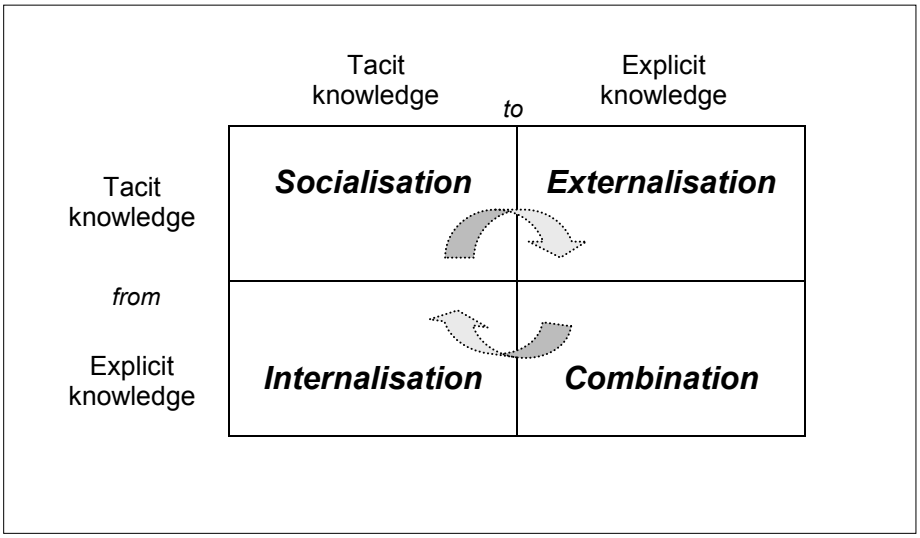
Table 2.5 Nonaka and Takeuchi's theory on knowledge creation and sharing

Process	It pertains to a process of …
Socialisation (*S*)	Sharing experiences and creating tacit knowledge such as skills and shared mental models.
Externalisation (*E*)	Articulating tacit knowledge into explicit concepts.
Combination (*C*)	Systemising concepts into a knowledge system.
Internalisation (*I*)	Embodying explicit knowledge into tacit knowledge.

(*Source: Nonaka and Takeuchi, 1995:62*)

The four knowledge conversion modes in the above table are represented by the *SECI* model in Figure 2.3. In this study, for expediency, the theory of knowledge creation will be known as Nonaka's theory and the *SECI* model will be known as the Nonaka's model.

Knowledge sharing is contained within the Nonaka's model when the knowledge creation starts with the sharing of tacit knowledge in the social context. "Socialisation aims at the sharing of tacit knowledge. On its own, however, it is a limited form of knowledge creation. Unless shared knowledge becomes explicit, it cannot be easily leveraged by the organisation as a whole" (Nonaka and Takeuchi, 1995:70).



(Source: Nonaka and Takeuchi, 1995:62)

Figure 2.3 *SECI* model – four modes of knowledge conversion

The shared knowledge in Nonaka's model can be aided and made more explicit by ICT which is an expansion of IT with an emphasis on communication as raised in Section 2.6.3. ICT enhances knowledge sharing by lowering temporal and spatial barriers between knowledge workers, and improving access to information about knowledge (Hendriks, 1999:91). But the significance of lowering these barriers is limited if an organisation ignores when and how the quality of the shared knowledge needs to be enhanced. The role of ICT for knowledge sharing can only be fully understood if it is related to the motivation for KM (Hendriks, 1999:99). KM will be more effectively enhanced by ICT when there is an equal emphasis on the social and technological factors of IT.

From a social perspective, there will be little knowledge sharing if there are issues on trust. Andrews and Delahaye have labelled trustworthiness as a component of a psychosocial filter that affects KM (2000:800). At the heart of productive work relationships and extensive KM stands trust (Plaskoff, 2003:173). Trust is central to KM and without it there will be little knowledge sharing even though an organisation may like to promote it as part of its culture. Some employees may associate his/her knowledge with power and KM may reduce their positions of strength when they have little trustful relationships with their colleagues. In organisations, trust is revolved around social and interpersonal dimensions for people to engage openly and communicatively. Such open communications may be effective enough for trust to take roots and support any KM that may follow.

It is asserted that communication processes function to create forms of knowledge within organizations (West and Meyer, 1997:43). It is also asserted that OL is embedded in an organisation's communication systems and processes linked to knowledge creation. These assertions may have positively associated communication with learning and knowledge creation but they remain challenged if employees are not open, honest, able and willing to share knowledge (Hislop, 2002:172). Learning and knowledge creation may result from a communication medium however they "are not pre-given, but are negotiated during the course of its development and through its manner of adoption by users" (Lea *et al*, 1995:464).

Communication is likely to be more effective when organisations have (a) a climate of sharing with a focus on human relations and employee interests and (b) this climate is focused on the right, just and fair treatment of employees (Ruppel and Harrington, 2000:5). The *SECI* model has within itself communication on the learning and sharing of explicit and tacit knowledge. The combination of explicit information with the tacit knowledge possessed by individuals can play an important role in the process leading to innovation (Liebowitz, 2002:2). These individuals are looked upon as knowledge workers.

2.6.7 Knowledge workers

"If you think competition is fierce now, just wait. For the moment, only a fraction of the world's six billion minds are considered part of the 'educated' workforce. But all of that is changing … to transform the way the world learns" (Murray and Greenes, 2007:7). In the knowledge-based economy, it is an organisation's knowledge workers' assets (their abilities to work with ideas, symbols, and other abstractions, rather than their labour or work history) which create value for the organisation (Guidice *et al*, 2009:144).

There is a growing focus on the importance of knowledge workers in the literature. This emphasis is important because of the growing dialogue on knowledge workers and the vital role they play in organisational learning and innovation (ibid.). The focus on effectiveness in this study is important. "Being effective as individuals and organisations is no longer optional in today's world – it's the price of entry to the playing field" (Covey, 2006:14). Learning, surviving, thriving, innovating, excelling and leading in the knowledge-based economy will require organisations and their knowledge workers to build on and beyond organisational effectiveness.

Knowledge workers are generally thought of to be highly educated with training in one or more of the professions (Robertson and Swan, 2003:834-5). They have been referred to as being skilled in 'symbolic analysts' - "a type of works that combined significant levels of technical skill in problem identification and problem solving, with marketing, strategic and financial acumen" (ibid.). It is generally debated that this kind of workers require and expect significant degrees of autonomy, premised on the dispositions of the workers themselves and the nature of the work performed by them. "Tapping into the higher reaches of human genius and motivation – what we could call voice – requires a new mind-set, a new skill-set, a new tool-set … a new habit" (Covey, 2006:14).

The 'voice' has been touched upon in relation to the Schumpeterian social school in Section 2. "The path to the enormously promising side of today's reality stands in stark contrast to the pain and frustration many are facing. It is the voice of the human spirit – full of hope and intelligence, resilient by nature, boundless in its potential to serve the common good. This voice also encompasses the souls of organisations that will survive, thrive and have a profound effect on the future of the world" (Covey, 2006:15).

"Voice is *unique personal significance* – significance that is revealed as we face our greatest challenges and that makes us equal to them" (ibid.). It lies at the nexus of *talent* (natural talents and strengths), *passion* (things that naturally energise, excite, motivate, and inspire), *need* (including what the world needs and demands enough to pay for it), and *conscience* (the still small voice that assures one of what is right and that actually prompts one to do it).

The learning of knowledge workers converges to organisational learning, a process originating at the heart of an organisation through which new knowledge is created (Lloria, 2007:675). The new knowledge created, when managed from the hearts of those who created it, augurs well for innovation effectiveness when the voices behind knowledge management are authentic.

Knowledge workers belong to the human agency dimension of innovation as covered in Section 2.3.2 in comparison to structure. These workers need to be examined from the autonomy-control dichotomy perspective as "empowered employees need direction if their efforts are not to be wasted or self-indulgently applied" (Tampoe, 1993:50). It may be so that in the examination, "the answer lies in drawing on the

inner drive and motivation of these knowledge workers, rather than better methods of supervision" (ibid.). The inner drive and motivation of the knowledge workers are managed in terms of their kindling and stirring towards the direction of effective innovations, the focal point of this study.

2.6.8 Knowledge management and innovation

"With the emergence of KM as a new discipline for studying what needs to be done in order to get the most out of organisational knowledge resources, linking KM and innovation becomes a necessity" (Abou-Zeid and Cheng, 2004:261). From the above discourses, innovation can in part keep an organisation competitive through "the application of knowledge to produce new knowledge" (Drucker, 1993:173).

There are quite many a study that addresses the association between KM and innovation (Johannessen et al, 1999; Horibe, 2002; Scarbrough, 2003; Chapman and Magnusson, 2006; Lundvall and Nielsen; Castro et al, 2011). This association results from the iterative process between individuals, organisations, and systems, using knowledge to find the directions in which the goals related to the innovations are met. Knowledge transfer during these iterations can be new knowledge or the reuse of existing knowledge in an organisation in a new way. To understand the development of innovation processes, one needs to focus on the underlying processes of creating and sharing new knowledge. These underlying processes support the ability of an organisation to create new approaches to improve their business processes in order to succeed in its competitive forays.

This ability is based on the knowledge found within the company and its structure and culture; such knowledge is also to be found outside its organisational boundary. These knowledge bases determine the way a company does business and it may be affected by the unease of spreading or reusing of knowledge as a basis for innovation (Marz *et al*, 2006:138). While studies have reported factors of KM as antecedent of innovation, none has empirically examined the relationships between the factors and innovation effectiveness. Innovation involves cross-fertilisation of knowledge and is a constitutive process of collective learning in an organisation (Vekstein, 1998:552).

From Figure 2.1, there are many approaches that can be considered for studies to link KM in the direction of innovation. Per the literature reviewed thus far, this linkage

is also associated with OL, which in Argyris and Schon's parlance is the detection and correction of errors. These four aspects – errors, learning, knowledge and innovation – have not yet been studied together in relation to innovation effectiveness in so far as the literature review is concerned. This study will do so in relation to its researcher's practical experience. It will review the literature further to look for prior studies with relevant models, constructs and survey instruments for a replicative research towards the accumulation of knowledge; a move away from fragmentation.

2.7 LINKING THE LITERATURE REVIEW TO SCHUMPETER

From the start of Section 2.2, this citation from Schumpeter is reiterated here – "The success of everything depends upon intuition, the capacity of seeing things in a way which afterwards proves to be true, even though it cannot be established at the moment, and of grasping the essential fact, discarding the unessential, even though one cannot give account of the principles by which this is done".

This citation is used to jumpstart the innovation-based review of the literature in this study; it pertains to a Schumpeterian overview of innovation. The legibility of the literature review, done in relation to the Schumpeterian creative/destructive thread of innovation, is looked into in this study. In Section 2.2 legibility has been used as a criterion to determine if the core ideas and contributions of the studies reviewed are recognisable and integrated with the Schumpeterian tradition (page 29). Here Schumpeter's thoughts (in parenthesis and italic) from the above citation, and their linked/perceived support in the literature reviewed thus far, are emphasised. The sections in this study where these supports are found are italicised.

"*The success of everything depends on intuition*"; understood thus, innovation also depends on intuition – "*the capacity of seeing things in a way which afterwards proves to be true*". This implies that an innovative undertaking may begin on a hunched perceptive note per a journey which may not be smooth going in reaching its pursued intention.

From *Section 2.1* – (a) the innovation journey is unpredictable and theory may never reach the precision to tell managers exactly what to do and how an innovation will turn out, (b) the diversity of innovation determinants studied has led to instability and

confusion, and (c) the instability of the determinants from case to case frustrates theory-building efforts.

"*Even though it cannot be established at the moment, and of grasping the essential fact, discarding the unessential, even though one cannot give account of the principles by which this is done*" - learning from experience is fundamental to the effectiveness of innovation.

From *Section 2.4.3* – (a) experiential learning is essential to innovation which is inherently risky, (b) trial-and-error learning is a highly uncertain undertaking ~ naive at first, mistakes encountered, more knowing later, and (c) many organisations do not learn from their errors regarding innovation, and are baffled repeating the same errors and feeling the same old frustrations.

In Table 2.1 are found the economic, social and cultural Schumpeterian schools of innovation. Even though it is stated in Section *2.2.5* that there is an inclination of this study towards the social school, the three Schumpeterian schools are not separate as such and there are overlaps amongst them. In this study, the social school takes centre-stage.

From *Section 2.2.2* – (a) there are grassroots impetuses underlying innovation that involve engagements of many agents, (b) innovators that run in packs will be more successful than those who go at it alone, (c) in organisations innovation processes (overlapping within and across departments) tap on human relationships, (d) relationships enable innovation to reveal itself in action as the innovation process takes after an uncertain progression, (e) the whole innovation is highly suspenseful as no one knows how it will unfold, and (f) in the middle of innovation, everything can look like a failure.

With his coinage of creative destruction, Schumpeter destroys to create with his thinking. Looked upon as an oxymoron, creative destruction has in its fold an inherent tension and preparedness to abandon past success in favour of an unclear but promising future embedded in innovation. The embrace of creative destruction is not easy as 'in the middle of innovation, everything can look like a failure'.

From Section *2.4.3* – (a) when it comes to innovation, it seems almost to have a death wish when we ignore the important role of failure, (b) innovation is a daunting

process and organisations should acknowledge failures and preach 'failure-as-a-part-of-life', and (c) organisational learning, without detecting and correcting errors in 'what we know' and 'how we learn', together with the knowledge that comes with it, can deteriorate, become obsolete, and result in bad decisions.

The above deals with how the Schumpeterian innovation perspectives and the ensuing literature review are linked. More detailed accounts on the linkages are found in – (a) Section *2.3* ~ innovation in the knowledge-based economy, (b) Section *2.4* ~ organisational learning, (c) Section *2.5* ~ errors, and (d) Section *2.6* ~ knowledge management.

2.8 CONCLUSION

The literature review is carried out extensively for a deeper understanding of innovation with a Schumpeterian overview. It then moves on to a more current review of innovation from these different angles - structure and human agency, process, HRM, culture, creativity, risk aversion and psychological safety, context and resource-based view competitiveness.

From the literature, errors, learning and knowledge are closely associated with innovation as main streams; and they are reviewed broadly under relevant streamers. For instance, learning is looked into with respect to Argyris and Schon's single-, double- and triple-loop learning. In addition it is reviewed in terms of experiential learning, particularly with learning from errors within a culture that is tolerant to errors from innovation. Per such experiential learning, knowledge is created for sharing to enhance innovation effectiveness iteratively.

CHAPTER 3

POSITIVISM – THE RESEARCH APPROACH IN THIS STUDY

Introduction

This study follows the procedural framework within which the research is conducted. It describes an approach to a problem that can be put into practice in a research programme or process.

Innovation and its effectiveness are approached in this thesis as an organisation and management study posited in the domain of social science.

Positivism is primarily embraced in this chapter as a philosophy of science. What characterises a positivist research is examined in relation to its philosophy, assumptions, implications and methods.

From this examination, insights and understanding are acquired to enable this researcher to do his study more appropriately, as designed and required methodologically of a positivist.

The aim of this chapter is to have this researcher better prepared to take on appropriate steps that are in line with deductive and inductive reasoning.

3.1 WHAT IS POSITIVISM?

Positivism is given its distinctive features as a philosophical ideology by French philosopher August Comte (1798-1857). It is defined as “a philosophy of science that believes there is an objective reality that exists apart from the perceptions of those who observe it; the goal of science is to better understand this reality” (Schutt, 2001:46). Such a definition is reflective of a realist position.

3.1.1 Positivist philosophical assumptions

Positivists argue that evidence is what can be experienced of a phenomenon. The experience can be observable or non-observable (e.g. gravity). Empirical study and independent verification are the proper basis for developing and evaluating explanations of the phenomenon (Rousseau *et al*, 2008:485).

In positivism, evidence constitutes repeated examination of cause–effect relationships. It seeks explanations founded on the notion of a unified reality governed by laws. Its emphasis on universality leads its advocates to make assumptions that may limit the research questions they ask. It downplays the role of context and history, making it less compatible to the study of organizational practices and experiences; the contextual and historical dimensions of organisations are ever evolving.

Comte is cited to have encapsulated his positivist view thus - “All good intellects have repeated, since Bacon’s time, that there can be no real knowledge but that which is based on observed facts” (Easterby-Smith *et al*, 2002:28). Positivism assumes that the social world exists externally, and that its properties should be measured through objective methods. Knowledge is only of significance if it is based on sense-experienced observations of the external reality.

The above focus on the assumptions of positivism reflects on a study’s philosophical ontology, epistemology and methodology; they constitute its paradigm. For a researcher, it is not wise to conduct research without the awareness and understanding of the philosophical issues. The decision to study a topic in a certain way always involves some kind of philosophical choice about what is important. This choice is grounded in a researcher’s ontological, epistemological and methodological creeds.

3.1.2 Paradigms are grounded in ontology, epistemology and methodology

A paradigm is "a general set of philosophical assumptions covering, for example, ontology (what is assumed to exist), epistemology (the nature of valid knowledge), ethics or axiology (what is valued or considered right) and methodology" (Mingers, 2001:242).

This chapter is focused on the ontological, epistemological and methodological assumptions that this researcher has identified with positivism. Besides Mingers' descriptions of these terms, Table 3.1 provides more thoughts behind the three assumptions of philosophies.

Table 3.1 Philosophical ontology, epistemology and methodology

Philosophical …	**Thoughts from …**		
	Guba (1990:18)	Easterby-Smith *et al* (2002:31)	Collis and Hussey (2003:48-50)
Ontology	What is the nature of the "knowable"? Or, what is the nature of "reality"?	Assumptions that we make about the nature of reality.	Assumptions on the nature of reality.
Epistemology	What is the nature of the relationship between the knower (the inquirer) and the known (or knowable)?	A general set of assumptions about the best ways of inquiring into the nature of the world.	The study of knowledge and what we accept as valid knowledge.
Methodology	How should the inquirer go about finding out knowledge?	Combination of techniques used to enquire into a specific situation.	The overall approach to the research process.

By making known his ontological, epistemological and methodological assumptions, this researcher makes known how he is adding to the body of knowledge in unique and acceptable ways. In this chapter, he shares with others the positivist paradigm that guides disciplined inquiry (Guba, 1990:18). By making known his paradigmatic position, this researcher next looks into the implications of the positivist assumptions.

3.1.3 Implications from the positivist philosophical assumptions

From the ontological and epistemological assumptions in Section 3.1.1, there are positivist implications to be drawn from them as found in Table 3.2. Not all the implications were proposed by Comte as there are some proposed by other thinkers after him.

Table 3.2 Positivist implications

Implication	Elaboration
Independence	The researcher must be independent from what is being researched.
Value-freedom	What to study and how to study it are determined objectively and not by human beliefs and interests.
Causality	The aim of the social sciences should be to identify causal explanations that explicate regularities in social behaviour.
Hypothesis & deduction	Science proceeds through the hypothesising regularities and then deducing what kinds of observations will reveal the truth or falsity of the hypotheses.
Operationalisation	Concepts need to be operationalised in a way to allow facts to be measured quantitatively.
Reductionism	Problems are better understood as a whole when they are reduced into the simplest possible elements.
Generalisation	To generalise about regularities in human and social behaviour, samples of sufficient size are selected from which inferences may be drawn about the wider population.
Cross-sectional analysis	Such regularities can be more easily identified by making comparisons of variations across samples.

(*Source: Easterby-Smith et al, 2002:28-29*)

The above implications are more appropriate for the natural sciences; but they are adopted in this study per its design of a social science research in an organisational and management study.

This research is preliminary posited in the realm of positivism to determine how it will hold out and stand fast as a social science study. For this determination, the theory and data in this study need to abide by the positivist implications in Table 3.2.

3.2 THEORY AND DATA

When social research is conducted, there is generally an attempt to connect theory with empirical data obtained from the social world. But before theory can be connected to data and vice versa, some clarity on these two terms is necessary before their connection. The relationship between theory and data is an issue that has been debated by philosophers for many centuries. Not thinking carefully through

these debates and issues can gravely change the worth of a research (Easterby-Smith *et al*, 2002:27).

3.2.1 What is theory?

It is defined as "a logically interrelated set of propositions about empirically reality" (Schutt, 2001:35-6). Theories help us to understand events/phenomena that are interrelated and how to predict and/or explain the outcomes of studies on these events/phenomena when certain conditions are met. Researchers resort to theories when they want to know what to look for in a study and to specify the implications of their findings for other research (ibid.).

The theory for this study comes from the literature reviewed in relation to this researcher's own experience. The research focus on innovation effectiveness is theorised with respect to errors, learning and knowledge. It has been argued that direct experience with the subject of one's research is most important if one is to develop new insights about it (Easterby-Smith *et al*, 2002:61). Personal experience influences what the researcher can see: experience works both as a sensitizer and as filter for the researcher (ibid.).

From the preceding account, it is theorised in this study that the learning and knowledge linked to an acceptance of errors from innovation will underlie the latter's effectiveness. As a social science research designed in the positivist tradition, one starts with a theory and then seeks data to confirm or disconfirm the theory.

3.2.2 What is data?

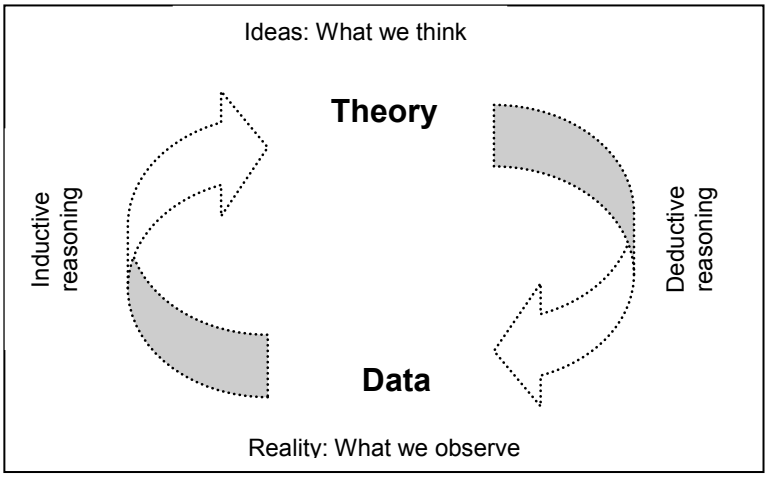
It is defined as "known facts or things that are used as a basis for inference or reckoning" (Collis and Hussey, 2003:160). There are some reservations on the term data which has been associated with the term evidence. It is a common mistake to think of data as evidence which is simply 'out there' and thus discovered and collected like picking strawberries (Schwandt, 2001:108). What constitutes evidence depends on one's inquiry purposes and the questions one seeks to answer. Evidence is generated in different ways that are deemed appropriate to serving particular purposes and answering particular questions (ibid).

In this study the data are collected as primary data from a questionnaire survey. They are both quantitative and qualitative, the former in numerical form and the latter with non-numerical characteristics. Generally how are data linked to theory? Which of the two comes first?

3.2.3 Theory or data first?

This question has been asked by quite a number of researchers with Easterby-Smith *et al* (2002:46) and Remenyi *et al* (2000:32) amongst them.

For an answer to the above question, the following figure is referred where theory is cyclically linked to data.



(Source: Schutt, 2001:38)

Figure 3.1 Links between theory and data

In the above figure, there are two ways in which theory can be linked to data and vice versa. These two ways are (a) deduction ~ when theory comes before data and (b) induction ~ when data comes before theory. Deductive and inductive researches can be both quantitative and qualitative.

The above differentiation between deduction and induction may make one to regard them as distinct and separate. But it is not useful to think of them thus as they are intimately intertwined (Remenyi *et al*, 2000:32). This intertwined intimacy comes from the inter-play between the two as modes of inference. A mode of inference is defined

as “a procedure of deriving claims about one thing, from claims about another thing: claims about *Q* from claims about *P*” (Fleetwood and Hesketh, 2010:242).

3.3 DEDUCTION

Deduction is an inferential procedure which starts with a theory and seeks to see if the theory applies to specific instances. It is defined as the derivation of a conclusion by logical reasoning in which the conclusion about particular issues follows necessarily from a general premise (Remenyi *et al*, 2000:281).

3.3.1 Deductive reasoning

It works from the more general to the more specific. In deduction one moves from a set of general premises to a more specific conclusion by adhering to an analytical process of logical coherence (Ketokivi and Mantere, 2010:316).

With deduction, a researcher moves from claims about *P* in general to claims about particular instances of *Q* – from claims that ‘all ravens are black’ to the claim that the ‘next raven observed will be black’ (Fleetwood and Hesketh, 2010:242).

A researcher may begin with a theory on a topic of interest and then narrows it down into hypotheses that can be tested. A hypothesis is a tentative explanation of a theory that is taken to be true of a study. In the context of research methodology, a hypothesis should be expressed in such a way that it directly follows from a theoretical conjecture found in the literature and potentially can be falsified (Remenyi *et al*, 2000:91). Observations such as the data from surveys are collected to test the hypotheses for a confirmation or disconfirmation of the theory.

Deductive reasoning has sometimes been referred to as ‘top-down’ approach as shown in Figure 3.2.

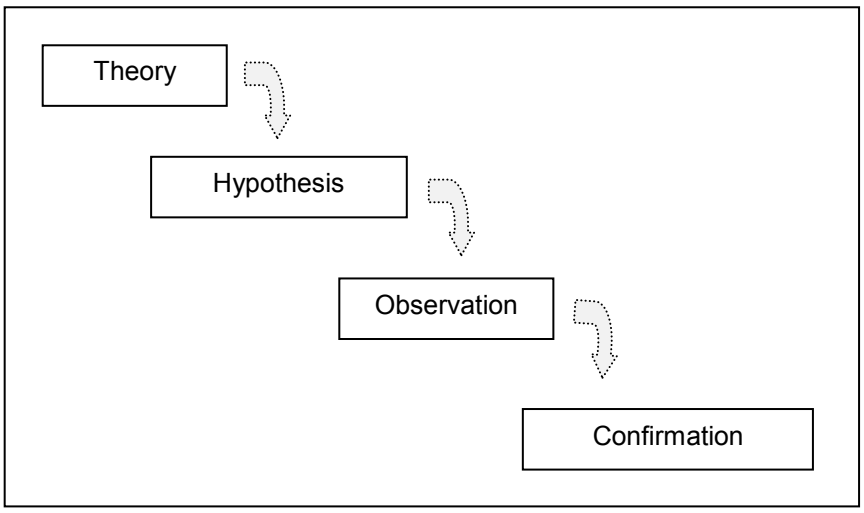


Figure 3.2 The 'top-down' approach of deduction

3.3.2 Deduction and positivism

In this study, positivism emphasises quantifiable observations that lend themselves to statistical analyses. Its positivist deduction is not regarded as an approach that will lead to interesting insights, especially for the social sciences in the field of management studies and organisational research.

One of the key tenets of positivism is the reductionist approach it takes to explore the relationships among the variables being studied. This approach is necessary to control an investigation and understanding of how the variables are behaving. According to Remenyi *et al*, the reductionist approach will lead to simplifications of the real world environment in which the variables naturally or usually exist (2000:36). This simplification means that in the results of a positivist research, some of the complicating factors, and likely the most interesting ones have been stripped out.

3.4 INDUCTION

It works in a reverse way from deduction by moving from specific observations to broader generalisations and theories. It is defined as the reasoned derivation of a generalised conclusion from the observation of particular instances (Remenyi *et al*, 2000:284).

3.4.1 Inductive reasoning

With induction, a researcher moves from the particular to the general – from claims about many instances of *P* to claims about *Q* – from claims that 'all raven thus far observed are black' to the claim that 'all ravens are black' (Fleetwood and Hesketh, 2010:243).

Induction is sometimes called the 'bottom up' approach as depicted in Figure 3.3. In inductive reasoning, we begin with specific observations and look for patterns and regularities to formulate some tentative hypotheses that we can explore, and finally end up developing some theories.

Inductive reasoning is one of the primary forms of reasoning in research and everyday life. Unlike deduction, inductive outcomes contain knowledge claims not analytically implied by the premise - "it amplifies our knowledge in that the conclusion is more than a restatement of the premises" (Ketokivi and Mantere, 2010:316).

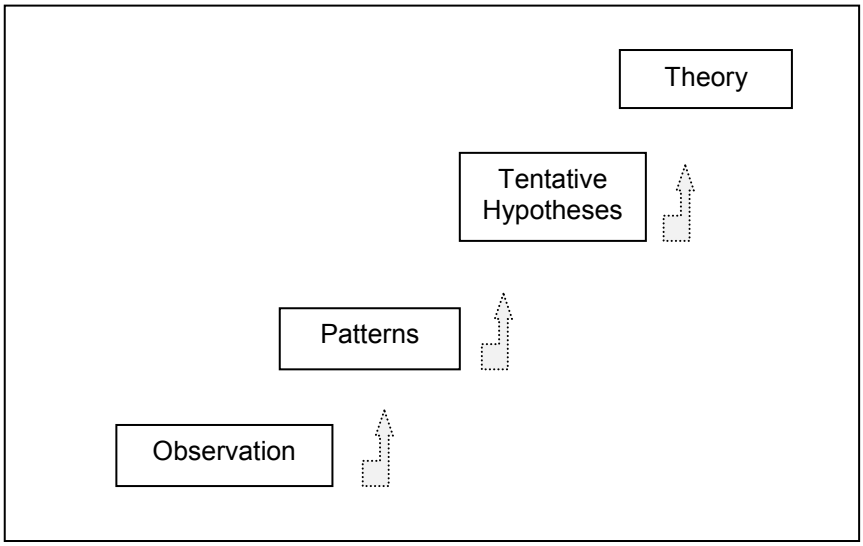


Figure 3.3 The 'bottom-up' approach of induction

Inductive reasoning is a theory building process which is more open-ended and exploratory than deductive reasoning

3.4.2 Induction and theoretical exploration

In contrast to the deductive approach, where a conceptual and theoretical structure is developed before empirical research, the outcome of induction works towards theory building (Truch, 2001:87).

Inductive exploration is not reductionist but holistic (Remenyi *et al*, 2000:36). It allows more complicated situations to be examined. It can involve itself not only with many ways of studying variables but also the context of a study.

Both the deductive and inductive approaches are used in this study as they are related to each other.

3.5 CONCLUSIONS

Knowing and understanding the relevancy of research paradigms are important as they can affect the merit of a research. The positivist approached is embraced in this study for its methodological design per a social science research on innovation with a theory derived from the literature and this researcher's experience. This theory is initially analysed deductively and an inductive explorative analysis of the same data follows thereafter. Deductive analysis and inductive exploration are carried out in this study in separate stages; they are designated Phase 1 and Phase 2 respectively.

The next chapter pertains to the preparatory research steps appropriate to Phase 1.

CHAPTER 4

RESEARCH DESIGN AND HYPOTHESIS DEVELOPMENT

Introduction

This chapter follows a research design path that is appropriate for a research steeped in a positivist paradigm as covered in Chapter 3.

There are quantitative data to be collected for the deductive analysis and inductive exploration touched upon in the preceding chapter. These data are used to test the hypothesis component of the 'top-down' approach of deduction in Figure 3.2. The same data are also used to initiate the observation component of the 'bottom-up' approach of induction in Figure 3.3.

In this chapter, the research methodology and methods adopted follow consistently the ontology and epistemology of the positivist approach underpinning this study.

4.1 COMMENCEMENT WITH THEORY

A theory has an *a prior* function in shaping research questions, problems, and initial hypotheses (Schwandt, 2001:251).

The theory in this study is derived from this researcher's experience relevant to this study on innovation effectiveness that is linked to errors, organisational learning and knowledge management. It is also rooted in the literature review done to capture this conceptual research flow: 'errors → culture → learning → knowledge → innovation effectiveness'. (Henceforth this conceptual flow is abbreviated and known as the 'ECLK → IE' process flow.)

From this conceptual flow, the theoretical framework of this study is delineated for the development of a research conceptual model.

4.1.1 Theoretical framework

For a positivist research study a theoretical framework is "a collection of theories and models from the literature which … is a fundamental part of this type of research as it explains the research questions or hypotheses" (Collis and Hussey, 2003:122).

The theoretical framework for this study is captured earlier in Figure 2.1. Capturing this framework early from the literature is important to determine if the issues to be researched on are sufficiently explicit and generally accepted by people working in the field for the researcher to derive workable and testable hypotheses (Remenyi *et al*, 2000:75).

The positivist approach is concerned with the relationship between "that part of the world which is the object of a particular study and the theoretical framework which is constructed in order to explain the observations that are made on the world" (Remenyi *et al*, 2000:88).

Figure 2.1 is constructed to allay the above concern prior to the development of a conceptual model from which data (or observations) can be thought about for their collection to test the hypotheses in this study.

4.1.2 Conceptual model

At the end of the literature review, a researcher would have prepared a conceptual model "that describes key variables relating to the phenomenon being researched and how these variables are linked to one another" (Remenyi and Money, 2004:123). In this model is a graphical representation of the theoretical conjecture (Remenyi *et al*, 2000:77).

A diagrammatic presentation of a conceptual model is of value as it allows a researcher to think through the variables involved and describe the possible relationships between them. From the conceptual model constructed, the research model proposed for this study is developed.

4.2 DEVELOPMENT OF CONCEPTUAL AND PROPOSED RESEARCH MODELS

The conceptual and research models are developed in relation to the 'ECLK → IE' process flow as raised in Section 4.1. These models are themselves components of this flow: theoretical framework → conceptual model → proposed research model.

For the development of these models, this researcher takes on a research strategy that is replicative.

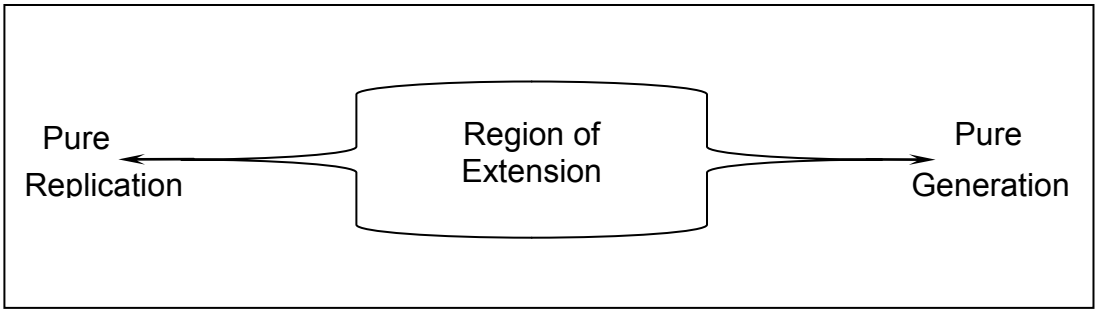
4.2.1 A replication strategy for the proposed research model

"In many natural sciences the replication of empirical findings is a common practice. In the social sciences … replications also have been conducted, but they seem to be less common" (Tsang and Kwan, 1999:759).

Tsang and Kwan ask - why is replication research seldom published in journals? The answer is replication has yet to be adequately recognized as a valuable part of theory development because (a) it is deemed that replications lacked creativity, (b) novelty is prized more than 'mere' replications, and (c) something new must be in a manuscript for it to be publishable (ibid.). But these authors believe that replication must be looked at from a deeper perspective how researchers understand the nature of science. The crucial role of replication is well established in science, and the principle of replicability is hailed as the hallmark of science (1999:761).

Research in general can be replicative (duplicating previous research parameters) and/or generative (modifying previous research parameters). “Any one research study can be thought of as occupying a conceptual space bounded by generation and replication” (Berthon *et al*, 1996:3).

The strategy of this study is to develop a proposed research model that is an integration of relevant models from previous studies. This integration is into pure replication as shown in Figure 4.1 from the work of Berthon *et al* (1996:4).



(Source: Berthon et al, 1996:4)

Figure 4.1 Research strategy – extension bounded by replication and generation

Figure 4.1 is relevant to all research paradigms but for different paradigms, replication takes on a very different role (Berthon *et al*, 1996:12-13).

This study is a pure replication of three previous relevant studies found in the literature; they are integrated for the derivation of this study’s conceptual model.

4.3 FROM THEORETICAL FRAMEWORK → CONCEPTUAL MODEL

The theoretical framework of Figure 2.1 is the foundation from which the conceptual model is constructed. Figure 2.1 is multifaceted and complex and the conceptual model is derived from it through reductionism.

4.3.1 A reductionist approach to developing the conceptual model

Reductionism is one of the positivist implications found in Table 3.2 and for the positivist undertaking at this juncture, the complexity in Figure 2.1 should be reduced to simplest terms (Easterby-Smith *et al*, 2002:30).

"One of the key tenets of positivism is that it takes a reductionist approach to exploring the relationships among the variables being studied" (Remenyi *et al*, 2000:35). Such an approach is necessary for a positivist so that he/she can control an investigation for him/her to understand the behaviour of the variables under investigation. Reductionism leads to simplifications of the real world environment.

And because of these simplifications, this researcher is reminded thus of the limitation of his positivist study as expounded by Remenyi *et al* – "the positivist findings are at best an indication of how the real world will actually behave because they are based on a reduced set of variables" (2000:36).

Thus when the theoretical framework is reduced to its conceptual model, the positivist research findings are associated more with the latter, a reduced picture of the former.

4.3.2 Reduction of the theoretical framework → conceptual model

Per this move, the theoretical framework of Figure 2.1 is reduced to only its high level constructs as shown in Figure 4.2.

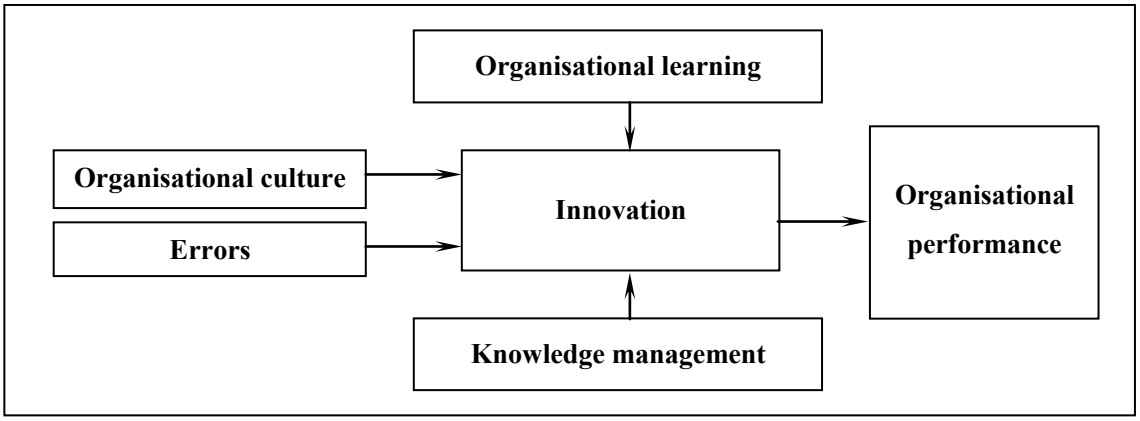


Figure 4.2 Conceptual model reduced from the theoretical framework

A construct is an abstract variable developed from ideas which serves as a higher level explanatory term; “frequently it is a construct that is tested in business and management research” (Remenyi *et al*, 2000:281).

The theoretical framework in Figure 2.1 is reduced to Figure 4.2 as depicted for a conceptual convergence towards innovation effectiveness as stipulated in this study’s conceptual research flow ‘ECLK → IE’ process flow of Section 4.1. This convergence will lead to the emergence of this study’s proposed research model.

4.4 FROM CONCEPTUAL MODEL → PROPOSED RESEARCH MODEL

The proposed research model focuses on innovation effectiveness as the outcome. From the literature reviewed, this researcher has yet to come across a study with a model that has innovation effectiveness as the outcome with error, culture, learning and knowledge the antecedents.

4.4.1 Progress from conceptual to research model on innovation effectiveness

From his literature review on effectiveness, Cameron has noted that 80 per cent of them have used effectiveness evaluation criteria that do not overlap with those used in other studies (1986:543). This has led to a criticism of the effectiveness literature as being disordered, fragmented and careless in their assessment. Per the theoretical framework (Figure 2.1) elicited from the literature and its reduction to the conceptual model (Figure 4.2), this researcher attempts to deal with the above criticism.

His attempt pertains to an integration of the overlapping aspects in the theoretical framework of Figure 2.1 into the constructs of the conceptual model. And the conceptual constructs in Figure 4.2 are integrated further for their translation into the research constructs of this study. The integration and translation are along these lines: -

(a) *Errors* + *Organisational culture* → *Error management culture*

Errors are beneficial to innovation when there is a positive tolerance for them (Section 2.5). From a cultural perspective, when an organisation is positive towards errors as experiential resources from which much learning and knowledge are to be

gained, such an organisation is likely to have a positive culture towards errors (Section 2.5.2). One focal area of this study is the management of errors as a part of an organisation's culture. In it errors and organisational culture are combined to fuse into EMC.

(b) *Organisational learning – remains as it is* (OL).
Organisational learning has been looked upon as the detection and correction of errors. Such learning can be single-, double- and triple-loop learning (Section 2.4.2). Much can be researched on organisational learning as reviewed (pages 50-54) and it remains as OL itself in this study.

(c) *Knowledge management – remains as it i*s (KM).
The flow of knowledge in organisations requires one to look at their whole organisational learning systems, including those associated with errors (Section 2.5.1). Like organisational learning, much can be researched on knowledge management as reviewed (pages 67-81) and it remains as KM itself in this study.

(d) *Innovation + organisational performance → Innovation effectiveness* (IE).
Innovation is not a stand-alone notion. It affects other concepts (in Figure 2.1) and is in turn affected by them (Section 2.3). By itself innovation is not enough for competitive advantage; its integration with the other concepts is needed to bring about effective organisational performance. The performance of an innovative organisation is a tapestry of complex, multi-dimensional and multi-disciplinary threads interwoven in this study as IE.

With the integration/translation, the conceptual model is reorganised for its transformation into the proposed research model. But prior to that, the literature is reviewed again for studies that are germane to the above four research constructs – EMC, OL, KM and IE.

4.4.2 Review of studies relevant to this study's research constructs

From the literature, three studies are found to be relevant to this study's replicative research. The models, constructs and survey instruments from these three studies are consolidated in this chapter to build on this study's proposed research model and survey questionnaire.

These three studies are designated Study A, B and C as captured in Table 4.1.

Table 4.1 Studies relevant to study's conceptual model

Study	Authors	Topic
A	Lee & Choi (2003)	"Knowledge management enablers, processes, and organisational performance: an integrative view and empirical examination"
B	Templeton *et al* (2002)	"Development of a measure for the organisational learning construct"
C	van Dyck *et al* (2005)	"Organisational error management culture and its impact on performance: a two-study replication"

How these three studies are put together in this study is shown in in the following sub-section where a research model is proposed to answer this research question as found in Chapter 1 - ***Are error management culture, organisational learning and knowledge management, the determinants of innovation effectiveness***?

4.4.3 This study's proposed research model

When the conceptual model in Figure 4.2 is transformed into the proposed research model, the outcome is in Figure 4.3 below.

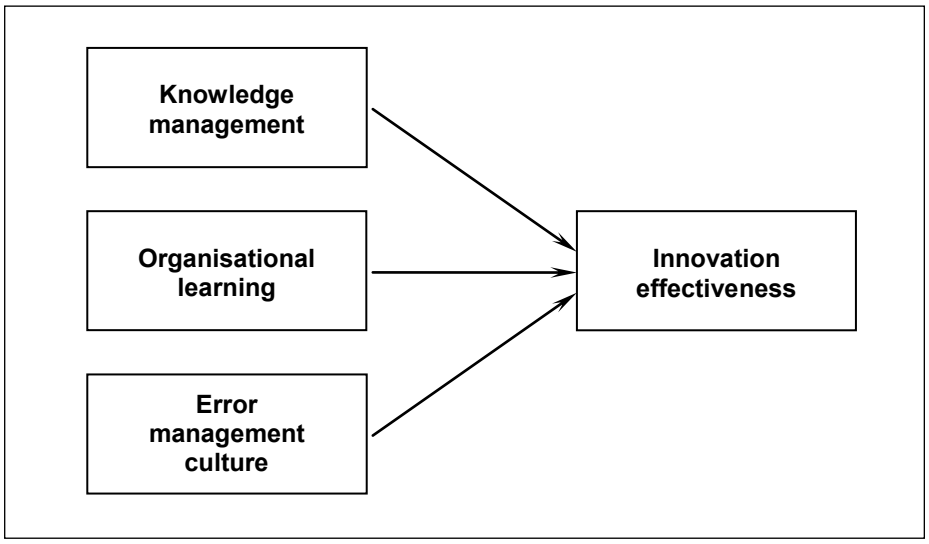


Figure 4.3 Proposed research model

In Figure 4.3, EMC, OL and KM, the antecedents of IE, are bundled together as complementarities. As dynamic capabilities, EMC, OL and KM can provide an organisation with strategic competitive advantages linked to the effectiveness of its innovations. They are the independent constructs of IE (the dependent construct) per these definitions: -

Construct	Definition
Independent	It is the construct that can be influenced to predict the values of the dependent construct.
Dependent	It is the construct whose values are predicted by the independent constructs.

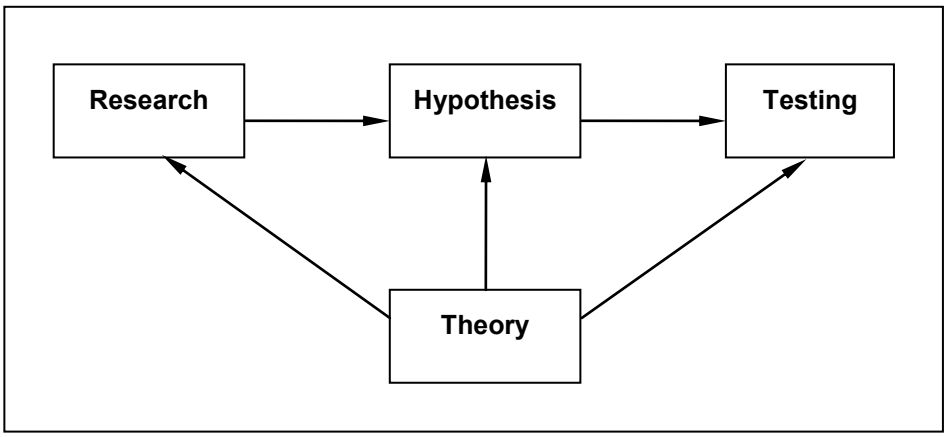
These constructs need to be delved deeper for a clearer understanding of them before they are operationalised per the positivist research methodology of this study. For such an understanding, their relationships as proposed in Figure 4.3 are looked into next per the positivist 'hypothesis' implication of Table 3.2.

4.4.4 Hypotheses of constructs

"A hypothesis is an unproven supposition or proposition that tentatively explains certain facts or phenomena. … Statistical techniques enable us to determine whether the proposed hypotheses can be confirmed by the empirical evidence" (Hair *et al,* 2003:253).

But to explain such phenomena one has to acknowledge the "dependence of actions on shared meanings while showing in what respects they are false, if they are" (Sayer, 2004:14). This researcher has assumed such dependence in his hypotheses and the testing of them will determine how this assumption manifest itself per the data collected.

How the hypotheses are featured in this dissertation is depicted in Figure 4.4.



(Source: Hair et al, 2003:56)

Figure 4.4 The flow of knowledge between key research components

The hypotheses in this study, represented by the hypothesis box in Figure 4.4, are derived by (a) the theory behind the 'ECLK → IE' process flow and (b) the positivist-deductive approach adopted. Described thus, the seven hypotheses in this study are as follows: -

H1: In organisations, there is a positive relation between knowledge management and innovation effectiveness.

H2: In organisations, there is a positive relation between organisational learning and innovation effectiveness.

H3: In organisations, there is a positive relation between error management culture and innovation effectiveness.

H4: In organisations, there is a positive relation between error management culture and organisational learning.

H5: In organisations, there is a positive relation between organisational learning and knowledge management.

H6: In organisations, there is a positive relation between error management culture and knowledge management.

H7: Organisationally, knowledge management, organisational learning and error management culture are the antecedents of innovation effectiveness.

All the seven hypotheses are reflections from Figure 4.3 and they are explained thus:

Hypothesis	Explanation
H1, **H2** & **H3**	For these three hypotheses, IE is the dependent constructs and EMC, OL and KM the independent constructs. Each hypothesis represents a bivariate correlation between IE and one of the constructs on the left.
H4, **H5** & **H6**	These three hypotheses focus on the 'errors → learning → knowledge' segment of the 'ECLK → IE' process flow. Each of them represents a bivariate correlation between each pair of the three independent constructs.
H7	This hypothesis is a multivariate representation of all the three independent constructs' interrelationships with IE as the dependent construct.

These hypotheses are tested through a questionnaire-based survey and the analyses of the survey data collected.

4.5 IMPLEMENTATION OF THE POSITIVIST RESEARCH METHODOLOGY

Generally research methodology is – "the procedural framework within which the research is conducted. It describes an approach to a problem that can be put into practice in a research programme or process" (Remenyi *et al*, 2000:28).

A comprehensive research methodology is important as it will provide a clearer understanding of how to enhance the rigour of adding something of value to the body of knowledge. Rigour is concerned with whether the research has been carried out with an appropriate and sound research methodology.

4.5.1 Positivist research methodology for a study on innovation effectiveness

This methodology is embraced in this social science even though this methodology is "borrowed from the natural sciences" (Remenyi and Money, 2004:123).

It has been indicated that "only by applying the methods of natural science, according to the positivist school of thought, will social science (including organisational research) ever be able to match the achievements of natural science in explanation, prediction, and control" (Lee, 1991:343). Such an indication is simplistic as the difficulties of capturing social reality by positivist research methodologies are said to be the reasons that organisational research, like the rest of social science, has not

yet reached the same level of scientific maturity that characterises natural science (ibid.).

With such difficulties being the case, then why is this study is posited in the realm of positivism? Surely with a subject as complex as innovation, it make no sense or logic to do a positivist research here. If it is so, why then is innovation researched thus? From the literature, there are studies on innovation carried out as positivist researches, especially those that are focused on the 'input-output' divide. Are such approaches suitable for studies on innovation effectiveness?

To address the above questions, this researcher has innovation effectiveness researched with a methodology designed in the positivist tradition to gain first-hand experience and knowledge in relation to the "uniqueness of experience as the basis of knowledge" (Giddens, 1975:2). To gain this first-hand experience and knowledge, this researcher follows closely the research methodology and methods that are traditionally designed for a positivist research.

By thus doing, this researcher may acquire first-hand knowledge on why a social science research such as his may not reached the same level of scientific maturity that characterises natural science as cited above. With this experience and knowledge, he will be in a better position to think of recommendations for future research at the end of this study.

4.5.2 Research methods and methodologies

Mingers defines method as "a well-defined sequences of operations that if carried out proficiently yield predictable results" (2001:241-2). Its synonym is 'techniques'. As for methodology, it is defined in the context of a philosophy as "a structured set of guidelines or activities to assist in generating valid and reliable research results" (ibid.). A methodology can consist of various 'methods' and it is "more general and less prescriptive than a method" (ibid.).

In this dissertation, *methodology* is focused in the domain of philosophy and *methods* are the specific research approaches used in practice for data collection, data analyses, results interpretations, etc. Depending on a researcher's philosophical stance, his/her research methodology/methods may differ from others and this will differentiate his/her contribution to the body of knowledge.

Methodology and methods are essential parts of the operationalisation of this study's research constructs.

4.5.3 Operationalisation of the research constructs

Operationalisation is one of the positivist implications in Table 3.2 and it is indicated there that concepts need to be operationalised in a way to allow facts to be measured quantitatively.

Before the constructs in Figure 4.3 are operationalised, their meaning must be explicit and specified. The definitions of these constructs are found in Table 4.2.

Table 4.2 Definitions of the research constructs

Construct	Definition	Reference
Knowledge management	It is the combination of management enablers for fostering knowledge consistently and knowledge processes for managing knowledge effectively.	Adapted from Lee and Choi (2003:181).
Organisational learning	It is the set of actions (knowledge acquisition, information distribution, information interpretation, and organisational memory) within the organisation that intentionally and unintentionally influence positive organisational change.	Templeton *et al* (2002:189)
Error management culture	It is organisational practices related to communicating about errors, to sharing error knowledge, to helping in error situations, and to quickly detecting and handling errors.	van Dyck *et al* (2005:7)
Innovation effectiveness	It is a combination of:- (a) Organisational inventiveness - the degree of belief that an organisation is actually producing creative (novel/useful) ideas (services/products). (b) Organisational performance – the degree of overall success, market share, growth rate profitability, and innovativeness in comparison with major competitors.	Adapted from Lee and Choi (2003:222)

From the above table, the three reference studies of the four constructs are integrated in this study as an accumulative expanded research of them through replication. These three references will be referred to as the three base studies.

4.5.4 Replication of three base studies for this study

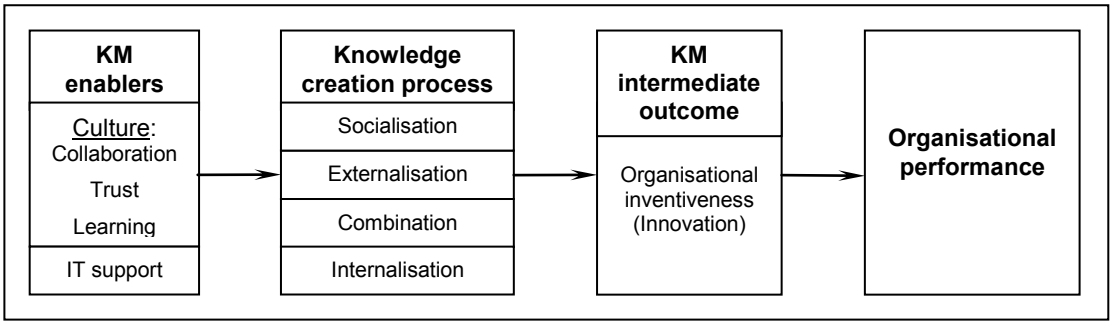
The three base studies used for replication, found in Table 4.1, are reiterated here thus: -

• Study A - “Knowledge management enablers, processes, and organisational performance: an integrative view and empirical examination” (Lee and Choi, 2003).

• Study B - “Development of a measure for the organisational learning construct” (Templeton *et al*, 2002).

• Study C - “Organisational error management culture and its impact on performance: a two-study replication” (van Dyck *et al*, 2005).

Study A is the primary backbone for this research and its model is as follows: -



(Adapted from: Lee and Choi, 2003:191)

Figure 4.5 Model from Study A

Figure 4.5 can be reconfigured to correspond more closely with the proposed research model of Figure 4.3 per this line of reasoning: -

• The ‘KM enablers’ has culture and learning included in Study A and these inclusions open the doors for EMC and OL to be admitted as enabling constructs.

• For the ‘KM creation process’, Lee and Choi have used Nonaka & Takeuchi’s *SECI* processes which have broadly been regarded as one of KM.

• With organisational inventiveness (innovation) cited by Lee and Choi as a ‘KM intermediate outcome’, it can combine with ‘organisational performance’ to become innovation effectiveness. This is quite similar to Section 4.4.1 where – ‘innovation + organisational performance → innovation effectiveness’.

Per the above reconfiguration, the replication of Study A, Study B and Study C are featured in Figure 4.6.

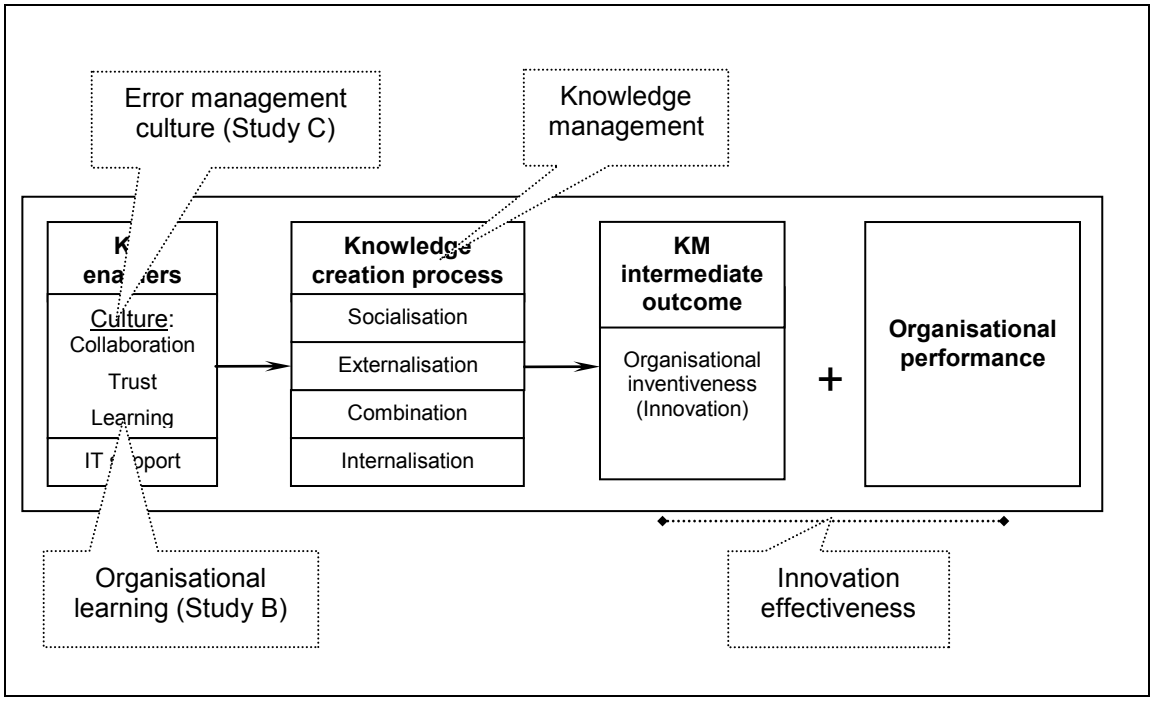


Figure 4.6 Incorporation of Study B and Study C into Study A

From Figure 4.6, all the questionnaire survey items of this study are replicated here from the three base studies. The appropriate use of the questionnaire items from Study 'A + B + C' starts with a pilot study of them.

4.6 PILOT SURVEY AND MAIN SURVEY

"We can borrow or adapt questionnaires from other researchers, but there still remains the task of making sure that these will 'work' with our population and will yield the data we require" (Oppenheim, 1992:47). The process of designing and trying out questionnaires is referred to as 'pilot work'.

4.6.1 Pilot survey

"The pilot is really one of the few legitimate places where problems and issues inherent in the survey tool can be identified and resolved before they cause significant damage to the overall survey" (Church and Waclawski, 1998:84).

All the original survey items of Study 'A + B + C' are put together for the pilot survey. They totalled 98 items and all of them are used in the pilot work which is carried out in three iterative stages with a total of 56 respondents.

The outcomes of the pilot work are these which are pertinent to the main survey: -

- The time taken to complete the survey has been determined.
- The response to the negatively worded items shows that they are not problematic.
- Provision of 'don't know' and 'not applicable' are added as new response options.
- Similar worded items are combined with a reduction of survey items from 98 to 86.

With the lessons gained from the pilot survey, this study is better geared for its main questionnaire survey per a positivist research.

4.6.2 Main survey

The 86 items from Study 'A + B + C' remaining after the pilot become the items of the main questionnaire. The details of the survey with this main questionnaire are found in Appendix 4A.

The unit of analysis for the positivist research in this study is an 'organisation'. It is imperative that the unit of analysis be clearly defined at the outset. All questions in the instrument should be collecting information at a consistent unit of analysis (Malhotra and Grover, 1998:410).

When the level of analysis is clear, the next step is whether to sample widely, or whether to go for depth (Easterby-Smith *et al*, 2002:44).

4.7 SAMPLES AND SAMPLING

Ideally, the sample chosen should not have significant differences between the sample and the population in any important characteristics. This is stressed so that the results from the statistical analysis of the sample data can be generalised to the population with specified degree of confidence.

For this dissertation, the target population are organisations relevant to the research. They are relevant in that they have the information the research is designed to collect. (Hair *et al*, 2003:209).

A frequently asked question when it comes to sampling is the suitable size of the sample. “In reality, there can only be a few guidelines to answering this question, rather than a single definitive response” (Bryman and Cramer, 2001:100).

The goal of the survey and sampling is to collect the data for analysis.

4.8 DATA COLLECTION

The data collected for a positivist research study are ‘primary’ as they are done at source for this study.

Data are also referred to as empirical evidence in positivist studies. Evidence is the essence of human knowledge. It deals with the regularities our senses and measuring tools can detect (Rousseau *et al*, 2008:480).

The participants in the survey are provided with a rating scale; this allows a numerical value to be given to an opinion (Collis and Hussey, 2003:184). In Appendix 4A, the multiple-item constructs in the main survey are measured with a seven-point Likert scaling. A seven-point range is used instead of a five-point range Likert scale as the former has more granularity.

4.8.1 The Likert scale

Per a Likert scale, an individual is faced with statements which are basically value judgements which may concern the individual’s reflection of reality. The adoption of a Likert scale must be considered in relation to – (a) the specific problem being researched on, (b) the context of data analysis, and (c) the problem solving potential of the methods used (Gob *et al*, 2007:606).

When a Likert scale is used to measure judgement, a respondent is to indicate a degree of agreement or disagreement using the following options for instance: strongly agree, agree, neither agree nor disagree, disagree, strongly disagree. Such

a scale purports to measure *direction* (by 'agree/disagree') and *intensity* (by 'strongly' or not) of judgement (Albaum, 1997:332). The scale is intended as a summated scale and is assumed to have interval scale properties even though it is not meant to be such. The standard Likert scale tends to confound the direction and intensity dimensions of judgement so there may be an under-reporting of the most intense agreement or disagreement. This scale "measures directly the interaction and indirectly the main effects of direction and intensity … the main effects are inferred from the interaction measure" (ibid.).

Despite its inadequacy, the Likert scale is still popularly adopted for surveying judgements as it is relatively easy to administrate to get an indicative picture of how the respondents are judging and perceiving.

4.8.2 Response rate

A total of 515 questionnaires are sent out to organisations and individuals who would find the survey to be of interest with 'organisation' as the unit of analysis. A survey net is thrown wide for a good geographical spread.

From the questionnaire sent out, only 181 of them are useable for analysis. There are 322 non-responses and 12 are not used for analysis as some of their data are missing.

The 181 usable responses represent a rate of 35.2%. A list of the usable responses' organisations is captured in Appendix 4B. This list does not include organisations with their names not indicated in some of the usable responses.

Extensive attempts have been made to have the sample size large through various channels. There is a concern that the non-respondents may in some way be different from those who have responded and they might affect the analysed results. Concerted follow-ups to the non-respondents are made to request for their participation. In some instance such requests are followed up thrice and despite this, there are still 322 non-respondents.

However, the response rate 35.2% compares reasonably well with these rates from the three base studies adopted for the construction of the integrated research model

– 43.0% (Lee and Choi, 2003:195), 31.1% (Templeton *et al*, 2002:193) and 22.0% & 17% (van Dyck *et al*, Study 1 & Study 2, 2005:1231 & 2005:1236 respectively).

As a general rule for regression analysis, each independent variable in a variate needs a ratio (number of observations to each independent variable) to be not less than 5:1. The desired ratio is between 15 to 20 observations for each independent variable (Hair *et al*, 2006:196).

There are four variates (or constructs) in the questionnaire and the maximum number of variables per variate is 8 (as in the organisational learning construct). As there are 181 usable responses, the ratio is >22 (as 181 ÷ 8 = 22.6), exceeding the desired ratio of between15 to 20. Thus the sample size of 181 is of some acceptable adequacy for statistical analysis.

In Appendix 4C is found the analyses of the respondent profiles.

4.9 CONCLUSION

The methodology used in this chapter is closely aligned with a research design rooted in positivism. Such an alignment allows this researcher to step inside the positivist domain to directly experience the nuances of doing such a quantitative research study.

By understanding positivism as a philosophy and by abiding with what its methodology and methods of collecting quantitative empirical data, this researcher is better prepared to take on the analyses of the data collected in the next chapter.

CHAPTER 5

DEDUCTIVE ANALYSIS - PHASE 1

Introduction

Deduction here involves the assessment of the proposed research model with the data collected for hypothesis testing.

This chapter starts with the coding of the survey items with the SPSS software which is used as a statistical tool for the deductive analyses of the data collected.

As this chapter is positivist in approach, the analyses are conducted objectively with the data collected. These data are analysed in this chapter according to the positivist tradition. By so doing, the data analyses are carried out deductively using the rules of formal logic and hypothetico-deductive logic to satisfy the requirements of falsifiability and logical consistency.

This chapter is designated Phase 1.

5.1 OVERVIEW OF THE QUANTITATIVE ANALYSES

In applying the hypothetico-deductive logic, a researcher focuses on testing a theory for empirical transparency. If the theory produces an acceptable prediction of a significant portion of the variance of the dependent variable, the theory is deemed to be empirically adequate (Ketokivi and Mantere, 2010:318).

The constructs and their factors are coded prior to the analyses and in Appendix 5A are found the codes. Thereafter the stages of these analyses are aligned with the positivist research tradition which follows an objective path steep in mathematics and statistics. The stages are: -

- Screening of the data from the main survey
- Reliability assessment of the data
- Validity assessment of the data
- Correlation assessment
- Bivariate regression
- Multivariate regression

5.2 DATA SCREENING

"Measures of central tendency and dispersion can reveal a lot about the distribution of a set of numbers from a survey" (Hair *et al*, 2003:244). The data of the items in the main survey are analysed on their data sample sizes, means, skewness and Kurtosis with Statistical Package for the Social Sciences (SPSS version 12).

5.2.1 Data size of each construct

The ranges of the four constructs are found in Table 5.1.

Table 5.1 Range of item data sample sizes

Items from construct …	Range
EMC	173 - 181
OL	109 - 181
KM	135 - 181
IE	139 - 167

The range differences of the constructs from the usable sample size of 181 are due to some respondents opting for 'don't know' and 'not applicable' when their responses fall outside the Likert scale adopted for the survey. From Table 5.1, the respondents appear to be unclear about the IE construct.

In Appendix 5B are found the descriptive analyses of the survey items and they are next summarily looked into.

5.2.2 Item means

The range of these means for each construct is in Table 5.2.

Table 5.2 Range of item means

Items from construct …	Range of means
EMC	4.54 – 5.63
OL	4.03 – 6.02
KM	3.74 – 5.49
IE	4.60 – 5.03

The means of all the survey items are above 3.5, the mid-point of the Likert scale of 7. This can interpret to mean that the respondents are generally positive about survey items.

5.2.3 Item skewness

"Skewness is a measure of the symmetry of a distribution; in most instances the comparison is made to a normal distribution" (Hair *et al*, 2006:40).

The skewness of the data collected are assessed in relation to this indication - "when skewness values are larger than +1 or smaller than -1, this indicates a substantially skewed distribution" (Hair *et al*, 2003:244).

From this assessment, there are seven items with skewed distributions as shown in Table 5.3.

Table 5.3 Items with skewness >+1 and <-1

Item code	Skewness
EMC_C_9	-1.054
EMC_E_15	-1.223
OL_F_2	-1.096
OL_G_6	-1.423
OL_G_7	-1.224
OL_G_8	-1.111
OL_N_28	-1.128

These seven items may be regarded as outliers. Outliers have characteristics which are "identifiable as distinctly different from other observations" (Hair *et al*, 2006:73). At this juncture, these outliers are noted. Their retention/rejection will depend on the results of more analyses such as those of factor analysis.

5.2.4 Item Kurtosis

Kurtosis is a "measure of the peakedness or flatness of a distribution when compared with a normal distribution". (Hair *et al*, 2006:39). A positive and negative Kurtosis value indicates a relatively peaked and relatively flat distribution respectively.

"A curve is too peaked when the Kurtosis exceeds +3 and is too flat when it is below -3" (Hair *et al*, 2003:244).

Assessed thus, the Kurtosis outcomes of the data collected are acceptable as they are within ± 3 and how close they are to a normal distribution is reflected in the histograms of Figure 5.1.

When the histograms are compared, it appears that OL's histogram is the closest to that of a normal distribution with a standard deviation of 0.85. For the other three constructs, their histograms deviate from a normal curve in this order – KM, EMC and IE. Their standard deviations are respectively – 1.01, 1.02 and 1.21 respectively.

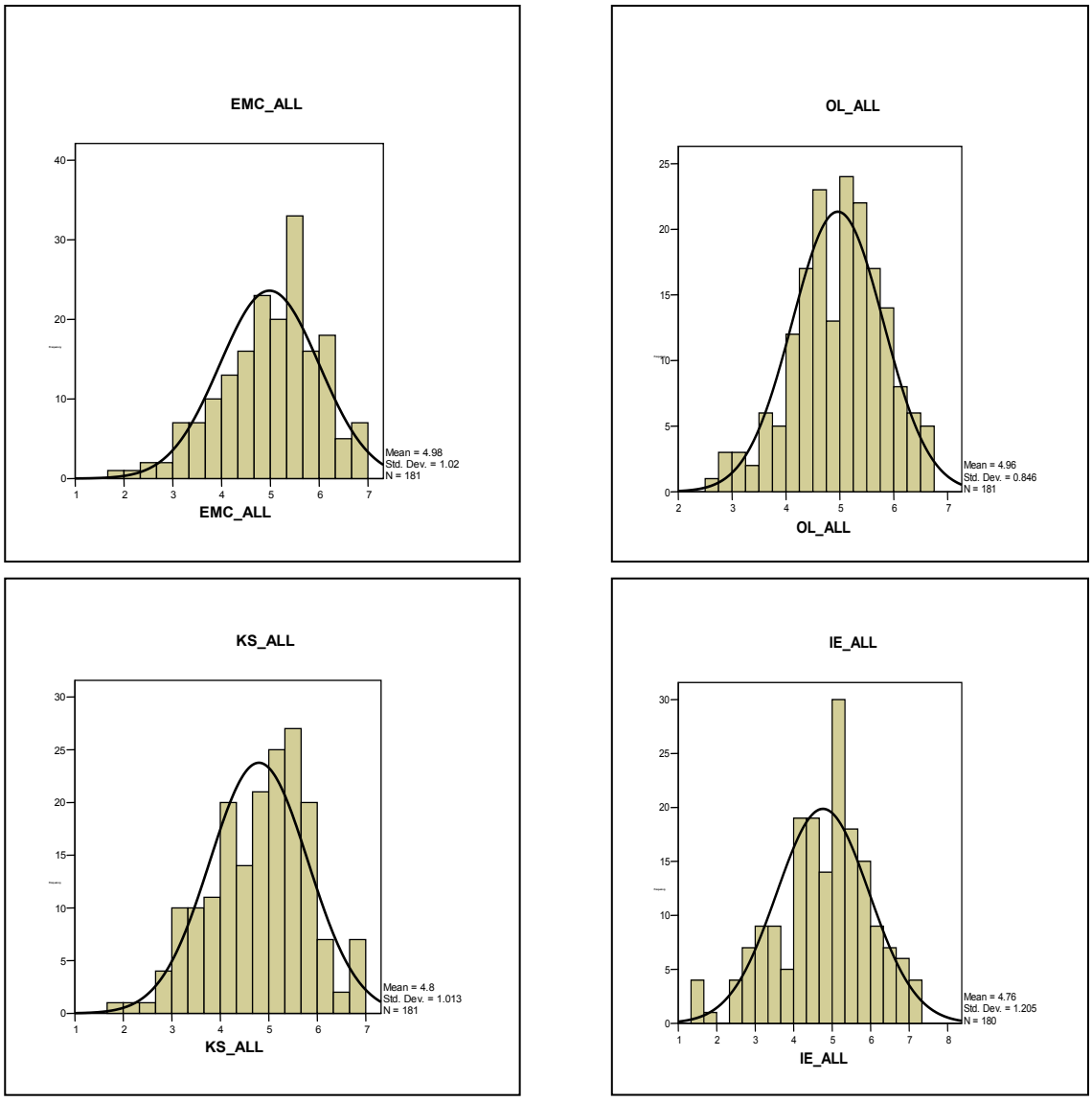


Figure 5.1 Histograms of the four research constructs

The above tests on the survey item data show them to be in acceptable order. But how these items interrelate with each other has to be determined.

"It is generally accepted that when a concept has been operationally defined, in that a measure of it has been proposed, the ensuing measurement device should be both reliable and valid" (Bryman and Cramer, 2001:62). Zikmund has indicated reliability and validity as two criteria for evaluating the consistency and accuracy respectively of the survey Items (1997:340).

5.3 RELIABILITY ASSESSMENT

Reliability is the degree to which measures are free from error and therefore yield consistent results (Zikmund, 1997:340). The reliability of the data collected is assessed here.

5.3.1 Construct reliability

Bryman and Cramer have separated reliability into its external and internal aspects as follows (2001:62): -

• External reliability – it refers to the degree of consistency of a measure over time.

• Internal reliability – it seeks to find if the survey items, which make up each of the constructs, are measuring the construct and whether these items are internally consistent.

External reliability is not looked into in this study as the measurement of the constructs is done at one point in time. But internal reliability is checked as it is "particularly important in connection with multiple-item scales" (Bryman and Cramer, 2001:63).

Cronbach's alpha (α) is a widely used indicator for the measurement of internal reliability; its acceptable lower limit is 0.80 (ibid.), although for exploratory research it may decrease to 0.60 (Hair *et al*, 2006:137).

5.3.2 Internal reliability of the constructs and their factors

Each of the new constructs and its factors are checked on their reliability and the results are as shown in Table 5.4.

Tables 5.4 Internal reliability outcomes

Construct level	Cronbach's α		Factor level	Cronbach's α
EMC_ALL	.904		EMC_C1	.890
			EMC_C2	.831
			EMC_C3	.813
			EMC_C4	.813
OL_ALL	.931		OL_C1	.834
			OL_C2	.831
			OL_C3	.811
			OL_C4	.803

			OL_C5	.758
			OL_C6	.670
KM_ALL	.972		KM_C1	.951
			KM_C2	.941
			KM_C3	.908
			KM_C4	.884
			KM_C5	.873
			KM_C6	.869
			KM_C7	.850
			KM_C8	.792
			KM_C9	.753
IE_ALL	.935		IE_C1	.949
			IE_C2	.927

All the above internal reliability results are above 0.60. The lowest Cronbach's alpha at the factor level (0.67) is linked to OL_C6 which has three survey items that are all negatively worded.

Overall the internal reliability of the data is in order as they are above the minimum threshold of 0.60. This has provided the condition necessary for the evaluation of their validity in the following section.

5.4 VALIDITY ASSESSMENT

Validity is the ability of a scale or measuring instrument to measure what is intended to be measured (Zikmund, 1997:342).

The validity of each construct's data is tested to show the extent to which each of them accurately represents its concept. These three validity types are looked into in this study – content, convergent and discriminant validity.

5.4.1 Content validity

Content (face) validity is the most important validity test because "without an understanding of every item's content or meaning, it is impossible to express and correctly specify a measurement theory" (Hair *et al*, 2006:778).

Content validity is looked into early during the pilot survey juncture when the survey items are assessed in three subsequent stages to determine their content validity.

5.4.2 Convergent validity

This validity assesses the degree to which two measures of the same concept are correlated (Hair *et al*, 2006:137).

"Item-to-total correlation" has been used as an indicator for content validity (with 0.4 as a minimum threshold) by Lee and Choi (2003:201). This study adopts the same indicator to assess the convergent validity of the research items.

Results per this indicator are derived from the "item-total statistics" outputs of SPSS reliability analyses and they are summarised in Table 5.5.

Table 5.5 Item-to-total correlation of each construct

Constructs	Item frequency per range of item-to-total					
	>0.2, <0.4	≥0.4, <0.5	≥0.5, <0.6	≥0.6, <0.7	≥0.7, <0.8	>0.8
EMC	-	-	3	5	3	-
OL	3	1	2	8	5	1
KM	-	-	1	6	15	6
IE	-	-	-	3	5	2

Except for three OL items, all the results in Table 5.5 are above the minimum value of 0.4 as adopted by Lee and Choi. Thus content validity appears to be not an issue.

5.4.3 Discriminant validity

This validity is the degree to which two conceptually similar concepts are distinct. Lee and Choi have used 'factor loading on single factors' to check on the discriminant validity amongst their research items (2003:201).

They have adopted 0.50 as the minimum for factor loading (ibid.) but for this study factor loading of 0.40 are adopted as they are "minimally acceptable" (Hair *et al*, 2006:129).

The 'factor loading on single factors' results per the constructs' rotated component matrixes from SPSS are used in this study to assess discriminant validity. These results are summarised in Table 5.6.

Table 5.6 Range of factor loading of each construct

Constructs	Item frequency per range of factor loading				
	≥0.5, <0.6	**≥0.6, <0.7**	**≥0.7, <0.8**	**≥0.8, <0.9**	**>0.9**
EMC	-	2	5	4	-
OL	4	4	5	7	-
KM	1	12	11	4	-
IE	-	-	1	7	2
No. of items	5	18	22	22	2
Percentage	100% ≥0.5	92.8% ≥0.6	66.7% ≥0.7	34.8% ≥0.8	2.9% >0.9

In Table 5.6, the factor loading spread of the four constructs are all above 0.5 indicating that the discriminant validity in this study is in order.

Now that the data are determined to be reliable and valid, the next step is to look into their correlations.

5.5 CORRELATION ASSESSMENT

A correlation exists between two constructs *X* and *Y* when the level of *Y* varies with the levels of *X*.

To determine if a correlation is likely to exist in the target population from which the sample is drawn, "inferential statistics" are used (Schutt, 2001:379). Pearson's linear correlation (***r***) is an indicator from which inferential statistics are drawn in this study.

5.5.1 Parametric requirements of Pearson's linear correlation

Pearson's ***r*** comes from a parametric technique which can compare "sample statistics with population parameters" (Collis and Hussey, 2003:196). But such a

technique can only be used on data which are ordinal and has a normal distribution (ibid.).

These two requirements are met in this study as the survey items have interval scales and the data have distributions that are close to normal curves as covered in Section 5.2.

5.5.2 Evaluation of Pearson's correlation

The strength of a correlation is denoted by the value of its Pearson's ***r***. When Pearson's ***r*** is high, the correlation between a pair of constructs in this study is high.

The Pearson's ***r*** results from each pair of constructs are found in Table 5.7.

Table 5.7 Pearson's correlation of study's constructs

Pair of constructs	Correlation	
	Pearson's *r*	**Significance**
OL & KM	.870	(**)
KM & IE	.834	(**)
OL & IE	.811	(**)
EMC & KM	.628	(**)
EMC & OL	.642	(**)
EMC & IE	.602	(**)

(** *correlation is significant at the 0.01 level*)

Linked to correlation is the concept of multicollinearity which is the "extent to which a variable can be explained by other variables in the analysis" (Hair *et al*, 2006:103). This dissertation has adopted 0.90 as the maximum on correlations as a guideline from Hair *et al* (2006:227).

From Table 5.7, the correlations are all below 0.9, with that between OL and KM at the highest of 0.87. They are below the upper limit of 0.9 from Hair *et al*. Interpreted thus, multicollinearity is assumed to be not a major issue in this study.

The ranking of decreasing Pearson's ***r*** for the correlation between each of the independent constructs with IE in Table 5.7 is in this order – (i) KM & IE, (ii) OL & IE and (iii) EMC & IE.

Correlation and regression are closely related but they serve different purposes (Bryman and Cramer, 2001:188). "Correlation is concerned with the degrees of relationships between variables, and regression with making predictions" (ibid.).

5.6 BIVARIATE REGRESSION

Regression is another statistical technique for measuring the linear association between a dependent construct and independent construct(s). But it is more; it assumes the dependent (or criterion) construct is predictively linked to the independent (or predictor) construct (Zikmund, 1997:832). Regression analysis tries to predict the values of a dependent construct from the specific values of the independent construct(s).

5.6.1 What is bivariate regression analysis?

This type of analysis involves two constructs and it establishes how the distribution of values from one construct is associated with the distribution of another. With this analysis, it is possible to determine if the variation exhibited by one construct is patterned in such a way that its variance is not randomly distributed in relation to the other construct (Bryman and Cramer, 2001:158).

A bivariate analysis relationship is generally represented by this equation: -

$y = a + bx + \varepsilon$ where

~ y is the dependent construct
~ x is the independent construct
~ *a* is the intercept
~ *b* is regression coefficient
~ ε is the error term (or residual)

The first six of the hypotheses (**H1** to **H6**) in this study are tested statistically with bivariate regression analysis.

5.6.2 Testing of hypotheses H1 to H6

These hypotheses, as found in Chapter 4, are tested on the relation between a pair of constructs with bivariate regression analysis.

For the each of these six hypotheses, its respective dependent and independent variables are as reflected in this tabulation: -

Hypothesis	H1	H2	H3	H4	H5	H6
Independent variable	KM	OL	EMC	EMC	OL	EMC
Dependent variable	IE	IE	IE	OL	KM	KM

Prior to the regression analysis, these statistical requirements of the research data are assumed to be in acceptable order – the presence of normality and the absence of multicollinearity. Normality has been verified in Section 5.2 and multicollinearity is assumed to be not a major issue in this study.

5.6.3 Questions pertaining to the testing of H1 to H6

When these six hypotheses are tested with bivariate regression analysis, answers to these four questions are sought per each hypothesis (Hair *et al*, 2003:298): -

- Does a relationship exist?
- Is the relationship positive or negative?
- If there is a relationship, how strong is it?
- If there is a relationship, what is the best way to describe it?

Each of **H1** to **H6** is tested on its null hypothesis (H_0) which states that its two constructs being examined are independent of one another and its alternate hypothesis (H_1) states that the two constructs are associated with each other (Collis and Hussey, 2003:125). “If the null hypothesis is confirmed, the proposition that there is a relationship must be rejected” (Bryman and Cramer, 2001:166). On the other hand, if the null hypothesis is rejected, the proposed relationship is confirmed.

To know whether a hypothesised association matters or not (that is whether the association is statistically significant and not merely due to chance) a researcher can refer to the statistical significance of the association.

5.6.4 Bivariate regression outcomes

The bivariate regression outcomes of the six hypotheses (**H1** to **H6**) are found in Table 5.8.

Table 5.8 Bivariate regression analysis results between constructs

Hypothesis	Between constructs …	Adjusted R^2
H1	KM & IE	0.735 (**)
H2	OL & IE	0.594 (**)
H3	EMC & IE	0.488 (**)
H4	EMC & OL	0.590 (**)
H5	OL & KM	0.798 (**)
H6	EMC & KM	0.659 (**)

(** *Correlation is significant at the 0.01 level*)

The results in Table 5.8 are significant at a level of 0.01 and all the six null hypotheses (each indicating that there is no association between each pair of constructs) are rejected. Thus hypotheses **H1** to **H6** are supported.

In Table 5.8, the 'adjusted R^2' value is used as "an indication of how well the model implied by the regression equation fits the data" (Bryman and Cramer, 2001:189). For example the R^2 value for the "KM & IE" relationship in Table 5.8 is 0.735 and this means that 73.5 % of the variance in IE is predicted by its bivariate regression with KM.

As for questions raised in Section 5.6.3, there is a positive relationship relation between each pair of constructs. With IE as a dependent construct, its bivariate regression outcomes with the three independent constructs are in this order of

decreasing strength – (i) KM & IE, (ii) OL & IE and (iii) EMC & IE. This ordering is the same as that for their correlations.

The strength of the bivariate regression of IE with each of the independent variable KM, OL and EMC are respectively 73.5, 59.4 and 48.8%. KM has come out to be a strongest predictor of IE and EMC, the weakest.

These bivariate results are further looked into when bivariate regression moves on next to multivariate regression.

5.7 MULTIVARIATE REGRESSION

In this section, all the three independent constructs are combined together and evaluated with IE as the dependent construct using multivariate regression.

5.7.1 What is multivariate regression analysis?

Multivariate regression is similar to its bivariate analogy but is more complex. It is used to explore the relationship among three or more constructs. With this exploration, causality can be demonstrated when cause and effect relationships are established (Bryman and Cramer, 2001:6). Also with it, a hypothesis on these constructs can be tested and "fed back into the theory that prompted it" (ibid.).

Generally a multivariate analysis relationship is represented by this equation: -

$$y = a + b_1x_1 + b_2x_2 + b_3x_3 + \varepsilon$$

where ~ y is the dependent construct (i.e. IE)
~ x_1 to x_3 are the three independent constructs (i.e. KM, OL and EMC)
~ a is the intercept
~ b_1 *to* b_3 are the regression coefficients, each for KM, OL and EMC
~ ε is the error term (or residual)

5.7.2 Testing of hypothesis H7 with multivariate regression analysis

Hypothesis **H7** in Chapter 4 reads – '*Organisationally, knowledge management, organisational learning and error management culture are the predictors of innovation effectiveness*'.

In this hypothesis, KM, OL and EMC are explored simultaneously as the predictors of IE. When **H7** is supported, this study's proposed research model (Figure 4.3) will be accepted. Otherwise the model will have to be re-examined.

5.7.3 Multivariate regression outcomes on testing hypothesis H7

The outcomes in Table 5.9 show KM to be the only predictor of IE, leaving out EMC and OL. Thus the proposed research model in Figure 4.3 is not supported.

Table 5.9 Multivariate regression outcomes per the test of H7

Adjusted R^2	Intercept (*a*)	Reg. coeff. (*b*)	*t* test	Sig.	*F* test	Sig.	Tolerance	VIF
.676	.825	.825	13.1	.000	172.0	.000	1.0	1.0

From Table 5.9, only KM positively predicts 67.6% of IE from the multiple regression and hypothesis **H7** is unsupported. But on the other hand, the direct importance of knowledge and its management to innovation from the literature is reinforced.

5.8 CONCLUSION

This chapter's focus is on the quantitative analyses of the data collected from the main survey. These analyses are sequentially built up, with a preceding stage addressed to be order before its subsequent stage is looked into more in depth.

The outcomes of the analyses appear to hold out well in relation to expectations up to the bivariate regression analysis level. But at the multivariate regression stage, the proposed research model is not supported. However, the importance of KM to IE is supported.

Thus the outcome of the deductive ‘top-down’ approach does not end up with a confirmation of the theory proposed from the literature as reflected in Figure 4.3. In the next chapter the same data collected is explored from a ‘bottom-up’ inductive approach to determine what can likely be an alternative explanation from the data per the factors that underlie IE.

CHAPTER 6

INDUCTIVE EXPLORATORY ANALYSIS – PHASE 2

Introduction

From the previous chapter, the deductive analysed outcomes confirm the importance of knowledge management to innovation effectiveness. Apart from this they do not address the absence of error tolerant culture and organisational learning, and their impact on innovation effectiveness. This lack of information will be addressed with an alternative process of inductive analysis. In this chapter the approach is exploratory. It looks at the same data set from the survey for patterns within the data with factor analysis.

This constitutes Phase 2 of this study with an inductive bottom-up analysis of data from a replication of three previous studies. The integration of their survey instruments provides a good spread of the aspects of error, learning and knowledge relevant to innovation as reviewed in the literature. From the inductive results, the factors antecedent to innovation are elucidated.

6.1 INDUCTIVE PROCESS ANALYSES

The same survey data for deduction are used for induction in this chapter to determine if there are meaningful patterns or regularities to address the research question as mooted in the introductory chapter. These data are from survey items of the three base studies and they cover quite broadly the various aspects of the four main constructs as reviewed in the literature.

Factor analysis is employed in this chapter to statistically group the survey items into factors with similar meanings. This approach is exploratory as there is no theoretical assumption on how the factors of EMC, OL, KM, and IE are relating to each other. The induction process pertains to a 'specific to general' approach.

6.2 FACTOR ANALYSIS

There are three independent constructs in this study and the items of these constructs are assumed to be unrelated to one another but they may in reality be inter-related with each other. The items of the dependent construct may also be inter-related amongst themselves.

Thus instead of seeing the items of the independent constructs as being distinct from each other, they are put together and analysed simultaneously with interdependence analytical techniques. The same is done with the dependent items.

Interdependence analytical techniques "seek to group things together" (Zikmund, 1997:657).The purpose of these techniques is to recognise the structure of a set of items. The interdependence analytical technique used in this study pertains to that of factor analysis.

6.2.1 Factor analysis of the survey data

As an interdependence technique, the primary purpose of factor analysis is to define the underlying structure among the variables in the analysis (Hair *et al*, 2006:104). In factor analysis, "all variables are simultaneously considered with no distinction" (Hair *et al*, 2006:109).

Factor analysis is used to sort out independent constructs' items through data reduction. The same is done with the dependent construct. It simplifies our understanding of the survey data in relation to the respondents' perceptions of the structures underlying the research constructs.

Here factor analysis is done to statistically reduce the data for an easier identification of the survey items so that the interrelationships amongst them can be seen more clearly. This clarity is better grasped when the following purposes behind the use of factor analysis are realised (Bryman and Cramer, 2001:261): -

• Assessment of how the survey items are tapping the same construct.

• Determination of how the survey items can be reduced to a smaller set.

• Making sense of complexity by the reduction to fewer factors.

This study is into exploratory factor analysis as it studies the data and provides the researcher with information about how many factors are needed to best characterise the data (Hair *et al*, 2006:773). This analysis is also embraced to refine the measures by identifying variables that should be removed from a conceptual and statistical perspective in order to enhance the reliability and validity of measured constructs (Muller, 2003:89).

6.2.2 Exploratory factor analysis

Exploration can be opted in a study, such as this, when its research issue has very few or no earlier studies for a researcher to refer to for information about the issue. "The aim of this type of study is to look for patterns … rather than testing or confirming a hypothesis" (Collis and Hussey, 2003:10). Exploratory factor analysis does not put any *a priori* constraints on the valuation of components or the number of components to be extracted (Hair *et al*, 2006:105).

These features of exploratory factor analysis are relevant to this study – principal component analysis, factor rotation and factor loading. The threshold for factor loading in this study is set at ±0.40 as "the range of ±0.30 to ±0.40 is considered to meet the minimal level for interpretation of structure" (Hair *et al*, 2006:128).

6.2.3 Examination of factor analysed independent outcomes

In factor analysis the prevailing concerns focus as much on the character and structure of the variables included in the analysis as on their statistical qualities (Hair *et al*, 2006:113).

A 'best fit', from the factor analysis, is concerned with the conceptual consistency of the analysis outcomes. This consistency is aligned with – (i) what have been unravelled from the literature review, (ii) this researcher's experience, (iii) the empirical findings of the three adopted studies, and (iv) the reliability and validity of the data from the survey which are found to be in order in the previous chapter.

For the determination of the 'best fit' independent factors, all the independent items are iteratively factor analysed together. Each iteration has a different pre-determined number of factors to be extracted. This number is incrementally stepped up from 10, 11, 12 … to 25 in this study.

From each iterative analysis, its SPSS output is examined on how the items are loading on the factor components. This researcher looks into how the items come together logically and fit the concepts that are captured in a proposed research model. From this examination, the 'best fit' is chosen from the 18-components factor analysis, the details of which are found in Appendix 6A.

6.2.4 Refinement of the factor analysed 'best fit' independent components

When Hair *et al* advise that "a simpler solution is better than a complex solution" (2003:57), this researcher has interpreted it to mean that these authors have in mind a parsimonious research applying the simplest approach that will address the research question satisfactorily (ibid.).

As a first step, the best fit solution is to be freed of 'no-loading' and 'single-item' factors. With this step taken, there are twelve components that are free of 'no-loading' and 'single-item' as shown in Appendix 6A.

In Appendix 6A some of the components have a large number of items that appears to cover more than one concept. They are factor analysed further (sub-factor analysis) to extract out simpler concepts. The extraction is to divide a conceptually complex

component into two or more sub-components that are internally consistent in meaning.

The final refined independent components after factor analysis are found in Table 6.1 with new codes assigned to the new components of the factor analysis.

Table 6.1 Refined 'best fit' factor analysed independent components

Construct	Component	New component code	Item code
EMC	1	EMC_C1	EMC_C_7
			EMC_C_8
			EMC_C_9
	2	EMC_C2	EMC_B_4
			EMC_B_5
			EMC_B_6
			EMC_E_15
	3	EMC_C3	EMC_D_11
			EMC_D_12
	4	EMC_C4	EMC_A_2
			EMC_A_3
OL	1	OL_C1	OL_F_1
			OL_J_14
			OL_J_16
			OL_M_25
	2	OL_C2	OL_F_3
			OL_F_4
			OL_H_9
	3	OL_C3	OL_G_6
			OL_G_7
	4	OL_C4	OL_F_2
			OL_H_10
			OL_H_11
	5	OL_C5	OL_J_13
			OL_J_15
			OL_K_20
	6	OL_C6	rOL_L_23
			rOL_M_24
			rOL_N_27
KM	1	KM_C1	KM_Q_4
			KM_Q_5
			KM_Q_6
			KM_Q_7
			KM_Q_8
	2	KM_C2	KM_V_29
			KM_W_30
			KM_W_31
			KM_W_32
			KM_W_33
	3	KM_C3	KM_V_26
			KM_V_27
			KM_V_28
	4	KM_C4	OL_K_17
			OL_K_18
			KM_S_14
			KM_S_15
	5	KM_C5	KM_P_1
			KM_P_2
			KM_P_3
	6	KM_C6	KM_S_16

			KM_U_23
			KM_V_25
	7	KM_C7	KM_T_21
			KM_U_22
	8	KM_C8	KM_R_9
			KM_R_12
			KM_T_18
	9	KM_C9	KM_T_19
			KM_T_20

6.2.5 Factor analysis of the dependent construct

The factor analysis here is on the IE items and the approach taken is similar to that for the independent items. After factor analysis, the new IE components too have new codes as found in Table 6.2.

Table 6.2 Refined 'best fit' factor analysed dependent components

Construct	Component	New component code	Item code
IE	1	IE_C1	IE_X_1
			IE_X_2
			IE_X_3
			IE_X_4
			IE_X_5
	2	IE_C2	IE_Y_6
			IE_Y_7
			IE_Y_8
			IE_Y_9

For both the factor analysed independent and dependent components, the conceptual consistency of the 'best fit' is linked to interrelationship assumptions that need to be verified and they are looked into next.

6.2.6 Verifying the interrelationships of items in the 'best fit'

When the conceptual consistency of the components and items of the 'best fit' is found to be adequate, the next step is to ensure that the variables are sufficiently inter-correlated to produce representative factors (Hair *et al*, 2006:114).

Even though it can be assumed that, with factor analysis, we may tap on some underlying structure that "does exist in the set of selected variables" (Hair *et al*, 2006:113), we may not know what this structure is in reality. It is the researcher's responsibility to make sure that the observed patterns of inter-correlations are conceptually valid and appropriate for a study with factor analysis (ibid.).

There are nine indicators with which the assumed underlying structure can be verified and they are found in Appendix 6B. From the verifications in Appendix 6B, the assumption that there is some underlying structure in the research items of the constructs is supported.

6.2.7 Reduction in research items from factor analysis

From the factor analyses, there are a total reduction of 17 items and 1 factor as shown in Table 6.3.

Table 6.3 Reduction of items and factors after factor analysis

Construct	No. of items in …		No. of item reduced		No. of factors in …		No. of factors reduced
	Main survey	Best fit			Main survey	Best fit	
EMC	15	11	4		5	4	1
OL	28	20	8		8	6	2
KS	33	28	5		8	10	(increase of two instead)
IE	10	10	-		2	2	-
Total no. of items reduced			17		**Total no. of factors reduced**		1

The 17 items removed after factor analysis are - EMC_A_1, EMC_D-10, EMC_E_13, EMC_E_14, OL_F_5, OL_G_8, OL_H_12, OL_K_19, OL_L_21, OL_L_22, OL_M_26, OL_N_28, KM_R_10, KM_R_11, KM_R_13, KM_T_17 and KM_U_24.

For the OL construct, two of its items (OL_K_17 and OL_K_18) have crossed over to the KM construct. This may be a reflection on the inter-correlation of the variables.

Some degree of parsimony is realised after factor analysis and the reduced items are removed from the original questionnaire survey. The remaining 69 items are captured in Appendix 6C together with their new factor codes. These 69 items are used for subsequent statistical analyses in this chapter in relation to multivariate regression.

6.2.8 Evaluation of the 69 factor analysed items for consistency and accuracy

After factor analysis, the 69 items in Appendix 6C are checked that they represent and measure the constructs in an accurate and consistent manner. "When these issues are addressed properly, measurement error is reduced" (Hair *et al*, 2003:169).

The details of the outcomes after factor analysis are found in Appendix 6D. How the factors in Appendix 6D are relating to each other is looked into next with multivariate regression analysis.

6.3 MULTIVARIATE REGRESSION OF FACTOR ANALYSED OUTCOMES

The multivariate regression here is different from that in Section 5.7. The inputs for the earlier regression in Chapter 5 are the raw data from the survey, whereas the regression inputs here are the 20 independent and 2 dependent factors derived from the factor analysis of the raw data in Section 6.2.

6.3.1 Multivariate regression of the 20 independent and 2 dependent factors

The 20 independent factors are regressed with each of the two dependent factors per the following two approaches: -

Approach	Independent variables	Dependent variable
A	EMC_C1, EMC_C2, EMC_C3, EMC_C4, OL_C1, OL_C2, OL_C3, OL_C4, OL_C5, OL_C6, KM_C1, KM_C2, KM_C3, KM_C4, KM_C5, KM_C6, KM_C7, KM_C8, KM_C9 and KM_C10	IE_C1
B	EMC_C1, EMC_C2, EMC_C3, EMC_C4, OL_C1, OL_C2, OL_C3, OL_C4, OL_C5, OL_C6, KM_C1, KM_C2, KM_C3, KM_C4, KM_C5, KM_C6, KM_C7, KM_C8, KM_9 and KM_C10	IE_C2

The regression results from the two approaches are found in Table 6.4.

Table 6.4 Multiple regression outcomes of Approach A and B

Approach	Dependent variable	Regression outcomes		
		Model	Adj. R^2	Sig.
A	IE_C1	KM_C2	.826	.000
		KM_C4		
		KM_C1		
		OL_C2		
		OL_C1		
		OL_C3		
B	IE_C2	KM_C2	.454	.000
		KM_C1		

The results in Table 6.4 are statistically significant. There are six factors predicting 82.6% of IE_C1 and two factors predict 45.4% of IE_C2.

These factors are named to reflect as close as possible the items that constitute each of them. The names are - IE_C1 (innovation traits), IE_C2 (innovation competitive advantage), KM_C1 (trust), KM_C2 (autonomy), KM_C4 (IT support), OL_C1 (access to learning and knowledge), OL_C2 (performance assessment) and OL_C3 (communication).

The two dependent factors are from the innovation effectiveness construct. The items named as ‘innovation traits’ are more reflective of the enablers that characterise innovation as a process, whilst those that come under ‘innovation competitive advantage’ are more reflective of the outcomes of innovation.

6.3.2 Ranking of the regressed factors

The independent factors in Table 6.4 are ranked for both ‘innovation traits’ and ‘innovation competitive advantage’ and their ranked outcomes are explicated in Table 6.5. When Table 6.5 is depicted schematically, the outcome is as shown in Figure 6.1.

Table 6.5 Ranking of the regression outcomes

Dependent factor	Independent factor	
	Rank	**Model**
Innovation traits	1	Autonomy
	2	IT support
	3	Trust
	4	Performance assessment
	5	Access to learning and knowledge
	6	Communication
Innovation competitive advantage	1	Autonomy
	2	Trust

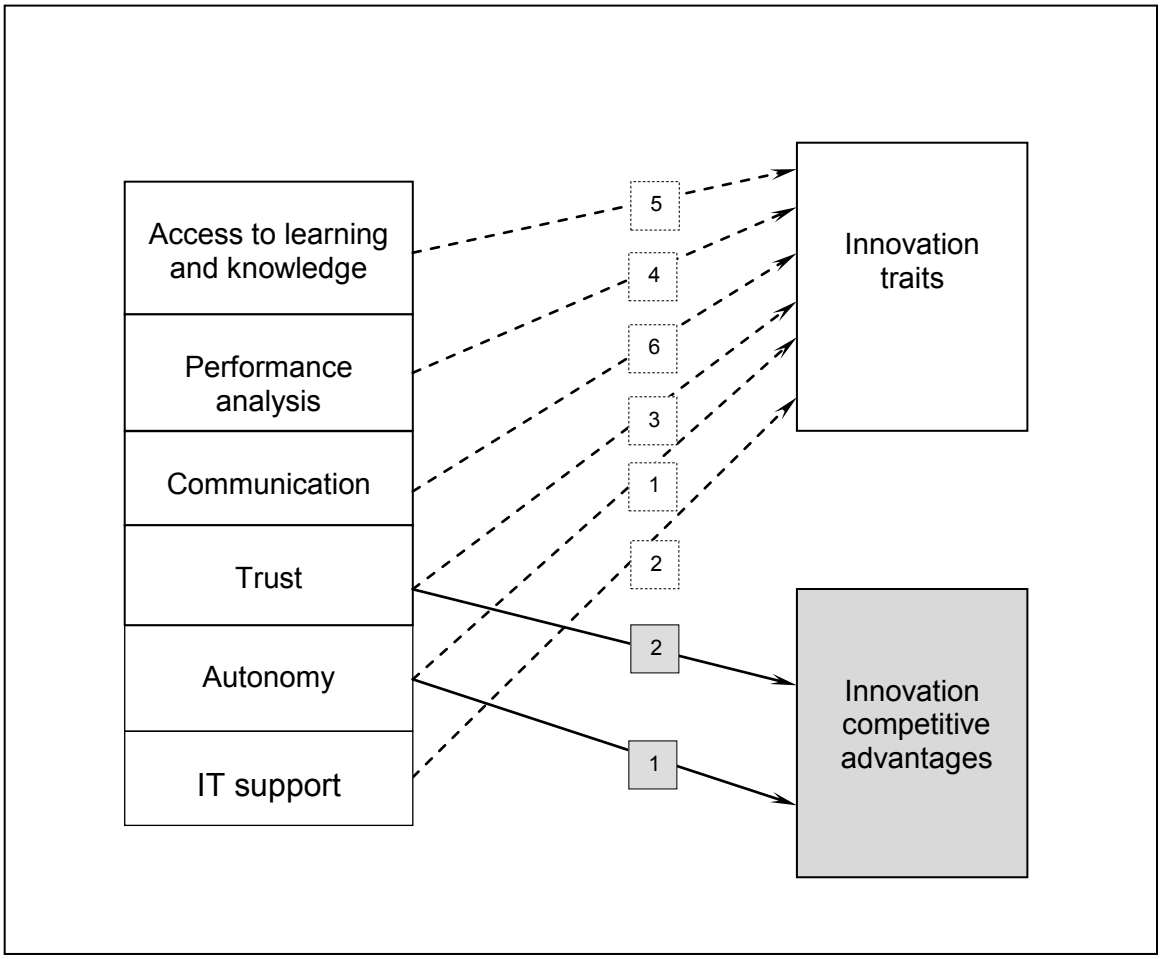


Figure 6.1 Schematic representation of the regression outcomes

From Figure 6.1, the top three independent factors antecedent to innovation effectiveness, from both E_C1 and IE_C2, are - 'autonomy', 'trust' and 'IT support'. But only 'autonomy' and 'trust' will be explored in-depth in the next chapter as both of them are common to 'innovation traits' and 'innovation competitive advantage'.

From Table 6.4 only the factors from OL and KM are featured after multivariate regression. Factors from EMC are not accounted for. The absence of EMC factors in the regression outcomes is looked into next.

6.4 WHY ARE THE EMC FACTORS MISSING FROM THE REGRESSION?

Answers to this question will be pursued and sought from these three perspectives – the work of van Dyck *et al* (2005), the questionnaire survey and this researcher's recollection of his tenure at TPS.

6.4.1 The EMC outcomes in van Dyck *et al*'s work

The research question of their work reads – "Is error aversion culture negatively related to firm performance and error management culture?" (2005:1231).

The above question is asked in relation to error aversion culture which is "another dimension of organisations' error culture and comprising aspects such as covering up and experiencing strain from errors" (ibid.). This dimension may relate negatively to firm performance and EMC as (a) errors may produce strain with demands on the erring individual, and (b) individuals not only have to deal with the tasks at hand but also with the social dimensions of errors and their negative self-images.

On the other hand, for organisations in which errors tend not to be punished and are accepted as part of daily organisational tasks, the additional cognitive demands of errors may be potentially reduced because there is less need for individuals to cope with their negative self-images by hiding errors or blaming others.

Error aversion culture is one of the four dimensions of error culture in van Dyck *et al*'s work; the other three are – EMC, blame and punishment, and empathy (2005:1231). Per these dimensions, these authors have hypothesised thus – "Error management culture is positively related to firm performance" (2005:1231).

How are the research question and hypothesis divulging themselves per the outcomes in van Dyck *et al*'s work? For the research question, the outcomes on error aversion culture suggest that (a) fear of being caught with making a mistake is an important issue and (b) people put a lot of energy into hiding the fact that they have made mistakes (2005:1234). These authors have emphasised that error aversion culture "needs to be developed in more details in future studies" (ibid.).

The work of van Dyck *et al* is a two-part study conducted in two European countries – first Holland and then Germany. The Dutch study reveals, from quantitative and qualitative cross-sectional data, that organisational EMC is significantly correlated with organisational goal achievement and an objective indicator of economic performance. This finding is confirmed in the German study. "The results suggest that organisations may want to introduce organisational error management as a way to boost firm performance" (van Dyck *et al*, 2005:1228).

Even with this suggestion, the last sentence of van Dyck *et al*'s work reads – "Yet, despite these encouraging examples, we believe that, to date, the potential for EMC to provide organisations with a competitive edge has not been fully realised" (2005:1238). It appears that the absence of EMC from this study's outcomes resonates to some extent with these authors' thinking at the end of their work.

6.4.2 The EMC outcomes in this study

From a contextual perspective, the EMC outcomes in this study are expected to be different from that of van Dyck *et al* although the same EMC survey items are used in both cases. This expected difference comes from the difference in the content of their survey questionnaires. In their study, the survey items consist of only those of EMC; whereas in this syudy, the survey items consist not only of a replication of the same EMC items, but there are the additional replications of the OL and KM items from Templeton *et al* (2002) and Lee & Choi (2003) respectively.

In this study, the EMC items have to 'compete' with the OL and KM items during the multivariate regression analysis. The ranking of the constructs' contributions per their regression with IE, as reflected in Table 6.5, are in this diminishing order – KM (with autonomy, IT support and trust as factors), OL (with performance assessment, access to learning & knowledge and communication as factors) and EMC (absent

without any factors). This ranking makes processual sense in relation to this flow in Section 1.6 - 'errors → culture → learning → knowledge → innovation'; it follows this reducing ranked closeness to innovation on the left of the flow – knowledge, learning, culture and error.

Besides the above ranked furthest distance of error from innovation that may demerit EMC from being accounted for in the regression outcomes, it does not mean that error plays no part in innovation effectiveness. It does in terms of the learning and knowledge that can ensue from it. An error can catalyse learning and knowing to fuel innovation. It does not play a role only when there is no organisational focus or culture on it as a rich resource; this can result in missed opportunities, no learning and loss of new knowledge. With that as a likely scenario, innovation is likely to be less effective.

When a respondent to this study's survey is from such a likely scenario, he or she may not be tuned or attuned to the more positive experiential aspects of EMC, and answering to the EMC survey items may not be easy. Also such answers may not be positive as reflected in these comments from some of the respondents: -

I see the willingness to accept the blame for an error very much tied to job security. In Germany it is difficult to fire somebody but in US quite easy. I would expect that a German IT person is more likely to say 'that is my problem' than his US counterpart.
We have a culture that allows us to discuss and correct errors with trusted peers. However it is often not safe to discuss these issues with senior management (at least in US).
I can certainly say that in the last organisation I worked for in the West, (in this case the USA) the culture of learning from mistakes effectively was not fully in place, but I find it very difficult to express that within the confines of your survey.
I find the subject of errors and mistakes interesting, and would be interested to know if you think that there is sufficient trust between managers and staff in Singapore to enable mistakes to be made and subsequent learning to be achieved.
In my organisation it is not that we do not learn from mistakes, but that we have to acknowledge the mistake and any resultant consequences before doing the learning. Getting a smooth and useful process for that is the difficult thing. Mostly companies either explode or sweep under the carpet.
The Singapore way of 'learning' and not sharing is still very much an Asian thing I feel. Sad but true; I see that daily at work.
"Errors are tolerated, but often time is not taken to properly assess the reasons for the errors – the teams are too small" (this respondent is from Germany).

The difficulty in answering the EMC items in the main survey is reflected in the standard deviations in Appendix 5B where 47% of the EMC items have standard deviations that are >1.5 (as compared to 42% and 27% respectively for the OL and KM items).

Only comments on EMC are received per the questionnaire survey as tabulated above. There is no comment from the respondents on the OL and KM constructs.

6.4.3 The EMC outcomes in relation to Tetra Pak in Singapore

EMC may be absent from Table 6.5 but it was prevalent at TPS during a good part of this researcher's tenure there even though it was not thought about in an erudite manner as in this study.

The founding Factory Manager and his team at TPS then were all new in a newly established organisation where errors abounded. Dealing with these errors effectively was the surest and fastest way for TPS to learn and grow in the right direction. By finding this direction on a path with errors as signposts, the founding members of TPS had inadvertently nurtured an error management culture as connoted in this study.

This researcher had, up to and until this study, approached the resolutions of errors based on practical pragmatism rather than a theoretical basis. To prevent this approach from sliding into adhocracy, this study is an attempt to move from pragmatism to theory building in the handling of errors. Carnall has stressed - "pragmatism above theory, but never adhocracy!" (1990:199).

The results from this study have provided this researcher with a platform not only to think and discuss about the management of errors experientially and pragmatically but also theoretically. At the start of this sub-section, it is indicated that EMC was prevalent at TPS for a good part of this researcher's 20 years there. Most of the time TPS's good performance was upheld by a strong EMC; there were also times when such a culture was not as strong at TPS.

Culture is a living organisational entity and a strong culture may/may not be consciously and actively sustained by organisations per these evolving features – characteristic and clear approach, values, heroes, rites and rituals, and networks

(Carnall, 1990:168). At TPS, its top management changed every three to four years and these changes had an effect on the strength of its EMC when new brooms swept clean.

6.5 CONCLUSION

The same data set in the previous chapter is inductively explored in this chapter and the outcomes are captured in Table 6.5. There are six independent factors as antecedents to innovation effectiveness which is now represented by two components - innovation traits and innovation competitive advantage. Of these six antecedents, autonomy and trust will be explored comprehensively as primary factors with the other four as secondary factors.

The exploration will be carried out in the next chapter in terms of a review of more current literature and the discussions that follow.

CHAPTER 7

DISCUSSIONS

Introduction

Autonomy and trust have been inductively derived at in this study as primary factors of knowledge management that are antecedent to innovation effectiveness. Each of them is explored in-depth in this chapter in relation to innovation effectiveness. It is indicated in the previous chapter that exploration is opted when a research issue has very few or no earlier studies for a researcher to refer to.

The two primary factors is each explored comprehensively (a) as individual factor, (b) in relation to each other, and (c) in relation to each of these other four secondary factors of innovation effectiveness - IT support, access to learning and knowledge, performance assessment and communication.

Exploration moves from the analyses in the previous chapters to discussions in this chapter. These discussions will be linked to (a) a literature review of more relevant current works and (b) this researcher's experiential reflections of his twenty years tenure at Tetra Pak in Singapore where a no blame culture lie beneath everyday working life.

7.1 DISCUSSIONS ON THE INDUCTIVE EXPLORATIONS

This researcher can identify with the outcomes of the inductive exploration in the previous chapter. In retrospection the outcomes make good practical sense to him per his tenure at TPS when quality was then considered to be a part of innovation in terms of finding new ways for improvements. But during those years his approach was more impromptu; not as clear as the results from this study have spelt out to be.

The inductive outcomes are finer grained and richer in information. Table 6.5 provide researchers and practitioners with a platform for thinking and arriving at issues linked to innovation effectiveness from the data collected. Of the six factors in Table 6.5, only two are common to both innovation traits and innovation competitive advantage – autonomy and trust. They are discussed here to indicate how they are comparing and contrasting to those in the literature linked to innovation effectiveness. Such a comparison/contrast can provide some insights on the generalisability of this study's outcomes.

7.1.1 Autonomy

The literature on innovation is divided on the need for autonomy and the need for control especially in the knowledge economy where employees are more increasingly recognised as knowledge workers. There is a tension between autonomy and control in relation to both innovation management and the knowledge economy as wrapped in the literature reviewed in Chapter 2. It has been argued that knowledge workers occupy strategic positions of power in the knowledge economy. But the direct economic importance of knowledge may lead to more direct control and exploitation of knowledge workers (Dankbaar, 2003:xii).

Autonomy enhances innovation as the latter develops better in organisation structures that are characterised by loosely defined tasks and responsibilities. But it is possible to introduce control into innovations when they are regarded as processes. Dankbaar has talked of an innovation process which is dissected into shorter phases where control is exercised by insisting on distinct temporal demarcations, in terms of resources and results, for decision making per each phase.

7.1.2 Trust

Trust too has limits. Unlimited trust is neither realistic nor appropriate in practice. When it comes to institutional trust, leaders need to create guidelines such that when it is misplaced, violators need to be confronted.

In his paper on the role of trust in innovation, Dovey explores this role "in the collaborative learning processes that underpin innovation as a competitive strategy in organisations" (2009:311). He finds that these processes that underpin idea generation and realisation in organisations are "strongly dependent for their effectiveness upon the availability, within and beyond stakeholder networks, of trust and other key social capital resources" (ibid.).

The practical implications of Dovey's findings are that, if innovation is dependent upon social capital resources like trust, then (a) leadership endeavour needs to focus on the creation of a social environment that nurtures rich stakeholder relationships, (b) new forms of governance and power management are required in organisations that are trying to compete through innovation, in addition to (c) more appropriate and aligned organisational structures (ibid.).

7.1.3 Alignment of experience with autonomy and trust

It is indicated before that this researcher's approach at TPS was *ad hoc*; but he can now align what he did then into the slots of autonomy and trust after having gone through the inductive exploration of them. He can now better explain and share his experience in terms of autonomy and trust.

At the start of TPS's operation in 1982, the seeds of autonomy and trust did not germinate well. Social processes and time were needed for autonomy and trust to gain roots at TPS. Its early adoption of a 'knows best/no blame' culture provides a timely recourse for the nurturing autonomy and trust. It is argued that employees are closer to the day-to-day tasks of their organisation than those who supervised or managed them. From this argument, it is asserted that employees, and not their managers, contribute more directly to innovation (Tafti *et al*, 2007:148).

7.2 EXPLORATION ON AUTONOMY

The word 'autonomy' is chosen for this factor as it pertains to knowledge workers as covered in the more current literature; they have the rights to their knowledge and the freedom to express them. The exploration on it will take on a social capital perspective.

"Social capital facilitates knowledge acquisition and exploitation by affecting conditions necessary for the creation of value through the exchange and combination of existing intellectual resources" (Yli-renko *et al*, 2001:589). It influences the knowledge available for the focal operator through his or her relationship networks, the actual knowledge disclosed to or retrieved by him or her, and the efficiency of the resulting knowledge transfers and exchanges (ibid). Social capital was originally applied in community researches to describe relational resources embedded in communal personal ties.

It is defined as "the value which accrues from the relationships between employees within and between organisations" (Burt, 1997; Alder and Kwon, 2002; Inkpen and Tsang, 2005). These relationships can be strong/weak and direct/indirect. "It is a form of capital that can change as relationships and rewards change over time" (Leana and Buren (1999:538). Such a perspective is looked at from the structures, cultures and contexts of organisations.

The survey items that make up autonomy in this study are: -

Our company stresses transmitting newly created concepts.
Our company stresses enactive liaisoning activities with functional departments by cross-functional development teams.
Our company stresses forming teams as a model and conducting experiments, and sharing results with entire departments.
Our company stresses searching and sharing new values and thoughts.
Our company stresses sharing and trying to understand management visions through communication with fellow colleagues.

7.2.1 Definitions on autonomy and its attributes

Based on the above five survey items, autonomy is defined in this study as "the degree to which companies encourage and support collaboration and knowledge

sharing amongst their employees". This definition is reviewed in relation other definitions on autonomy in the literature.

This review is done on autonomy in relation to innovation. Studies pertaining to autonomy and innovation as key search words are looked into on their definitions on autonomy and the following are found: -

Study from	Definition on autonomy
Feldman (1989:86)	Self-directed behaviour within general limits set by managerial control.
Tafti *et al* (2007:150).	The extent to which workers have control over their own schedules or control over the specific procedures in which they carry out their schedules.
Stern *et al* (2008:1554)	The extent to which employees perceive that they have the freedom and discretion to plan, schedule and carry out their jobs as they see fit.
Foss *et al* (2009:873)	The substantial freedom, independence and discretion to share matters pertaining to innovation amongst employees.
Clercq *et al* (2011:682)	The extent to which functional managers perceive that cross-functional knowledge exchange is feasible.

The main attributes of autonomy behind these definitions are further reviewed from the literature and they are contained in Table 7.1.

Table 7.1 Attributes of autonomy

Study	Attributes on autonomy		
	Collaboration	Knowledge sharing	Control
Feldman (1989)	-	-	√
Tafti *et al* (2007)	√	√	√
Stern *et al* (2008)	-	√	-
Foss *et al* ((2009)	-	√	-
Clercq *et al* (2011)	√	√	√
This study (2013)	√	√	-

Collaboration and knowledge sharing as attributes of autonomy in this study are supported by the literature as in Table 7.1, more so on knowledge sharing than

collaboration. One other attribute in the literature that is not featured in this study's definition of autonomy is control. These three attributes of autonomy are looked into singularly per their bearing to this study.

7.2.2 Autonomy and collaboration

Innovation is a collaborative undertaking that is dependent on an organisation's employees to generate ideas and then collectively realised these ideas into new products, services and ways of working. Collaboration is the degree to which employees actively help each other in their work.

Autonomy can help to reduce barriers among employees and functional units. It helps in enabling the employees and units to collaborate across organisational borders (Tafti *et al*, 2007:150). Promoting collaboration and knowledge sharing among employees is important as it enhances the creation of synergies among the resources of these employees leading to better problem solving. There is a need for context-bound work to examine the interplay of cross-functional collaboration and organisational context in fostering product innovativeness (Clercq *et al*, 2011:681).

Tafti *et al* propose that organisations with collaboration, through self-managed teams and cross-training, can work more effectively towards realising organisational objectives. The realisation of organisational objectives is supported by one survey item on autonomy that stresses the collaborated attempts of employees to understand management visions through communication with each other. Also the formation of teams and cross-functional development are reflected in two other survey items that make up autonomy in this study.

Cross-functional teams can be instrumental in forging collaboration and knowledge sharing in accordance to a 'knows best/no blame' culture as an organisation grows. When collaborative knowledge sharing become more of an organisational norm, teams can become more autonomous and earlier top-down control modes can become more bottom-up and lateral. For example in the domain of quality management, effective organisational performance can progress from quality control to quality assurance. With this move, more autonomy is placed in the hands of employees who over time have proven their trustworthiness.

However, the effectiveness of the collaboration of cross-functional teams is fraught with challenges as it involves employees from diverse backgrounds, interests and attitudes (Clereq *et al*, 2011:680). The translation of cross-functional collaboration into shared knowledge for innovation is not easy to monitor or regulate as often this collaboration is intangible in nature. It is dependent on organisational context which plays an important role in intra-organisational knowledge exchange in terms of resource allocation, politics, risks and psychological safety. Collaboration is context specific, organisational wise.

7.2.3 Autonomy and knowledge sharing

'Sharing' is reflected in three of the items that comprise autonomy which is generally associated with decentralisation in the literature. Within a decentralised structure, knowledge management is more positively associated with innovativeness. A decentralised structure with a high level of autonomy can facilitate and motivate employees to share knowledge for translations into new products and services (Chen *et al*, 2010:854).

Organisational norms regard knowledge sharing as usual, correct and socially expected work place behaviour (Wang, 2004:371). But an employee has the autonomy to share or not to share knowledge with others from the perspective of self-interest especially when it comes to tacit knowledge. Such knowledge cannot be accessed like explicit knowledge when it comes to sharing. It is up to the owners of tacit knowledge to decide if they want to have such knowledge shared. If (s)he perceives that the tacit knowledge possessed provides an advantage when competing with others organisationally, sharing this knowledge may pose an organisational dilemma.

Based on self-interests, knowledge sharing may decrease with increasing competition for work performance which in turn may negatively affect innovation effectiveness. Besides this motivational barrier, there are other barriers concerned with knowledge supplier-receiver relationships, knowledge source reliability, ability to learn and apply new knowledge, and so on (Sai and Sheng, 2005:45).

The ability to share knowledge and facilitate innovations within and across departments is a key concern of management (Foss *et al*, 2009:878). There are proposals in the literature on how the autonomy on knowledge sharing can be

positively addressed to enhance innovation. Two such proposals are looked into here – job design and IT.

Job design is a human resource management activity. Traditionally, job design is focussed on the job itself rather than on the individuals or teams who are to undertake the job. Foss *et al* argue that job design matters to knowledge sharing for motivational reasons. They consider job design as an antecedent of knowledge sharing and autonomy as a psychological state which gives an employee the opportunity to determine when and how specific tasks are carried out (2009:879). From their study, they find that job autonomy increases employees' intrinsic motivation toward knowledge sharing (2009:887). They regard intrinsic motivation as doing an activity which accords well with an employee's interest and personal values.

The second proposal is the use of IT to facilitate innovators' ability to collaborate with each other and in their search for relevant information and knowledge. But organisations need to know how to build IT competencies necessary for innovation and to use them to support rather than hinder innovation (Gordon and Tarafdar, 2007:271). To this end, Tafti *et al* examine the relationship between human resource practices and IT practices and draw attention to "the dual capability of IT to control over and monitor workers and to increase the empowerment and autonomy of workers" (2007:163).

7.2.4 Autonomy and control

For a newly established organisation, when staff relationships are new with behaviours skewed more to psychological fear, control is more likely to minimise autonomy. However in the literature, autonomy and control are looked upon as a dichotomy required for organisational performance and by association, innovation.

Innovation in an organisation requires the simultaneous regulation of autonomy and control (Feldman, 1989:83). Autonomy is dependent structurally and managerially on a context of control for these reasons – (a) organisational structure assumes a system of management control and (b) managers are responsible and accountable for innovations that are beneficial and accrue to organisational goals.

Feldman defines control as the exercise of authority through a hierarchical structure that limits or channels behaviour (1989:86). This definition does not ignore autonomy. It can be interpreted to mean limited or channelled autonomy.

From the current literature reviewed on innovation and autonomy, control is not associated with the traditional techniques of command and control expected of top-down management structures. Such traditional techniques will not accord well with employees as knowledge workers who are more able and independent in decision making processes. When it comes to innovation, organisations need to be concerned with organisational learning and the facilitation of greater autonomy for knowledge workers than with bureaucratic control (Dovey, 2009:311).

For the facilitation of greater autonomy, organisations need to alleviate psychological fear by reacting sensitively and perceptively to finger-pointing when things go wrong. Such sensitivity and perceptivity can be accorded with an embrace of the 'knows best/no blame' culture raised in Section 7.2.3. Effective problem resolutions provide good breaks for the promotion and propagation of such a culture, especially when cross-functional teams are formed and autonomy is given to these teams to (a) determine the cause(s) of the problems and (b) propose their resolutions.

Nurturing a 'knows best/no blame' culture needs time to get a buy-in from employees. Also cross-functional teams need time for their formation, growth and maturation. Both are raised in the preceding sections per an alignment of experience with autonomy and trust as underlying factors.

7.3 EXPLORATION ON TRUST

Like autonomy, trust has also been covered in the review of more current literature. It too is looked at from the social capital perspective as a resource embedded in employees' relationships. It is a complex resource that takes time to build and can be easily destroyed. Trust nurtured through self-reflexive human relationships can be destroyed by self-serving behaviours (Dovey, 2009:314). The lack of trust can inhibit the sharing of knowledge amongst employees. Trust that enhances a favourable environment for knowledge sharing also alleviates the fear of risk taking.

From this study, the survey items that make up trust are these: -

Our company members are generally trustworthy.
Our company members have reciprocal faith in other members' behaviours in working towards organisational goals.
Our company members have reciprocal faith in others' ability.
Our company members have reciprocal faith in others' decision toward organisational interests than individual interests.
Our company members have relationships based on reciprocal faith.

7.3.1 Definitions on trust and its attributes

Trust in this study per the above survey items is defined as "the degree of reciprocal faith employees have in each other's ability and decision towards organisational interests as reflected in their behaviours and relationships".

Similar to autonomy, this definition is reviewed in relation other definitions on trust in the literature linked to innovation. Approached thus, the definitions of trust found in the literature are these: -

Study from	Definition on trust
Clegg *et al* (2002:409)	A willingness to accept vulnerability based upon having positive expectation about other people's intentions and behaviours in situations which are interdependent and/or risky.
Sui (2007:151)	A psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions and behaviour of another.

The main attributes of trust behind these definitions are further reviewed from the literature and they are found in Table 7.2.

Table 7.2 Attributes of trust

Study	Attributes on trust		
	Behaviour	Relationship	Reciprocal faith
Clegg *et al* (2002)	√	-	-
Sui (2007)	√	√	-
Dovey (2009)	√	√	-
This study (2013)	√	√	√

The items that make up trust and its attributes of behaviour and relationship are also found in the literature to some extent. But reciprocal faith that features strongly in this study's survey items is not found in the literature. In this study, reciprocal faith is a new contribution to the body of knowledge on innovation effectiveness. It is argued and proposed as a combination of reciprocal trust and reciprocal learning which are found in the literature. Such a proposal aligns with the accumulation of knowledge.

Each of these three attributes of trust is explored in the following sections.

7.3.2 Trust and behaviour

Trust in this section is focused in the context of innovation and it is engaged at the macro-, meso- and micro-level of organisational life. Trust manifests when an individual or group takes for granted the honouring of their expectations of behaviour and intent by others.

"There is substantial support for the assumption that high levels of trust have a positive effect on the effectiveness and quality of organisational knowledge sharing and innovation" (Ellonen *et al*, 2008:165). But the contexts of such support vary widely and the literature on behaviour as an attribute to trust in innovation is fragmented. Organisational trust can be of various types – institutional and interpersonal; and there are different dimensions of behaviour associated with them (ibid.).

Institutional trust has been associated with employees' attitudes towards their organisation's vision, strategy, competencies and human resource policies. Such a trust is determined by the efficiency and fairness of systems that are employed organisation-wide. With this trust, employees act in anticipation of the success of innovation undertakings that are beneficial to them. There are elements of institutional trust in the make-up of trust in this study as there is a focus on organisational goals and interests.

"Innovation trust plays an important role in the innovation process … because engagement in innovative behaviours involves effort and risk" (Clegg *et al*, 2007:410). Employees are less likely to behave in a trusting manner if they believe that their ideas are not listened to and they do not have a share of the benefits that

may accrue from their ideas. Institutional trust is more formal and is reflective of management policies and managerial conduct in the implementation of the policies.

Institutional transparency is important in engaging the trust of employees and it can possibly be done with the setting of collective performance objectives. For example annual targets for these objectives can be collectively agreed upon by management and non-management; and the reward scheme for meeting such targets must be made known to all employees upfront at the beginning of a fiscal year. Regular performance reviews are to be made and the results shared organisation-wide. Timely reviews and information sharing are tabs on appropriate behaviours and relationships required for achieving the targets. They can indirectly bring about transparency and trust to the fore.

As for interpersonal trust, it has been considered as (a) lateral trust (trust amongst employees) and (b) vertical trust (trust between employees and leaders). Behavioural characteristics of interpersonal trust have been cited as ability, capability, integrity, truthfulness and goodwill (Ellonen *et al*, 2008:162.). Confidence in the ability of colleagues and faith in their intentions, as items of trust in this study, are found in the literature as measures of interpersonal trust (Clegg *et al*, 2002:410).

Interpersonal trust is important especially with the increasing prevalence of telecommunication when firms expand globally. This trust is enhanced when employees are confident that their colleagues are competent and will act in a fair and ethical manner (Sui, 2007:153).

Interpersonal trust is more informal and is complementary to institutional trust with respect to organisational mechanisms that support knowledge creation and transfer (Ellonen *et al*, 2008:166). It is more embedded in autonomous teams in terms of relationships and behaviours. Look at thus, it is easier to engage an organisation's institutional trust than its interpersonal trust.

As an essential condition of a working organisation, interpersonal trust creates behaviours that are committed to the acquisition and dissemination of knowledge, and it relies on human relationships (Sui, 2007:166). This condition is especially important for the sharing of tacit knowledge underlined by individual relationships.

7.3.3 Trust and relationship

"Trust is a dynamic aspect of human relationships and it requires interaction over time to be developed" (Sui, 2007:152). Lateral trust refers to the relationships amongst co-workers or peers and vertical trust pertains to the relationships between employees and their superiors and subordinates. Thus the degree of trust may differ depending on the structural relationships in organisations (ibid.).

When it comes to relationship, one of the trust items in this study indicates that 'our company members are generally trustworthy'. Trustworthiness has been looked into in terms of these three components – ability, benevolence and integrity (Semercioz *et al*, 2011:126). Relationship trust linked to ability and integrity is deemed to be cognitive-based; and that linked to benevolence is affective-based (ibid.). Cognitive-based trust is more associated with reliability and affective-based trust is more into the care and concern of others (Sui, 2007:151).

The focus on trust and relationship can generate strong learning cycles leading to deep knowledge bases that inform good decision-making (Dovey, 2009:322). When relationships are built on a strong foundation of trust in which there are honest and direct communication, the ground is laid for the development of stakeholder trust in the interest of sustainable innovation (ibid.).

The importance of trusting relationships is now only being understood for the magnitude of its contribution to organisation performance. Relationship outcomes have a strong effect on the overall evaluations of how an organisation is performing (Bowen, 2006:346).

Innovation depends on various relational processes, like informal interactions, the development of trust between functional departments or the presence of shared goals across the organisation (Clercq *et al*, 2011:681). "In a social exchange relationship, parties choose to reciprocate in kind and trust is usually reciprocated in trust" (Chan *et al*, 2008:446).

7.3.4 Trust and reciprocal faith

Trust is a condition in which an employee may exhibit behaviour that may make him/her vulnerable to others for the sake of learning (Tafti *et al*, 2007:151). But the

lack of trust and reciprocity impedes the sharing of knowledge (Reinholt *et al*, 2011:1277).

Reciprocal faith is proposed as an attribute of trust as it appears in four of the five survey items that make up trust in this study. From these four items, it is defined in this study as "the extent of confidence employees have on their colleagues to respond positively in the process of exchange in learning and knowledge".

To reciprocate means "to give and take mutually; to show or feel in response" (Serva *et al*, 2005:627). Insofar as the literature is reviewed, reciprocal faith has not been studied as an attribute of trust in the domain of innovation. Reciprocity is deemed to be important in the understanding of trust in relationships. To have reciprocal faith developed as an attribute to trust, other works close to its concept are reviewed. Two such works are found – one on reciprocal trust and the other on reciprocal learning.

As mentioned at the start of Section 7.4, trust takes time to build, so does reciprocal faith as it can be nurtured or eroded with time as employees interact. Thus reciprocal faith in this study will be looked at as a process. It will also be determined if reciprocal trust and reciprocal learning are suitable platforms to engage reciprocal faith.

Reciprocal faith in trust can be considered in relation to existing trusts between employees and whether these trusts beget more trusts with time. This consideration implies an active process of exchange of trust between employees relative to the outcomes of previous such exchanges. The essential character of all trust relations is their reciprocal nature (Reed, 2001:203).

Serva *et al* have conceptualised reciprocal trust not as a type of trust, but rather as a dynamic process through which trust grows or diminishes (2005:627). They define reciprocal trust as "the trust that results when a party observes the actions of another and reconsiders one's attitudes and subsequent behaviours based on those observations" (ibid.).

It is proposed in this study that reciprocal faith can flow and be measured in parallel with reciprocal trust. When reciprocal trust examines an employee's actions and other employees' trust-related reactions to those actions, reciprocal faith can be gauged in tandem. High reciprocal trust will lead to high reciprocal faith and *vice versa*.

Similarly reciprocal faith can be considered in tandem with the process of reciprocal learning which has been defined as “the blending of knowledge and skills by which firms jointly develop new knowledge, capabilities or products” (Lubatkin *et al*, 2001:1354). Although this definition is on inter-firm alliances, it is still relevant to individual and team alliances in an organisation.

As a process, reciprocal learning can be monitored on its effectiveness in terms new knowledge or products as in knowledge sharing for innovation effectiveness. For reciprocal learning, employees are required to act as “co-researchers” or “co-inventors” (ibid.). Self-learning is expected of the employees to improve their own respective knowledge base. In addition they are expected to learn how to learn together, and learn how to make use of the new knowledge in innovative ways.

The ability of employees to learn dependently and interdependently is a hallmark of reciprocal learning and its association with reciprocal faith. This is relevant to trust as one of its items in this study reads – ‘our company members have reciprocal faith in others’ ability’. Thus a good reciprocal learning ability is reflected of a good reciprocal faith in such ability.

The above discourses on reciprocal trust and reciprocal learning converge to reciprocal faith. This convergence may take years for reciprocal faith to gain good roots but these roots may be deracinated within a short period. Reciprocal faith was antecedent to trust at TPS and it held up well for quite a while at the earlier period of its history.

The non-managerial staff was unionised during this period of time, as a consequence of Singapore government’s drive for unionised tripartism - a key competitive advantage for Singapore, underpinning its economic competitiveness, harmonious labour-management relations and overall progress of the nation. The union then exist at TPS only in name. It was not an avenue resorted to by the non-managerial staff as there was reciprocal faith with management; but not until the wind of subsequent changes set in and negatively affected the role of the union at TPS. The altered reciprocal faith was a consequence of the change in its top management every three to four years leading to leadership discontinuity.

7.4 PUTTING AUTONOMY AND TRUST TOGETHER

In the current literature on studies pertaining to knowledge management and innovation, many factors have been identified as important for a positive relationship between the two. These factors have been studied as bundles in individual studies.

In the two preceding sections, the explorations are on autonomy and trust as single factors. But they can be studied together as put alongside each other in Table 7.3.

Table 7.3 Autonomy and trust - together with their attributes

Antecedent	**Attributes of antecedent**		
Autonomy	Collaboration	Knowledge sharing	Control
Trust	Behaviour	Relationship	Reciprocal faith

Streams of research on autonomy and trust as a bundle are found in the fields of psychology, sociology, organisation and management studies. Autonomy and trust are not independent and their interrelationships must be considered (Clercq *et al*, 2011:681). Their interrelationships are not just between them as factors but also (a) between each factor and the other's attributes (e.g. collaboration and trust) and (b) between their attributes (e.g. collaboration and behaviour).

These interrelationships are reflected in the following as found in the literature: -

- Many of the constitutive features of innovation such as collaboration depend on high levels of trust. (Dovey, 2009:323).
- High levels of trust have a positive effect on the effectiveness and quality of organisational knowledge sharing and innovation (Semercioz *et al*, 2011:128).
- The conventional dichotomy between trust and control has become unsustainable, as theoretical and empirical in organisational study has consistently blurred the boundaries between them (Reed, 2001:202).
- Trust plays a key role as a foundation of collaboration (Paul and McDaniel, 2004:185).
- Trust is often emphasised as the factor facilitating knowledge sharing among employees (Reinholt and Foss, 2011:1286).
- Giving up control as been associated with the decision to trust (Hosmer, 1995:382).

- Worker autonomy requires that worker be trusted to allocate their time wisely and to make good decisions for the organisation (Tafti *et al*, 2007:151).

From Table 7.3, there are multitudinous ways that autonomy, trust and their attributes can be studied with respect to innovation effectiveness. Coupled to the multi-dimensional and multi-disciplinary perspectives of innovation, managers may have to take a great deal of effort to be able to trust and provide autonomy to their colleagues for innovation to be effective. A manager's world is an interpersonal vortex of demands on personality, ego and empathy (Tafti *et al*, 2007:155). This vortex will whirl with great complexity when the interrelationships of autonomy and trust with other factors of knowledge management and innovation are taken into consideration.

In this chapter, both autonomy and trust are looked into further in relation to innovation effectiveness. But this time round each of them is discussed in conjunction with the other four factors of innovation traits in Table 6.5. They are – 'IT support', 'performance assessment', 'access to learning and knowledge', and 'communication'. For the access to learning and knowledge factor, knowledge workers are used as a proxy.

7.5 INTERRELATIONSHIPS OF AUTONOMY WITH OTHER FACTORS

Per these interrelationships, Table 6.5 is referred. Starting with IT, it is proposed in Section 7.3.3 that IT be used to facilitate the collaboration of employees in their sharing of knowledge for innovation. It is looked into here how the proposal can be influenced by autonomy.

IT has been hyped to provide many organisational benefits when it is used appropriately, but one rarely mentioned the benefit of IT is its role in engaging organisations to be innovative. IT can support in the collaboration of innovators to share knowledge. But how will autonomy affect IT support thus?

From an IT perspective, autonomy has been considered as an enabling factor in an organisation's efforts towards innovation. It is argued that the introduction of IT enables employees to work more effectively with changing work conditions (Elie-dit-Cosaque *et al*, 2011:210).

IT support can enhance an employees' autonomy in terms of their potential power to communicate with management and colleagues. It can also enhance better flow of information relevant to their jobs per their various positions in the organisation. This latent enhancement empowers employees with autonomous opportunities to do their jobs and contribute more effectively to innovation (Brey, 1999:17). IT support can tweak employees' ability to make decisions more autonomously, increasing the importance of knowledge work in today's economy (Tafti *et al*, 2007:147).

But the autonomy offered by IT support is not always pro-innovation as it offers less face-to-face interaction among employees to foster a collaborative culture – a hallmark of Google's approach to business (Straits Times, 2013:A22). In trying to make itself innovative again, Yahoo is abolishing its work-at-home policy and ordering everyone to return to physically work in the office. Yahoo is taking one of America's biggest workplace issues – whether working from home, and other flexible arrangements, lead to higher productivity or inhibits collaboration and innovation (ibid.).

The above comparison on Google and Yahoo provides a transition of the autonomous focus from IT support to performance assessment as factors of innovation traits. When it comes to linking organisational performance with autonomy, the linkage transcends IT support as there are many other factors underlying innovation effectiveness, of which six have surfaced in this study as captured in Table 6.5.

Organisations are open-systems that relate to their environments, both internal and external. These environments are dynamic, ever changing and uncertain, leaving management unclear as to what they should do and how to do it to improve their organisations' performances through effective innovation. The process of innovation is uncertain as it results from the fact that future events do not follow the paths of those in the past, and knowledge of the future is always not complete and fallible (Jalonen, 2012:2).

Autonomy in innovation tasks can be considered at two levels – strategic and operational. Strategic autonomy involves the freedom to select goals for an organisation, and operational autonomy involves the freedom to approach these goals for their attainments within the strategic constraints (Pinnington and Haslop, 1995:5). The former autonomy is generally placed in the hands of management, and

the latter in the hands of all employees per their daily operational roles. Appended to these autonomies is the continuous monitoring of performances linked to the goals of an organisation, with its employees as individuals and teams.

Compared to routine tasks which are more stable and predictable, innovation tasks are not easily programmable and they often involve risk-taking and autonomy in decision making processes. Innovative organisations are more and more seeking out employees who can account for their own behaviours and can contribute more effectively to organisational performance. Such behaviours are more often linked to employees with proactive personalities.

A proactive personality enhances innovation effectiveness as it describes one who (a) is relatively unaffected by situational constraints, (b) seeks out opportunities to improve things and (c) perseveres until he or she brings about meaningful changes. The performance of an employee with such a personality is moderated by job autonomy (Fuller *et al*, 2010:30). This autonomy moderation can be seen in organisations where proactive employees are more self-motivated, less supervised and take pride in the freedom accorded to them.

Autonomous motivation has been shown to lead to better behaviours and attitudes that reflect positively on an organisation's innovations than controlled motivation (Gagne, 2009:571). But not all employees can be autonomously motivated. Some employees may not be proactive but more reactive. They may have less personal initiatives and do not like the responsibilities that came with autonomy.

Innovation accrues from autonomy when employees have the discretion in the decision making processes on matters they know well and are relevant to the progress of their organisations. But this discretion is not absolute as it is not possible for an employee to know everything in uncertain circumstances. It can be deemed to be acceptable when an employee has sounded out thus – 'I don't know but I will find out'. This moderated autonomy allows employees proactive access to learning and knowledge which is another innovation trait factor in this study. It is indicated earlier that knowledge workers will be used as a proxy for this factor.

On the other hand, it is not quite acceptable when an employee is more inclined towards - 'I don't know what I don't know'. To such an employee, the response from management should be more like - 'then who knows?' Such a management

approach is non-retaliatory but it is not soft either so as to allow an organisation to move that “little bit along the road” (Pedler *et al*, 1997:150).

A culture, that encourages teamwork, employee support and autonomy, fosters knowledge sharing for innovation. Whereas a culture, that is demanding of employees with tight control, discourages such sharing. Participative decision making that are autonomous has been reported to be positively linked to knowledge sharing and increases the effects of individual self-efficacy on knowledge transfer (Gagne, 2009:575).

In the literature review in Chapter 2, Peter Drucker had indicated that continuous innovation has to be part of the work, task and responsibility of knowledge workers. This indication pertains to the recognition that innovation is a people-intensive effort which involves employees who learn and gain knowledge needed for their innovation undertakings. Learning and knowing are inseparable components of knowledge, and the sharing of it amongst knowledge workers involves both these components.

In comparison with traditional employees, the emergent class of knowledge workers is viewed as the vanguards of new organisational arrangements and a precursor to new employment relationships as they have the potential to extract deeper concessions from their employers due to the level of employer-employee interdependency (Donnelly, 2004: 78).

The more current literature on knowledge workers are still focused on motivating them as reflected earlier in Chapter 2 as the “the challenge for the 1990s” with the following emphasis – (a) how knowledge workers perceive they are being managed, (b) how they think they should be managed to be more organisationally effective (Tampoe, 1993:50).

Knowledge workers have become an organisation’s asset with what they know and their ability to work with ideas for innovation on their own. They have been described as ‘gold-collar’ workers in view of their higher level of education, expertise or experience and their ability to engage in complex and uncertain work environment (Guidice *et al*, 2009:145). Most organisations have a mix of ‘gold- and blue-collar’ workers, the latter referring to those in the lower echelon linked to the more traditional line functions. Its gold collared employees hold positions above the

supervisory level. But both collared types are regarded as knowledge workers in terms of 'knows best' as touched upon earlier.

These have been considered as contributing to an effective working environment for knowledge workers towards innovation – (a) motivated and committed employees, (b) individual competence ~ comprising task competence and creative autonomy, (c) facilitative work environment ~ task consistency and resources, (d) directed skills and commercial relevance of the assigned tasks, and (e) knowledge exchange ~ the genuine transmission of information (Tampoe, 1993:54).

There is a growing dialogue in the literature on knowledge workers and the vital role they play in innovation. The knowledge of these workers that is important for innovation is more of the tacit type – embedded in their minds, experiences and skills that are difficult to tap for sharing with others. This study focuses on the sharing of both explicit and tacit knowledge for innovative effectiveness, and autonomy is theoretically derived as one of the factors for such sharing. How is this theoretical inference reflected in the recent literature?

In these literature, there is wide support on knowledge sharing as an antecedent to innovation effectiveness from a knowledge worker's perspective (Robertson and Swan, 2003; Rutten, 2004; Lloria, 2007; Guidice *et al*, 2009; Vie, 2012). As to how autonomy is tied up with knowledge workers, the findings from the literature are follows: -

• Organisations need to facilitate with greater autonomy for knowledge workers than with control (Dovey, 2009:311).

• Traditional techniques of command and control fail with knowledge workers (Tafti *et al*, 2007:148).

• Knowledge workers prefer autonomy but they do not want to be left alone completely; they expect to work independently within constraints. Most expect their managers to follow up on them, give them feedback and correct them if they are drifting from their goals (Vie, 2012:16).

Knowledge workers can be looked at from the management and non-management levels. At these two levels, autonomy is not perceived to be the same. At the management level, autonomy is less controlled than the non-management staff that had autonomy with their daily tasks but was supervised. At the non-management level, an organisation has to balance the need for the autonomy of its employees to

be innovative with the need to conform to organisational norms to achieve effective outcomes (Tampoe, 1993:49).

In a mechanistic and authoritarian organisation, the lack of autonomy accorded to communication may lower organisational performance when compared to one that is organic and participative. In the latter organisation, the collaborative and communicative environment regards its employees as ends in themselves. Organisations are encouraged to use collaborative and innovative styles to contribute to higher autonomy of its employees and the communication function as a whole (Bowen, 2006:330). Autonomy is needed for the communication function to contribute to innovative organisational effectiveness, and communication is one of the factors underlying innovation traits in Table 6.5.

Autonomy is considered as one of the perks associated with professional status and it is more often than not accorded to employees who can communicate well based on their knowledge and experience. High levels of communication skills are a prerequisite for effective facilitation of knowledge sharing (Sharkies, 2009:492).

In some organisations, good communicators are referred to and relied on for their abilities to help others in making decisions. When they could not help readily, they would communicate with others who could per - 'I don't know but I will find out', as mentioned above. They enjoyed the status and respect given to them as autonomous sources of help.

7.6 INTERRELATIONSHIPS OF TRUST WITH OTHER FACTORS

As for autonomy, these interrelationships of trust are looked into relative to IT support, performance assessment, knowledge workers and communication.

It has been studied that an organisation's culture, trust and IT contribute to knowledge sharing (Issa and Haddad, 2007:182). It is found that IT assists in the sharing of knowledge and does motivate the sharing of it for innovation. But not all knowledge types can be shared through IT, especially tacit knowledge.

It is argued that IT has also its other less transparent aspects. It comes with an element of control, the control by employers over its staff. Such control comes with IT

systems that are unified and centralised (Kocoglu *et al*, 2011:115). IT is only a tool that helps knowledge sharing. In the organisations studied, the most important aspect contributing to knowledge sharing is trustful relationship shaped by its culture.

In organisations, knowledge sharing is more influenced by the face-to-face interactions then through their adoption of IT. Sometimes the role played by IT is not more than a tool for the collection and collation of information, from which knowledge is shared from the reports generated.

The linkage between trust and IT has been studied based on virtual teams like the case of Yahoo's employees who work from their homes. Per such teams, the members may not have prior history of working together and may never meet each other in person as they are geographically dispersed. For these teams, trust is critical as its members communicate through information and communication technologies (ICTs).

These technologies have made possible the interconnection of employees across temporal and spatial expanses for the exchange of information in various forms and media. But the traditional control mechanisms from face-to-face communication have little fit with ICT communication, and control based on authority is often yielded to self-control and self-direction which depend heavily on trust (Robert *et al*, 2009:242).

Trust on IT can be assessed on two fronts, technology and human. On the technology front, IT trust may be achieved on a combination of a variety of hardware, software and network solutions (Usoro *et al*, 2009:61-3). It may also be affected by the complexity and transparency of the technology used. On the human front of IT, trust in an on-line environment may be looked at from a human angle. From such an angle, this question has been asked – "If someone does not trust a person in real life, why should he or she trust him or her in virtual life?" (ibid.).

Numerous IT technologies have been developed to support knowledge exchanges needed for innovation, but practical experiences have found that technology alone cannot ascertain that knowledge will be volunteered and shared. The linkage between trust, IT technologies and innovation has been studied based on virtual teams. The current innovation situation at Yahoo is a reflection on this aspect.

Trust has been described as the key to organisational performance as it facilitates discretionary efforts from employees to help their organisations to innovate. It operates in two ways – (a) in a direct way that affects attitudes, cooperation and performance and (b) in a more indirect way that influences the conditions under which the preceding outcomes are likely to prevail (Sharkies, 2009:491). It is a fragile resource that takes effort and time to build but that can be destroyed easily.

Trust is an organisation's intangible resource from the resource based view as its discretionary efforts cannot be easily replicated or imitated. Discretionary efforts are necessary when organisations become more reliant on the voluntary engagements of their employees to be involved in the participation and identification of opportunities for innovation through continuous learning (Sharkies, 2009:493). Such involvement is deemed to be a willingness to perform beyond expectations and this is important to because an organisation cannot specify in employment contracts all the demands it would place on its employees, particularly with innovation's uncertainty.

The perception of these issues by employees is important to the building of trust – (a) the treatment by their organisations and colleagues, (b) trust in their immediate superiors and (c) job security tied to innovation which can lead to restructuring and downsizing. These factors will determine the relationships between employer-employees which are moderated by trust.

When it comes to their own performances in relation to trust, employees are particularly concerned about how they are evaluated by their immediate superiors in terms of their relationships. When traditional organisation relationships linked to job security are replaced by those that are more psychological in view of changes, the trust between superior-subordinate can be negatively affected. The uncertainty of trusting management may make non-management staff to take steps to protect themselves e.g. looking towards labour unions for support.

Inconsistent and unfair treatments of employees do not augur well for the advancement of trust in organisations. Such treatments can affect the perception of justice by the employees, which in turn will affect their organisational commitments. When it comes to such situations, organisations have to work fast on strengthening trust as it played a moderating role in clearing the misperceptions of justice in order to get employees' commitments on track again.

When trust and innovation are put together, the following found in the literature are associated with knowledge workers: -

• Without bonds of trust, knowledge workers are less likely to have access to or provide knowledge in a timely manner (Guidice *et al*, 2009:150).

• When hierarchies are flattened and traditional incentives work poorly with knowledge workers, trust becomes critical (Ellonen *et al*, 2008:177).

Organisational trust may waver for knowledge workers when there is a change in the top management at their organisations. During such a transition, institutional mistrust may set in resulting in employees resigning or being told to leave. Again such mistrust may lead to choosing labour unions as recourses for safeguards.

Trust in communication is important because technology, infrastructure and management influences, by themselves, cannot be relied upon to facilitate communication. Good communication flows allow an organisation to harvest the benefits of its employees' collaborative knowledge and skills (Sharkies, 2009:491-2). The facilitator of such communication flows is trust which depends on personal acquaintance, reputation and reciprocity. When communication is trustfully open, it is more likely to result in the production of new ideas and new ways of working (ibid.).

Relationship is one of the attributes of trust in Table 7.3 and employee personal contact is required for the building of relationships to overcome some of the impediments in knowledge sharing. Such impediments may arise as organisations may not know where the knowledge is located. Personal contacts between employees, formal and informal, contribute to the building of close relationships. "Little trust is likely to develop in an extended relationship and therefore it is likely that less knowledge will be transferred in circumstances where the relationship is distant or communication difficult" (Sharkies, 2009:492). Organisation meetings are opportunities for contacts and relationships to be formed and these meetings can be interspersed with coffee breaks for moments of social informality to prevail.

The association between communication and trust is complex and simple studies focusing on either the quality or quantity of information shared may be ineffective for dealing with all employees in an organisation (Thomas *et al*, 2009:287). For example when it comes to top management, the information from them is seldom specific to an individual's job and is focused more strategically on the organisation in general. They trust their managers/supervisors to translate their more abstract information into

relevant communication that are task-oriented. In turn employees trust that their managers/supervisors are communicating to them correctly the connection between their jobs and the organisation's strategic goals (Thomas *et al*, 2009:303).

The 'lost in translation' syndrome must not be taken lightly and pains to alleviate this loss need to be considered in terms of appropriate engagements. For instance simultaneous information sharing sessions, when all employees are hearing the same information from the top together, can be one such engagement. Following these sessions, dialogues at all organisational levels must be secured to translate the strategic goals from the top into employees' daily job task routines.

The above discussions on autonomy and trust relative to innovation effectiveness are apparently complex and complicated. But they are less so for this researcher as he can relate them per the context of TPS. In other contexts, the understanding of these discussions may not be same. This researcher has left TPS for more than ten years now and his recall of TPS may not reflect what it is now as its current context may have changed. Different contexts, identified or recollected, may lead to different discussions of autonomy and trust per their importance to innovation effectiveness.

7.7 CONCLUSION

The inductive attributes of autonomy and trust from this study are compared with those found in the more current literature. Collaboration and knowledge sharing as attributes of autonomy from this study are supported in the literature. However, control as an attribute of autonomy, not accounted for in this study, is featured in the literature. As for the attributes of trust from this study, behaviour and relationship, they too are supported in the literature. However reciprocal faith as an antecedent of trust from this study is new and it is a contribution from this study.

Autonomy and trust, as primary factors underlying the complex nexus of innovation in this study, are themselves complex as reflected in their relationships with other factors of innovation traits (IT support, performance analysis, access to learning and knowing, and communication) as discussed. These two factors of innovation effectiveness are not looked upon as predictors of it in this study. Rather they underlie it in the scope and context of this study.

CHAPTER 8

CONCLUDING CHAPTER

It is unwise for a researcher to conduct a research without being mindful of its philosophical issues. A decision to study a topic in a certain way always involves some kind of philosophical choice about what is relevant to a study. This choice is grounded in a researcher's ontological, epistemological and methodological doctrines. In this concluding chapter, the researcher reflects on the positivist philosophy embraced in this study and the methodological path taken.

Following this reflection a (a) the main contributions from this study, (b) its limitations, and (c) recommendations for future research.

8.1 SUMMARY ON THE UNDERSTANDING OF PHILOSOPHICAL ISSUES

Knowing and understanding the relevancy of paradigms and their philosophical assumptions are important as failure to think through philosophical issues can seriously affect the quality of management research (Easterby-Smith *et al*, 2002:27).

Such an understanding is essential and useful to researchers as it can help them to decide on the research designs to choose from in terms of what kind of data is required, how it is to be gathered and interpreted, and how this will provide good answers to research questions.

As to how the understanding of the philosophical issues is to be attended to in this study, this researcher has noted in the literature that social sciences have oft time been referenced to those in the natural sciences. By referencing his study thus, he can spell out more clearly upfront that the methodology used will have results that are convincing, or at least credible in relation to the positivist stance adopted.

It appears to suggest in the literature that if social scientists build their studies methodologically on a natural science foundation, they have an established and justified tradition of explicitly showing how they have contributed something of value to the body of knowledge. The social sciences have often tried to develop methodologies that take after those in the natural sciences as their role model. Since the natural sciences have, over time, developed precise, and well-defined paradigmatic laws and theories, “the role of the narrative is played down in the attempt to formulate equivalent paradigmatic theories based on quantitative evidence” (Remenyi *et al*, 2000:127).

The importance of narrative thinking, the composition of a consistent story that describes the important features of the phenomenon under investigation, is often not documented or at least not clearly acknowledged in academic research (ibid.). This study has attempted to address this gap by upping the narrative gist of its research design. It has adopted a positivist stance and the deductive and inductive phases of its research methodology follow the steps taken by some of the researchers in the natural sciences as noted in the literature.

But it has added a narrative dimension to its findings from this researcher’s experience in a practical world that has a close association with topic studied. The following sections summarily reflect on the path taken.

8.2. SUMMARY ON DEDUCTION IN THIS STUDY

The deductive approach is steeped in positivism in its evaluation of the association between the independent constructs and dependent construct. It pre-questions if EMC, OL and KM are the antecedents of innovation effectiveness.

Evaluation is defined as “a process which attempts to determine, as systemically and objectively as possible, the relevance, effectiveness, efficiency, sustainability and impact of activities in the light of specific objectives” (Vakola, 2000:813). The evaluation of this association in Chapter 5 per what should be done is specified. It is indicated in Section 3.3 that the normative rule for deductive reasoning is logical coherence. The hypothetico-deductive path adopted in this study follows that which is commonly used as a criterion for normative reasoning. Normative theory is evaluative in form. It seeks to enhance a researcher’s ability to specify and control how things should be done in terms of what works and what does not (Truch, 2001:78).

Based on this criterion, this researcher is able to evaluate the statistical inferences from data using reasoning that is theory, context, and researcher invariant. It is undertaken to inform decisions, clarify options, reduce uncertainties and provide information about processes within contextual boundaries in time, space, values and politics (ibid.).

In the application of the hypothetic-deductive methods, a researcher may “sidesteps the question of alternative explanation and focuses instead on testing a single theory” (Ketokivi and Mantere, 2010:318). As the outcome of deduction is a restatement of the premises, it does not add interesting new knowledge as sounded out in Chapter 3. Deductive practices are methodologically complete.

But the limitation of the deductive approach is that a researcher cannot reach a theoretical supposition from empirical observation (Ketokivi and Mantere, 2013:79). It is argued that the criterion of deduction which emphasises contextual invariance may influence a researcher’s thoughts on universal scientific thinking. It is not this researcher’s inclination to be influenced thus.

The deduction outcome in Chapter 5 confirms the importance of knowledge to innovation as knowledge management is derived as the sole antecedent of innovation effectiveness. Evaluated thus, it is deemed that this outcome gives a

reliable and independent assessment of the association between knowledge and innovation. It forms the basis of continuing activities and information on which research decisions can be based. It motivates this researcher to examine the factors underlying such an association further through induction as reflected in Chapter 6.

8.3 SUMMARY ON INDUCTION IN THIS STUDY

Induction is more focused on pattern matching and meaning and its outcomes contain knowledge claims which are more than a restatement of the premises especially when this researcher can associate the outcomes with his experiences at TPS.

The inductive approach has not a defined framework to account for what happens in the process of constructing theoretical explanations from data. Unlike deduction, there are many variants of inductive reasoning. As it lacks the normative foundation, it is methodologically incomplete (Ketokivi and Mantere, 2110:316). This leads to what has often been referred to as Hume's problem of induction (Truch, 2001:86).

8.3.1 Humean problem of induction

This problem arises because the testing of a theory involves observations; and even if all observations made support the theory, there is still uncertainty if future observations will support it. "There is nothing in any object, consider'd in itself, which can afford us a reason for drawing a conclusion beyond it; and that even after the observation of the frequent or constant conjunction of objects, we have no reason to draw any inference concerning any object beyond those of which we have had experience" (Hume,1969:189).

Deduction is context invariant and induction is context variant, and both have delimiting appeal in a social science study.

8.3.2 Contextual variance of induction

In a management study it is essential to understand the context within which the research is being conducted by taking into account organisational, social, political and cultural factors that impinge on the research problem (Remenyi *et al*, 2000:96).

In reality, these factors vary infinitely and inductive studies have contexts that vary from one to the other. As such the convergence of these studies towards generalisation may not be easy.

Towards the end of Chapter 6, it is indicated that the discussions on autonomy and trust are not that difficult for this researcher as he can associate them with TPS during his tenure there. But he may find it difficult to do so now as he has not been working there for more than ten years. Also other researchers may discuss autonomy and trust differently from Chapter 6 in relation to contextualisation based on their different backgrounds, interests and experiences.

Ketokivi and Mantere (2010:323-5) have identified three forms of contextualisation and they are: -

• Subjective contextualisation - it is based on the premise that researchers have idiosyncratic backgrounds and knowledge bases that are reflected in their reasoning styles.

• Empirical contextualisation - by discussing telling examples and contextual details, a researcher attempts to establish a sense of authenticity.

• Theoretical contextualisation – it seeks explanations through establishing the relevance of claims with respect to a particular theory.

This study is more into empirical contextualisation when TPS is behind this researcher's mind per the discussions in Chapter 6. But theoretical contextualisation is also of relevance when this study's findings, that autonomy and trust underlie innovation, are considered for other contexts besides that of TPS. It is proposed in this study that more contextual discussions will be better in enriching the association of autonomy and trust with innovation in the social world. This enrichment is more so than more studies of having the social world based on the natural sciences to confirm these two factors or the generation of other linked factors.

8.3.3 Upping the narratives of social sciences modelled on natural sciences

Organisations need better stories than better constructs. Better stories would allow a more comprehensive exploration of both the empirical context studied and the subjective context of a researcher's reasoning process (Ketokivi and Mantere, 2010:322). "Authentic subjectivity consists, not in overcoming the particularities of one's subjective viewpoint but in getting more deeply in touch with the unique particularities of one's own perspectives in order to better appreciate both the

similarities with and differences from the standpoints of other individuals" (Coghlan, 2007:338).

Stories, important from the community of practice perspective, are "predicated on the 'situated cognition' psychological view that learning arises by a process of enculturation in which neophyte members to a community acquire that particular community's subjective world view or collective memory" (DeFillippi and Ornstein, 2003:27). Enculturation includes learning the narratives that constitute the collective memory of the community and learning to recognise those events where a specific story represents community knowledge applicable to the situation (such as this researcher's recollection of TPS).

This study is into advocating the narratives since the relationship between narrative thinking and paradigmatic thinking lies at the heart of modern research into business and management and social science in general (Remenyi *et al*, 2000:127). To bring the narratives to the fore, relevant research methods must be sought and reviewed for adoption. This attention to methods is needed when more sophisticated practices which go beyond traditional approaches are being employed by business and management researchers (Remenyi *et al*, 2000:30).

The question is how a researcher moves on to more sophisticated practices. This researcher's original intention was to do just the deductive phase of his study to confirm that knowledge underlies innovation. But the dearth of explanation from the deductive confirmatory phase prods him on to add the inductive phase. It is so because both the need for more information and the inductive approach taken make sense in adding more value to this study.

8.3.4 Sophisticated research practices and sense-making

If a research lacks explanations on its findings, it may be looked upon as less useful than one that is more explanatory. Generally a researcher who is more into explanations can be assumed to be motivated to want his or her work to be more engaging with its worth and application. Such motivation is a first step towards his or her search for more sophisticated research practices. The second step for the researcher is to reflect on sense-making which only he or she is assumed to know best per his or her study e.g. this researcher's sense-making reflection with respect to TPS.

Sense-making [from K. Weick's book (1995) – *Sense-making in Organisations*] is defined as "the cyclical process of taking action, extracting information from stimuli resulting from that action, and incorporating information and stimuli from that action into mental frameworks that guide further action" (Seligman, 2006:109).

The process of sense-making in this study is not simple or linear. Together with evaluation, as indicated earlier, the process is highly iterative. The stimuli of wanting to know the factors underlying innovation effectiveness is anchored inside this researcher's mental framework, together with assumptions and anticipations. The interpretations of the evaluation outcomes have been mentioned as "the reciprocal interactions of information seeking, meaning ascription, and actions" (ibid.).

Waterman, R., in his book (1990) - *Adhocracy*: *the power to change* - has referred to sense-making as the structuring of the unknown. By knowing that (a) KM is the antecedent of innovation effectiveness to (b) autonomy and trust as the factors underlying this effectiveness, this researcher has moved from the deductively less known to the inductively more known. But the research journey does not stop here in this study because what remain largely unexplored are the processes by which autonomy and trust, and other factors, work together to make innovation more effective.

Such a process-focused viewpoint gives rise to new questions such as these amongst others – (a) How can autonomy and trust be related to each other? (b) If so, how and why is autonomy related to trust in terms of innovation effectiveness? (c) What other important factors, besides autonomy and trust, underlie innovation effectiveness? (d) How do these others factors, autonomy and trust work together or against each other?

Answers to the above questions can be explored in future research and this will be touched upon in a later section (Section 8.6 – Recommendations for future research) after the contributions from this study and its limitations are addressed.

8.4 MAIN CONTRIBUTIONS FROM THIS STUDY

The contributions from this study are focused in relation to some of the gaps on innovation studies reviewed in the literature. The contributions are broadly summarised as theoretical and methodological

Theoretical contributions

(a) In some of the literature there are gaps between innovation theory and practice. A researcher may study innovation without the practical involvement with it but not this researcher. The initial theory for this study is based on his experience during his twenty years at TPS and the literature review associated with this experience.

(b) From the literature, diverse aspects of innovation are studied leading to a fragmented corpus. Errors, learning and knowledge are inherent to innovation and this researcher closely reviewed literature relevant to them. Three studies are relevant and, as an accumulation to the body of knowledge, they are replicated for research in this study.

(c) In the literature, sometimes there is little clarity on the measurement metrics used, whether they are devised or recommended. The measurement metrics used in this study are drawn from the above three studies. One consideration on their adoption is that they reflect fairly closely the day-to-day context of working life at TPS.

(d) The reliability of the adopted metrics is quite well demonstrated in this study. From the deductive analysis knowledge management is antecedent to innovation effectiveness; and from the inductive exploration, knowledge and learning factors underlie innovation traits and innovation competitive advantage.

(e) Although EMC is not teased out as an antecedent to innovation effectiveness, its absence is not to be construed simply that errors are irrelevant to such effectiveness; this is covered in Section 6.4. Rather errors catalyse the learning and knowing essential for innovations conceived in organisations with strong EMC's. For organisations with weak EMC's, the possibility for EMC to provide organisations with competitive edges may not be realistic and realisable as discussed in Section 6.4.1. Respondents to this study's questionnaire survey may encounter difficulties if they are from organisations with weak EMC's. Such difficulties may be in the moulds of those expressed in Section 6.4.2.

(f) The initial model proposed for this study is depicted in Figure 4.3 to answer its research question - ***Are error management culture, organisational learning and knowledge management, the antecedents of innovation effectiveness?*** This model is referred to as an ordering framework in this study and the deductive outcome does not answer the question fully. Only KM turns out to be the antecedent of innovation effectiveness as supported in the literature. However, autonomy and trust of knowledge workers are inductively determined to underlie innovation effectiveness. Thus the explanation conceptualised from this study reads - ***The autonomy and trust of knowledge workers underlie innovation effectiveness***.

Methodological contributions

(a) This social science study is posited as a positivist research and traditionally most of such studies are quantitative. This study is deductively quantitative but it has an inductive qualitative dimension to it.

(b) Besides adding a quantitative approach with another that is qualitative, this study has combined deduction with induction. The result is retroduction which may help to establish the close and dynamic links between empirical and theoretical investigations such as those captured in this study.

(c) With a retroductive approach in research, quantitative co-relational data can be combined with the qualitative processual accounts for the unlocking of innovation as a black box. This will be further deliberated in Section 8.6 (Recommendations for future research).

(d) The embrace of replication in this study is intended to lessen fragmentation in social science studies linked to its research topic; when this intention is realised, the accompanying goal of knowledge accumulation is likely to be realised more objectively.

8.5 LIMITATIONS OF THIS STUDY

This is a social science study underlined with a positivist research philosophy which is more suited for the natural sciences and some of the limitations of this study are associated with its embrace of the positivist assumptions found in Chapter 3. The

assumptions are for closed systems and event regularities; but in actuality social reality is open and social events are not regular.

When a researcher studies the social world as a positivist, such a study is presumed to consist of observed events; but "underneath the events we see, and causing them, are a set of structures and mechanisms we often do not see" (Fleetwood and Hesketh, 2010:25).

This study has contextual limitations as innovation is complex and its antecedents are not only independent but also interdependent. In a different context, the complexity of innovation may have employees interacting differently. At TPS when there was a change in top management every three to four years, its organisational context appeared to change in tandem. What had worked well with previous management might not be so with the incumbent.

This study relies on cross-sectional data and the direction of causality cannot be substantiated as 'facts' in this study. Because of contextualisation, "facts are not like clay on a potter's wheel, that can be moulded to produce the desired result" (Ketokivi and Mantere, 2010:324). Contextualisation as its term implies is context dependent and this "leads to its most crucial weakness: the challenge of subjectivism" (ibid.).

As positivism is more into objectivism, it is less suited to address subjective issues in research and as indicated in Section 7.3.4, more sophisticated research practices and sense-making approaches are to be considered in future researches linked to this study.

8.6 RECOMMENDATIONS FOR FUTURE RESEARCH

These recommendations are linked to this study's limitations. Besides the positivist path taken in this study, there are other research approaches which can be explored to increase the understanding of the complex issues surrounding the study of innovation in reality. The approach recommended for future research is posited in the philosophical realm of critical realism.

8.6.1 Ontological explorations in future research

For future research, it is recommended that what innovation is in reality be looked into ontologically. From the literature reviewed, ontology is often not looked into in a study and explication of innovation; it is poorly conceived or implicitly assumed in some extremely simplistic approaches.

It is recommended that future research explores into "how to identify and exposit a realist and sustainable theory of human action in the innovation process" (Courvisanos, 2007). Such explorations must reflect the real social world; and for such reflections, the research philosophy will have to change from positivism, as in this study, to critical realism in future studies.

8.6.2 A move from positivism to critical realism in future research

It is supposed by many that realism claims an advantaged access to truth but such a supposition is inconsistent with its philosophy. Realism is a fallibilist philosophy and one which is wary of simple concepts correspondence to truth (Sayer, 2000:2).

"Contrary to what is assumed, realism does not claim privileged access to the real world. Its most basic claim is simply that there is a world which exists largely independently of the researcher's knowledge of it" (Sayer, 2004:6). This cognitive independence is supported thus - realism is the "doctrine that there are real objects that exist independently of our knowledge of their existence" (Schwandt, 2001:219). The independent existence of the social entities may lead to arguments especially when they are not directly observable but this does not mean that these entities cannot be studied for analyses.

Presently in O&M studies, the distinctive contribution of realist social science and its potential for unifying these studies is not fully exploited yet. Also the differences between realism and other philosophical approaches are not clearly differentiated in terms of the willingness to be precise in the usage of terminologies or the careful distinction of philosophical research positions (Ackroyd and Fleetwood, 2000:3-8).

In the literature, many current O&M studies are committed to either of these – (a) a logical realist ontology which privileges empirical, observable phenomena or (b) a strongly social constructionist ontology which privileges discursive, linguistic, or other semiotic phenomena. To understand what these two ontological positions entail,

some details on the less commonly used terminologies in these O&M studies are found in Appendix 8A. They are collated thus to support the emphasis that a researcher must be precise in the use of terminologies and to be careful in distinguishing different research positions adopted (Fleetwood and Hesketh, 2010:115-119).

The move to critical realism in future research will address these two inappropriate ontological positions in the social sciences – strong positivism (logical positivism) and strong social constructionism as detailed in Appendix 8A.

8.6.3 What is critical realism?

Critical realism is based on a philosophy of science most closely associated with the works of Roy Bhaskar. It regards "the objects of knowledge as the structures and mechanisms that generate phenomena; and the knowledge as produced in the social activity of science" (Bhaskar, 1978:25).

To the critical realists, objects of knowledge are real; they are neither phenomena nor human constructs imposed upon the phenomena, but "real structures which endure and operate independently of our knowledge, our experience and the conditions which allow us access to them" (ibid.).

Critical realists acknowledge that worldly entities really exist 'out there', independent of human knowledge or our ability to perceive them. This independence does not rely on any direct knowledge or indirect beliefs on such entities. The world is not easily reducible to our perceptions and experiences with it, and the nature of reality is not easily and simply apprehended, characterised, or measured which means that "humans experience only a portion of it" (Wynn and Williams, 2012:790).

(a) *The stratified world of critical realism*

Critical realism differentiates not only between the world and our experience of it, but between the *real*, the *actual* and the *empirical*, defining these in a special way (Sayer, 2000:11).

The real, the actual and the empirical are the domains of reality as argued by Bhaskar (1978:56). From his arguments - structures/mechanisms, events and

experiences constitute the domains of the real, the actual and the empirical of the world respectively as shown in Table 8.1.

Table 8.1 Three layered domains of the world

Constituents	Domains of the …		
	Real	Actual	Empirical
Structures/mechanisms	√	-	-
Events	√	√	-
Experiences	√	√	√

(Source: Bhaskra, 1978:13)

When critical realists refer to the *real* domain, they are of the belief that we do not have privileged knowledge of it in relation to these two aspects – (a) the real pertains to whatever exists, natural and social, regardless of our knowledge and understanding of its nature and (b) the real is the realm of objects and their structures and powers. In the social world, the real has also been referred to as the domain of the *deep* where social structures like mechanisms, institutions, rules, powers and so on are found to exist as independent causal phenomena (Fleetwood and Hesketh, 2010:137).

Actual events may be governed by deep causal phenomena which are not observable (ibid.) e.g. employees' creative potentials underlying innovation. The actual domain refers to what happens if and when the causal phenomena in the real are triggered. What happen in the actual, as perceived by positivists, are regular events assumed in closed systems. To the critical realists, such event regularities are extremely unlikely in the social world that is inherently open.

The empirical domain is defined as "the domain of experience, and insofar as it refers successfully, it can do so with respect to either the real or the actual though it is contingent (neither necessary nor impossible) whether we know the real or the actual" (Sayer, 2000:12). The encounters in the empirical are recognised through observation, perception or measurement.

A significant implication of the stratified ontology is the recognition of the plausibility that powers may exist unexercised and hence that "what has happened or been known to have happened does not exhaust what could happen or have happened"

(Sayer, 2000:12). The nature of the objects present at a given time can enable or constrain what can happen but does not pre-determine a happening. The critical realist ontology makes it conceivable to understand how we could be or become many things which presently we are not. This ontology has a good resonance with the emergence of the unexpected outcomes of innovation as raised in this study.

(b) *Critical realist stratification and emergence*

The positivist ontology is populated by either the empirical or the actual, or a conflation of the two per these assumptions – (a) what we can observe is all that exists and (b) what actually happens at the level of events exhausts the world, leaving no domain of the real, of powers which can either be activated or remain dormant (Sayer, 2000:12).

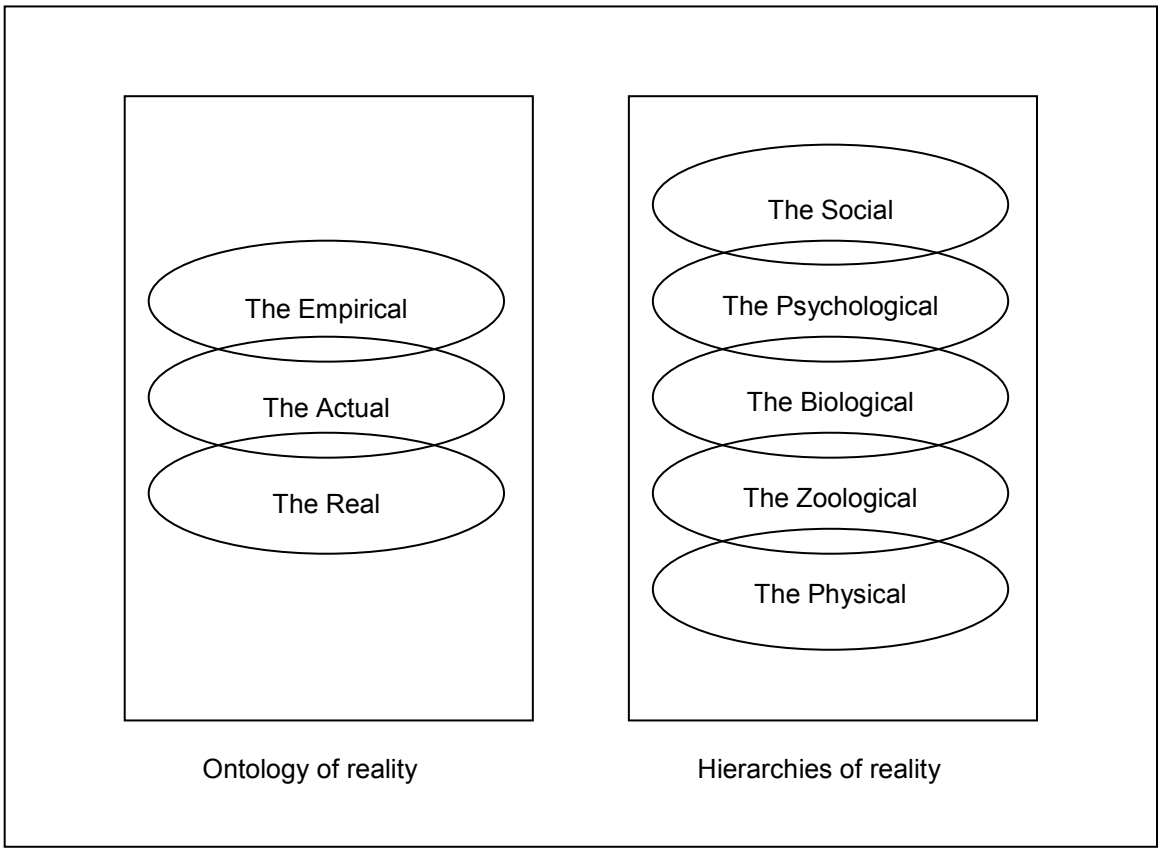
But critical realists argue that the world is characterised by emergence; that is emergent situations in which the conjunction of two or more factors can give rise to new phenomena. These new phenomena have properties which are irreducible to those of their components although the latter are needed for the former's existence. With the critical realist paradigm the world has both natural and social structures which have emergent powers not reducible to those of their constituent parts (Tsoukas, 2000:30).

When there is a shift from a positivist view of the social world to that with a critical realist view, its ontology moves from one that is *flat* to another that is *layered*. The layered ontology for the social sciences is more complicated for interpretation as compared to that for the natural sciences. For the critical realist, the deep complexity of social science is more complicated with its open system through emergent properties.

(c) *Emergent domains of reality from a social layered ontology*

The world besides being stratified is also hierarchically complex as shown on the right side of Figure 8.1. Reality will emerge differently as it moves progressively in this sequence - 'physics and chemistry → zoology and biology → psychology → sociology'.

Of the five hierarchical levels in Figure 8.1, each level up emerges from the level below (Burgoyne, 2009:157). Like the layered ontology in Figure 8.1, these hierarchies of reality are not to be conflated.



(*Adapted from: Burgoyne, 2009:157*)

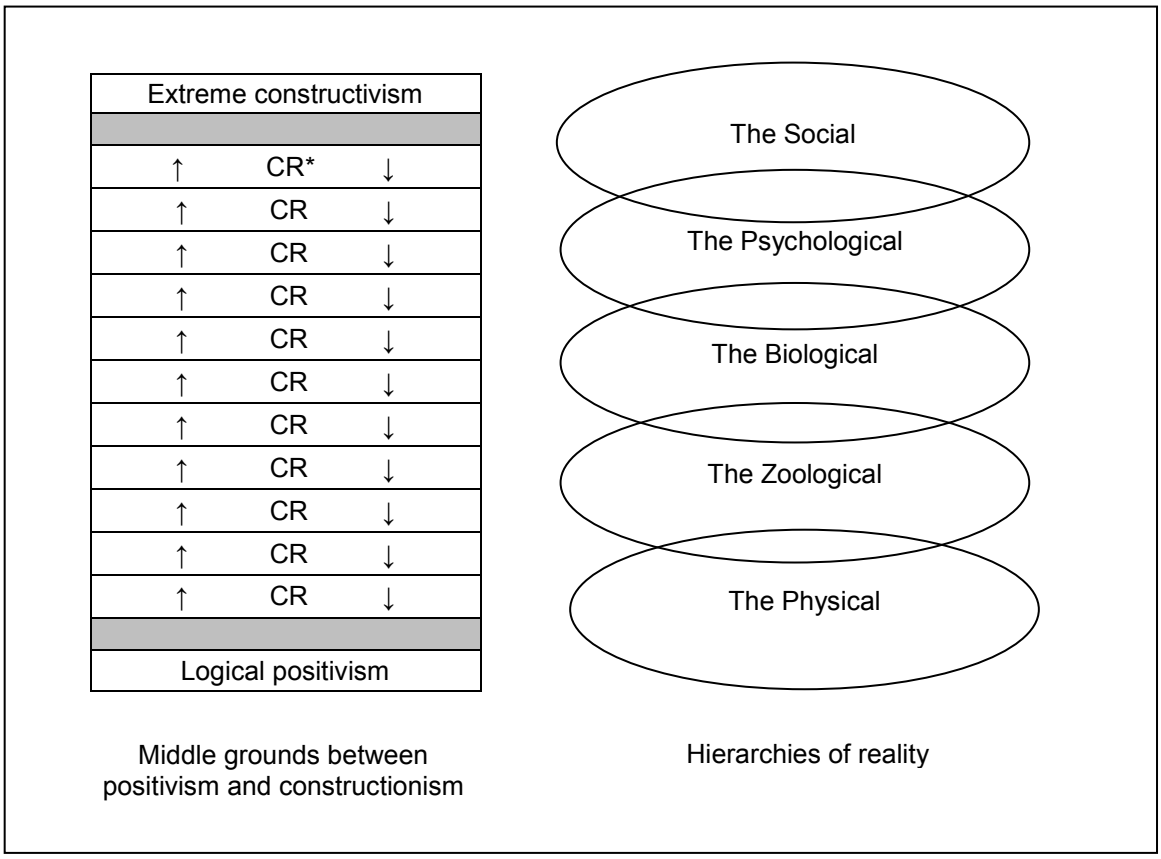
Figure 8.1 Ontology and hierarchies of reality

Bhaskar has pointed out that the stratified nature of the social world is multi-layered and divided into a number of distinct, yet interdependent domains each with their own particular properties (Houston, 2010:74-77). His notion of social stratification contains domains of deep reality each with its own internal dynamics, generative mechanisms and logics.

(d) *Critical realism – resolution of logical positivism and strong social constructionism*

This resolution pertains to the reconciliation between logical positivism and strong (or extreme) social constructionism as shown in Figure 8.2 where the left and right sides are related. When the left hand side of Figure 8.1 is zoomed and expanded upon, the

left hand side of Figure 8.2 comes into being. It depicts the possible direction(s) one can paradigmatically approach a research with respect to ontology, epistemology and methodology as a critical realist.



(**CR = Critical realist middle grounds*)

Figure 8.2 A critical realist reconciliation of positivism and constructionism

In Figure 8.2, a critical realist moves away from both logical positivism and extreme social constructionism; he or she shies from them by not being close to either in the areas shaded grey. The arrows signify a bottom-up or top-down critical realist approach in the reconciliation. When positivism and social constructionism are reconciliated through critical realism, the closed systems usually associated with positivism can move on to the open ones of critical realism.

(e) *Closed and open systems*

Positivism with its empirical realism is based on its (a) theory-neutral observations, (b) conflation of ontology with epistemology presupposing the world with what can be

observed, (c) flat, non-stratified ontology which cannot grasp emergence, (d) non-practical view of the relationship between knowledge and its object, (e) unqualified naturalism and disbelief of interpretive understanding, and (f) indifference to the nature of science as a social activity.

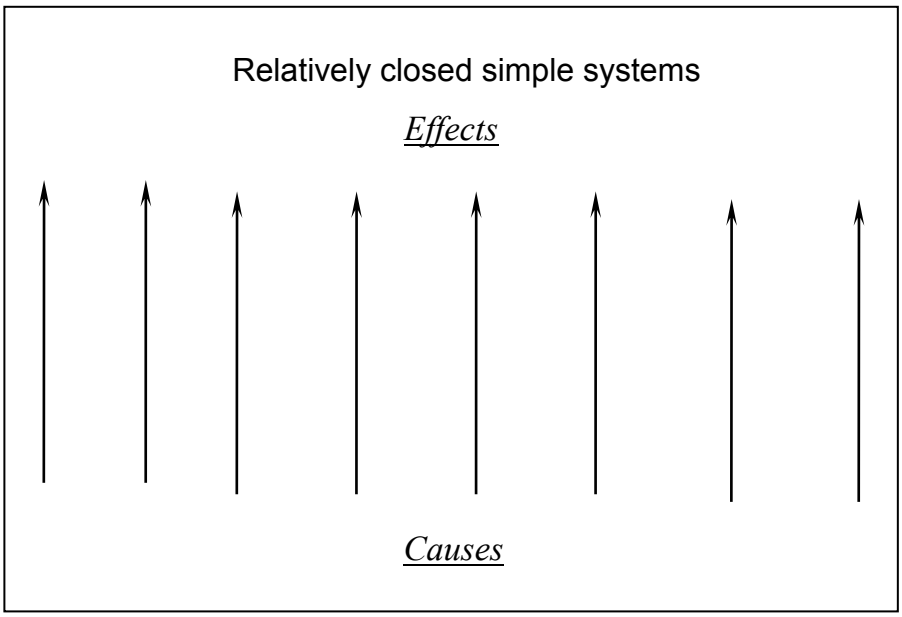
These positivist characteristics are based on the assumption of universal closed systems and its Humean view of causation as constant conjunction of events, encouraging researchers to seek empirical regularities as the objectives of scientific research.

Unlike the positivists, critical realists see the social world with systems that are not closed. Organisations studied are partially social and political; they are open systems not easily amenable to laboratory-like studies.

Even though event regularities and closed systems are fundamentally 'scientistic' (see Appendix 8A), they occur very rarely as such in the natural world, and almost none in the social world (Fleetwood and Hesketh, 2010:22). The 'causal laws' in the natural world are seen as tendencies in the social world by the critical realists.

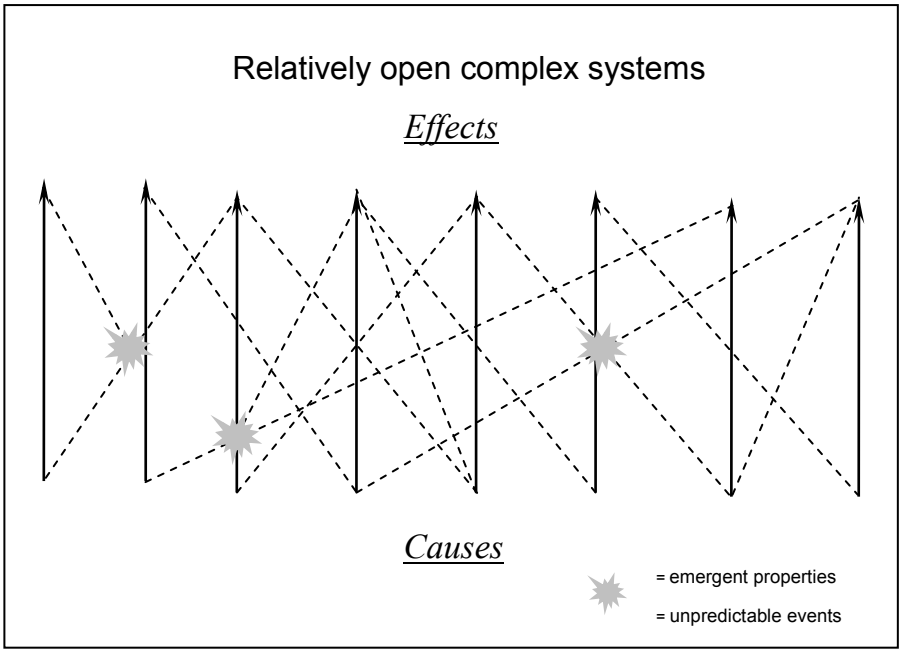
Bhaskar's critical realism adopts a view of reality as an open system that is beyond our ability to directly control. Social systems seldom exhibit likelihood for experimental closure; they cannot be adequately constrained in the real world as can be done with natural or physical laboratory experiments. A social event not only depends on the causal powers linked to a particular social structure, "but also on the continuously changing contextual conditions and the evolving properties of components within the structure" (Wynn and Williams, 2012:793).

For the critical realists, with the non-static and ever-changing reality of open systems, they shift their attention from predicting the enactments of mechanisms to the identification and likely explanations of the tendencies of the mechanisms to act within a defined contextual environment at a known point in time and space.
In Figure 8.3 and 8.4 are graphical representations respectively of a simple closed system with event regularities and a complex relatively open system with non-regularity of events.



(*Source: Burgoyne, 2010: slide 12*)

Figure 8.3 Cause and effect in closed simple systems



(*Source: Burgoyne, 2010: slide 12*)

Figure 8.4 Cause and effect in open complex systems

(f) *Critical realist world as an open system with emergent properties*

The right hand side of Figure 8.2 can be looked at horizontally instead of vertically. With a horizontal view, the right hand side is transformed ontologically into what is shown in the top half of Figure 8.5.

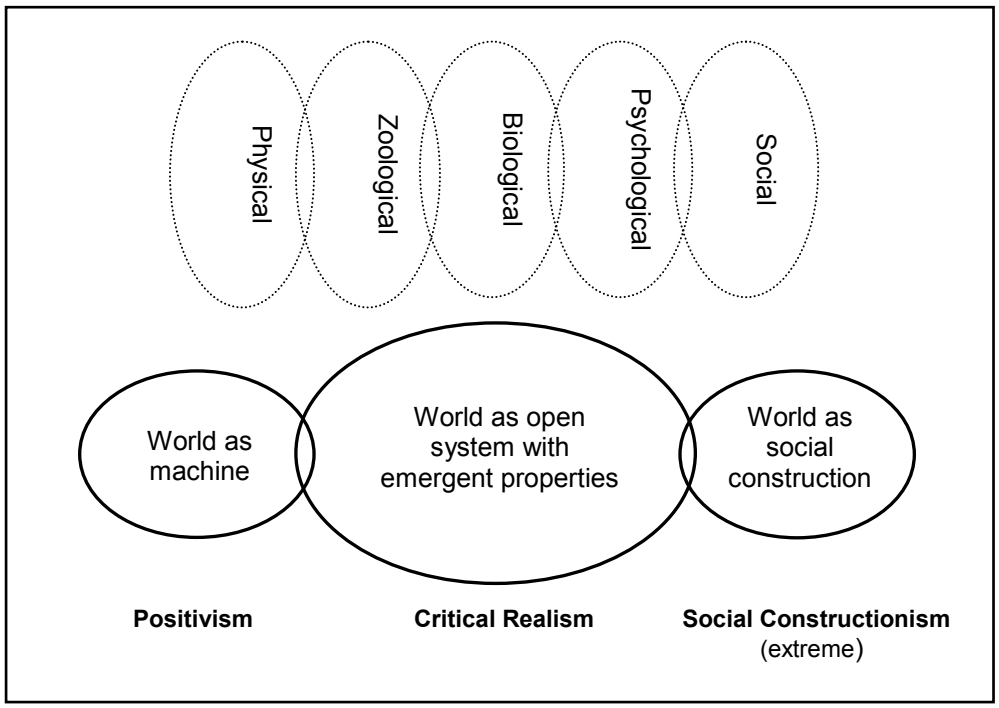


Figure 8.5 Three ontological views

Of interest to critical realist management is the world as an open system with emergent properties as captured in Figure 8.5. In this world, reality can be (a) processes, (b) contextual fields of information and (c) realms of symbolic discourses. From such a wide range of interests, management research is not what has sometimes been mistaken as a social science. Management is concerned with the organization of all that exists – phenomena traditionally outlined by the physical, natural, biological, psychological, social, economic and political sciences. "Management is genuinely a post- and multi- disciplinary area" (Burgoyne, 2008:65).

Seen thus as a critical realist, the word 'management' generally deals with systems and problems that have elements at all the levels of the hierarchies of reality in Figure 8.2.

(g) *Problems as challenges and opportunities in complex open systems*

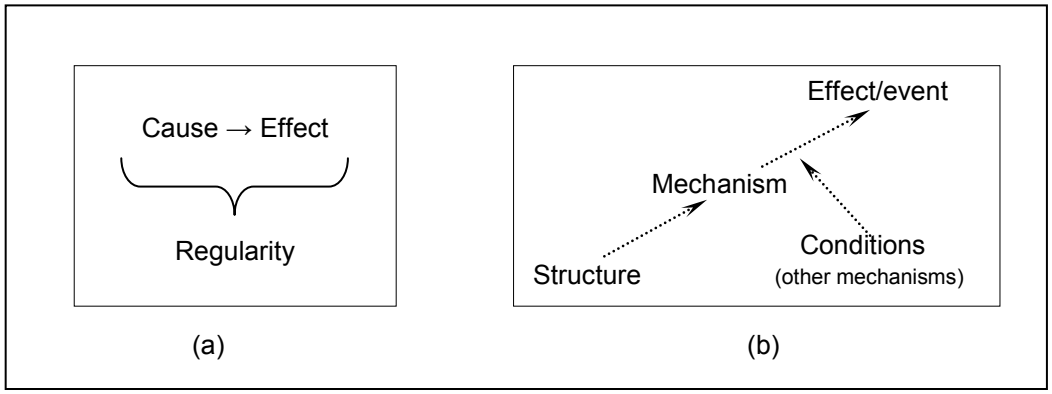
To call a challenge a problem is unhealthily off-putting as it is likely to lead to the neglect of solutions that might exist. But to insist on calling everything an opportunity appears naive as there can be cases of wrong interpretations of appreciative inquiry (Burgoyne, 2009:153).

With challenges and opportunities differentiated thus, the errors from innovations dare a researcher to face up to them in the contextual fields of experience, learning and knowledge. But critical realists argue that human experiences are only fragments of the real world. Access to the real world cannot be easily understood, characterised or measured. The social world is irreducible to that which is observed or experienced; and that which is experienced is not to be fused with casual mechanisms, events and actions (Fleetwood and Hesketh, 2010:137).

(h) *Critical realist causation*

The analysis of causation is one of the distinctive features of critical realism. Its causal analysis rejects the Humean 'successionist' view which involves regularities among the sequence of events in the social sciences (Sayer, 2000:13-14). From the critical realist ontological stratification, objects under examination have emergent causal powers.

In Figure 8.6 are found the positivist and critical realist views of causation put alongside each other.



(*Source: Sayer, 2000:14-15*)

Figure 8.6 Causation – (a) positivist view and (b) critical realist view

Given the variety and changeability of the contexts in social life, the absence of a positivist regular association between 'cause' and 'effect' is to be expected when it comes to critical realist mechanisms.

(i) *Concealment of mechanisms*

Critical realists believe in the existence of mechanisms which are constrained by the fact that they are often not directly observable or measurable. "They may be said to be real, though it is rarely that they are actually manifest and rarer still that they are empirically identified by men" (Bhaskar, 1978:47).

The implication linked to the concealment of mechanisms is that researchers' efforts to create knowledge about the real domain is focused not on the direct inaccessibility of structures and mechanisms in the real but rather the recognition of their manifest effects in the actual and empirical. Knowledge of reality is not always based on an ability to perceive but an ability to do something.

The absence of EMC from the regressions in Chapter 5 and 6 is a case in point. The EMC mechanism may not be absent but concealed in this study. Its absence from this study is most probably concealed as experienced by this researcher at TPS. This high probability may be better revealed and explained in future by critical realist researchers.

(j) *Mechanisms and explanations rather than predictions*

Why should we be concerned with the problem of causality? This question is asked partly because positivism insists on a particular kind of causality. But an answer to the question may have it that the success of social interventions and the consequent credibility of social science depend on our knowing what the mechanisms are (Hage and Meeker, 1988:1). Also per such an answer (i.e. by knowing what the mechanisms are) explanations can be offered based on the context. We will not be able make changes without understanding – (a) the reasons for a change having one effect rather than another; and (b) the conditions under which the change we want may occur. We have, therefore, practical as well as theoretical interests in the *why* of social life (ibid).

Critical realism stresses explanations over predictions because the validity of the latter depends on *ceteris paribus* conditions which are not appropriate in open system due to the underlying mechanisms (Miller and Tsang, 2010:145). The goal of a critical research study is to explain the mechanisms that generate a certain event, more so than its ability to make predictions about the event.

An explanation specifies the underlying antecedent factors assumed to cause a particular outcome. Critical realism maintains that a researcher can hardly, if ever, identify a complete set of antecedents which will always lead to a particular outcome. This is due to the potential interactions of mechanisms subsequently enacted by structural entities and contextual factors in open systems. Such gaps in perception may lead to fallible knowledge.

(k) *Fallibility of knowledge*

The knowledge of underlying structures and mechanisms is not created *ex nihilo* but developed in conjunction with prevailing social dealings and opinions along with a researcher's own sensory and conceptual evaluations. Thus all knowledge in critical realism is value-aware and theoretically primed; it stems from multiple value-aware perceptions of a single independent reality (Wyn and Williams, 2012:793).

Critical realism acknowledges the potential fallibility of all knowledge claims and it supports modesty regarding the verification and falsification of theory testing (Miller and Tsang, 2010:140). In social science studies, it is not realistic to assume that all relevant data will be consistent with a theory. This makes it hard for positivist researchers to reason on the non-fallibility of their research outcomes.

"Causal mechanisms cannot simply be 'read off' from events or patterns in events, there is a concern … with a different form of inference to the more common induction and deduction" (Lawson, 2004:236). This different form of inference is retroduction.

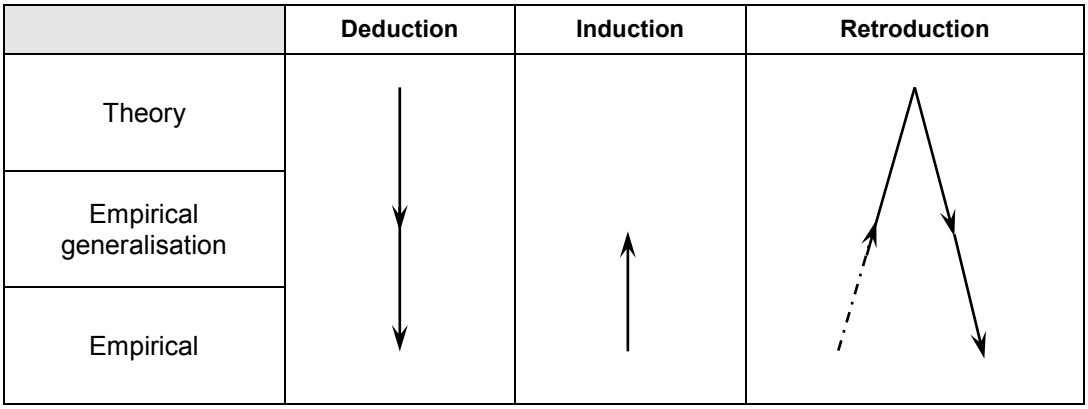
(l) *Retroduction as a mode of inference for critical realists*

"Retroduction involves moving from a conception of some phenomenon of interest to a conception of a different kind of thing (power, mechanism, etc.) that could have generated the given phenomenon" (Lawson, 2004:236). Retroduction has sometimes been referred to as abduction.

It is employed when we are relatively unsure about the operational mechanisms underlying a phenomenon under investigation. Hypothetical conjectures are often made on a journey of discovery with a scientific imagination. Such an imagination is not predicated on total ignorance, and does require knowledge in the forms of theories, observations and other knowledge (ibid.). In this study, the knowledge from this researcher's experience at TPS has cut into his scientific imagination.

Retroduction is a distinctive feature of the critical realist deployment of research methods. It involves an inference which "moves from a description of some phenomenon to a description of something which produces it or is a condition for it" (Bhaskar, 1986:11). It implicates a reverberation between induction and deduction in a research that is characterised by the linking of evidence (induction) and social theory (deduction) in a continually evolving, dynamic process (Saether, 1998:245).

When a critical realist embraces retroduction, it does not mean that he or she abandons the deductive logic, because "without which it would be difficult if not impossible to form coherent arguments or write coherent sentences" (Fleetwood and Hesketh, 2010:243). An understanding of induction, deduction and retroduction is shown in Figure 8.7.



(*Source: Saether, 1998:246*)

Figure 8.7 Deduction, induction and retroduction

In the above figure, the first part of the retroduction arrow is dotted to indicate that it, in the true sense of the word, starts with the 'lift' from empirical information to theoretical patterns (Saether, 1998:246).

Retroduction usually involves asking a particular kind of question – "what thing if existed, might account for the existence of *P*?" (Fleetwood and Hesketh, 2010:244). This might result in the identification of *Q* as the thing in question. We would say we have retroduced from phenomenon *P* to phenomenon *Q*. *P* may be considered as the 'ordering framework' and *Q* as 'conceptualisation'.

Initially there may not be any knowledge on *P* and fitting empirical data with it may be difficult; and the process of generating *Q* may have started with a black box. But when *Q* is determined with reiterative cycles of retroduction, the cover of the black box may be prised open to reveal some of the mechanisms underlying the phenomenon starting with *P*.

(m) *Retroductive steps proposed for a critical realist research*

To Bhaskar merely knowing that event *P* has been followed by event *Q* is an insufficient and unnecessary condition for establishing a relationship between the two. What is important is gaining an understanding of how *P* gives rise to *Q* (Houston, 2010:82). For Sayer (1992) this type of inference is the driving force behind the retroductive procedure.

Retroduction is "a movement, paradigmatically, from a 'surface phenomenon' to some 'deeper' causal thing" (Lawson, 1997:25). Blaikie (2003) has metaphorically elaborated retroduction "as going *back from, below or behind* observed patterns … to discover what produced them" (Houston, 2010:82). When it comes to the pioneer in the field of retroduction, Peirce (1958) viewed it as "thinking backward from effect to cause" (ibid.).

The retroductive path is chosen for the recommended future innovation research such as this study posited in critical realism.

(n) *Innovation - a critical realist perspective*

An innovation can be looked upon as a social project which is described by Margaret Archer (2003:5-6) thus – "A project involves an end that is desired, however tentatively or nebulously, and also some notion, however imprecise, of the course of action through which to accomplish it … (W)hen a project is constrained or enabled during its execution, agents can act strategically to try to discover ways around it or

to define a second-best outcome (where constraints are concerned) … (T)hey can deliberate about how to get the most out of propitious circumstances, which may mean adopting a more ambitious goal, so that a good outcome is turned into a better one (where enablements are concerned)" (Fleetwood, 2008:194).

For innovation, autonomy can be regarded as having structural influences and trust as having agential influences as discussed earlier. Organisations are thought to be transformational when they are transformed via the activities of their employees as agents (Fleetwood and Hesketh, 2010:25). Like human resource management, innovations are multiply caused, complex, evolving and subject to the exercise of human agency (Fleetwood and Hesketh, 2010:142). Both HRM and innovation require reflection and deliberation

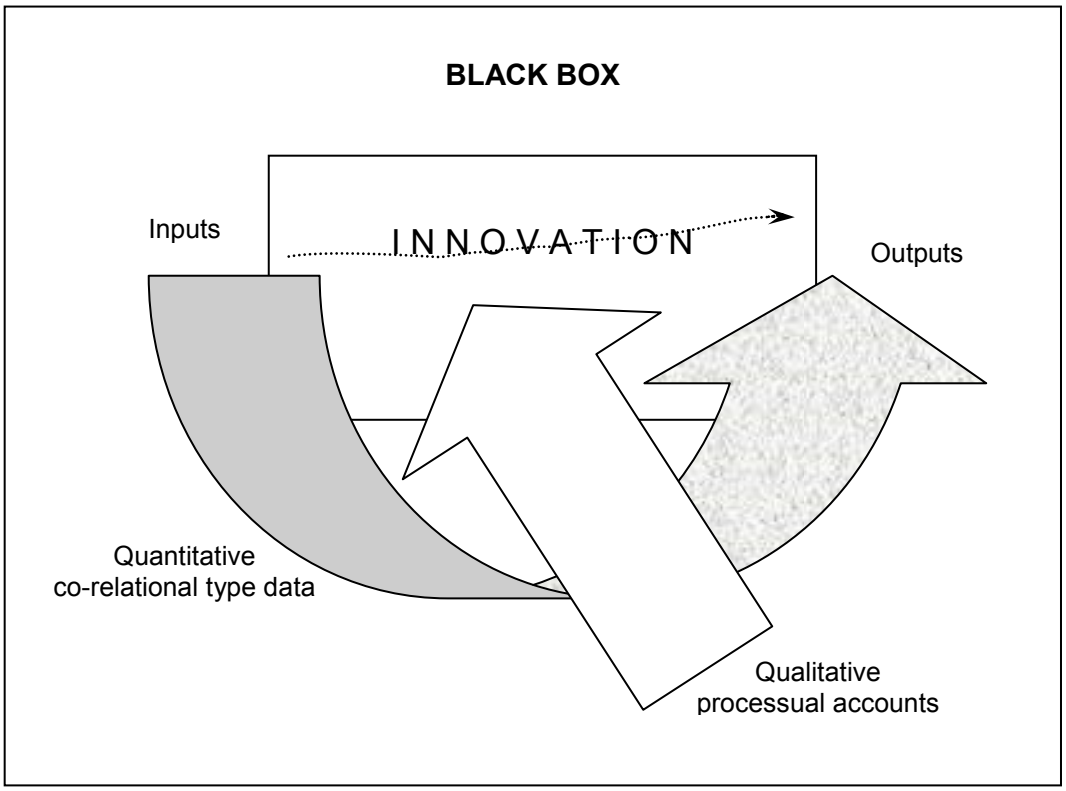
But reflexive deliberations are not infallible, so is the knowledge linked to them which is iteratively produced and reproduced through the constitutions of structures and agents, not as two independent parts of a phenomenon, a dualism, but a duality (Edwards, 2000:449). This duality can be explored in a future research on innovation in terms of it in a black box from two dual perspectives – 'deduction-induction' and 'quantitative-qualitative'.

(o) *Critical realist opening of an innovation's black box with retroduction*

Retroduction can be used by the critical realists to unlock a black box with innovation as a phenomenon as depicted in Figure 8.8. Innovation, conceived as a black box, has been metaphorically described in the literature.

To understand innovation better, two keys can be used to unlock its black box – one deductive followed by the other which is inductive as in Chapter 5 and 6 respectively. From Figure 8.8, the 'quantitative co-relational type data' are proffered by deduction and they are extended by the 'qualitative processual accounts' from induction. In this figure, the 'inputs → processes → outputs' flow of innovation is depicted graphically for a dynamic understanding of it.

The quantitative data correlate the inputs into and outputs from the black box (which can be a process like innovation positioned well within the organisation) and the qualitative accounts look at the innovation processes within the black box. A researcher can iterate between the 'quantitative-qualitative' duality to home in on what is significant to effective innovation.



(*Source: Burgoyne, 2011*)

Figure 8.8: Critical realist unlocking of a phenomenon's black box with retroduction

The positivist approach in this study of looking at innovation from both the deductive and inductive angles is a move that is a close semblance to that of a retroductive approach a critical realist would methodologically adopt.

(p) *Critical realist research methodologies*

Some philosophical debates tend to misappropriate critical realism as a method *per se*. (Yeung, 1997:51). It is not a method (Miller and Tsang, 2010:140) but a reconciliation of positivism and social constructionism. But this does not mean that the critical realism will replace both positivism and social constructionism. The critical realist research methodology is configurational in approach.

Configuration methodological approaches to research are deemed by critical realists to be better than those based on contingency. The latter approaches are seen as fragmentary, reductionist and mostly deterministic while the former ones offer syntheses and equifinality (Fleetwood and Hesketh, 2010:243). Critical realists

consider both positivist and social constructionist studies for synthesis *en route* to equifinality; their considerations pertain to the principle that in open systems a given end state can be reached by many potential means.

As Bhaskar does not recommend a specific research methodology in critical realism, it can be pluralist in approach in terms of different empirical research methods which focus on different aspects of reality; and combining many methods together in a research program yields a richer understanding of the phenomenon of interest (Mingers, 2001:241).

Critical realism does not abandon positivism or deductivism. "We support the use of multivariate correlational methods, but believe that they do not, by themselves, fulfil the exigencies of critical realism" (Miller and Tsang, 2010:147). Open systems do not necessarily undermine empirical regularities as their occurrence can still provide some interesting insights into the operative mechanisms, despite the critical realistic emphasis that open systems mean no event regularities.

The research designs of critical realist methodologies may be more intensive (Miller and Tsang, 2010:151-2). Intensive researches attempt to uncover the explanatory mechanisms that are relevant to specific cases and are more qualitative in approach. They are often linked to case study, ethnomethodology and action research amongst others.

Bhaskar has agreed with the description of critical realism as ontologically bold but epistemologically cautious when it comes to the notion of causality (Wynn and Williams, 2012:789). A primary goal of a critical realist research is to provide clear and empirically supported assertions about causality, especially *how* and *why* a phenomenon occurred. Its other goal is to explain the mechanisms that generate a phenomenon, more so than the ability to predict the nuances of it.

While Bhaskar does not recommend any particular research methodology, some critical realist researchers have started to take on methodologies to explore with studies on *how* and *why* structures, events and actions interact in a specific context. The aim of these researchers is to identify and explain causal mechanisms.

(q) *Critical realist research methodological approaches for innovation*

“If social scientists truly wish to understand certain phenomenon, they should try to change them. Creating, no predicting, is the most robust test of validity-actionability” ~ Kurt Lewin (Kaplan, 1998:89).

From a critical realist perspective, innovation calls for creating and not predicting in relation to the exploration, exploitation and application of knowledge gained from experience. An innovation process can be made subject to description like all other social events. But when an innovation is launched, it is not known to what extent its process will be successful in relation to intended goals; often not even knowing what a successful process will imply.

What knowledge do the researcher and the client organisation need? (Gustavsen, 2005:275). It is apparent that when doing a research on innovation, knowledge cannot be applied as a matter of routine as all innovation processes evolved differently with unique characteristics. It is the role of a researcher to evolve in tandem with the process of innovation. Also the client organisation matters as it is contextual to the innovation under examination. The report forthcoming from the researcher pertains to a story of the organisation in focus, such like this study which has TPS focused as a background.

“Organisational inquiry can proceed only by concerting inaccessible information, by clarifying obscure information, and by resolving the inadequacies in organisational theory of action (the mistakes, incongruities, and inconsistencies) which clarification reveals” (Argyris and Schon, 1978:85).

When it comes to innovation and its errors, the information needed to resolve the errors is obtained through iterative learning, and the use of ensuing knowledge associated with each iteration. For a critical realist research, the iterations can be carried out retroductively.

8.6.4 'Errors→culture→learning→knowledge→innovation': a critical realist view

This ‘errors converging to innovation’ process flow is captured in the main study under the positivist umbrella; but it will be approached differently in the recommended future research under the canopy of critical realism.

A paper will be written on this transition from positivism to critical realism per the process flow in question. Here the transition to be reflected in the would-be paper is here regarded summarily and predominantly in terms of diagrams. It is proposed and assumed acceptable that a diagram, like a picture, is worth a thousand words. Where complexity exists, diagrams can provide clarity and comprehension through visualisation.

The transition of this study to a critical realist perspective in future research can take on developing steps, alphabetically arrayed in the rest of this sub-section.

(a) *An innovation cycle as a learning cycle*

The cycle proposed here is generic and it depicts what can commonly be expected of an innovation process in organisations. This cycle is captured in Figure 8.9.

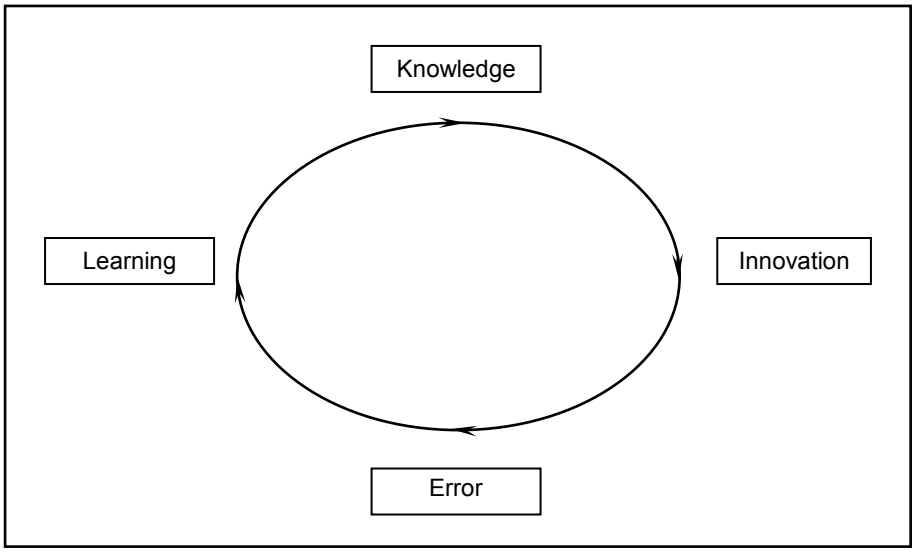


Figure 8.9 The innovation cycle

The above cycle captures closely this flow of the study - 'errors → culture → learning → knowledge → innovation'.

Figure 8.9 can be likened to Kolb's experiential learning cycle, of Figure 2.2, per the correspondence alignment in Table 8.2.

Table 8.2 One-to-one stage correspondence between Kolb and Innovation cycles

Cycle	Kolb learning cycle	Innovation cycle
Stage	Active experimentation	Innovation
	Concrete experience	Errors
	Reflective observation	Learning
	Abstract conceptualisation	Knowledge

From the close association between the two cycles, the innovation cycle can be superimposed unto the Kolb learning cycle as shown in Figure 8.10.

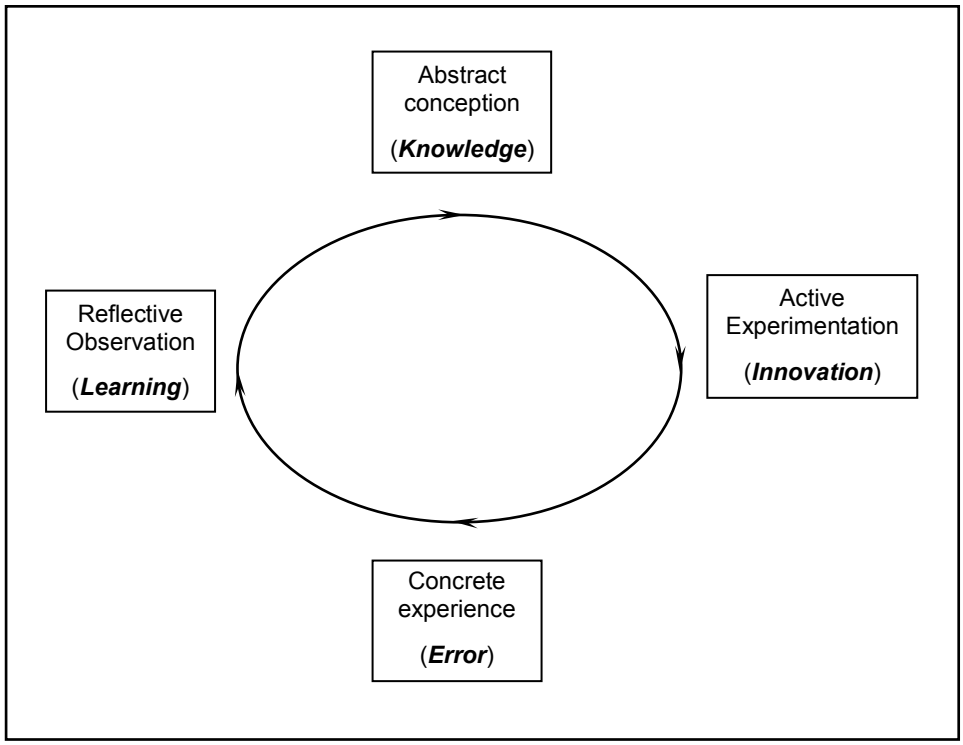


Figure 8.10 The innovation cycle as a learning cycle ~ a single-loop

In Figure 8.10, the Kolb learning cycle has been transformed into an innovation-learning cycle. With this transformation, the efforts of a research on innovation are centralised and consolidated in terms of error, learning, knowledge and innovation effectiveness as in this study.

Similar to the Kolb cycle, the innovation-learning cycle depicts what learning has taken place and it does not focus on – (a) how the learning takes place and (b) why the learning is done the way it is for innovation. It pertains to single-loop learning as discussed in the literature review. This form of learning has been described as incremental and translational in that it supports the status quo. It cannot produce the types of shifts necessary for fundamental changes grounded in the basic factors that underlie innovation for organisational sustainability (Edwards, 2009:197).

As Kolb's learning cycle is epistemological (Burgoyne, 2009:154) so is the innovation-learning cycle in Figure 8.10. For enhanced learning, Burgoyne has proposed an ontological cycle to be added to the Kolb cycle and such an ontological addition can also be done with the innovation-learning cycle.

(b) *Adding a deeper ontological cycle to the innovation-learning cycle*

The ontological cycle that can be layered below the innovation-learning cycle of Figure 8.10 is found in Figure 8.11.

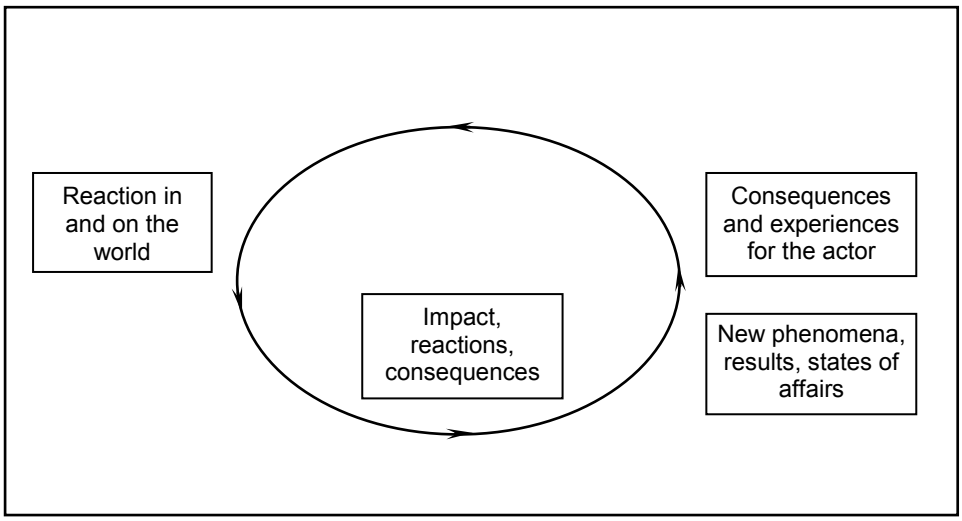


Figure 8.11 The 'experimenting on the world cycle'

The cycle in Figure 8.11 befits innovation as it is named 'experimenting on the world cycle' (Burgoyne, 2009:155). When such an 'experimenting on the world' cycle in is added beneath the innovation-learning cycle in Figure 8.10, the result is in Figure 8.12. The combination of the two cycles is named the 'whole innovation-learning

process' because the innovation cycle is now fused to a learning cycle, epistemologically and ontologically.

Compared to the innovation-learning cycle as a single-loop, the whole innovation-learning process is a double-loop as discussed in the literature review. It provides generative transformational learning which requires re-framing insights and behaviours for institutional implementation to garner new experiences, learning and knowledge. Double-loop learning is not a simple process of linear progression learning, a reflection characteristic of innovation (Edwards, 2009:198).

"One cannot engage in double-loop learning (the type that re-valuates basic assumptions) with single-loop models" (Daneke, 2001:518). Solutions to problems on innovation that are caused by deeply held views and which are performed through institutionalised systems practice cannot be found with single-loop learning as it is associated with incremental learning (Edwards, 2009:197).

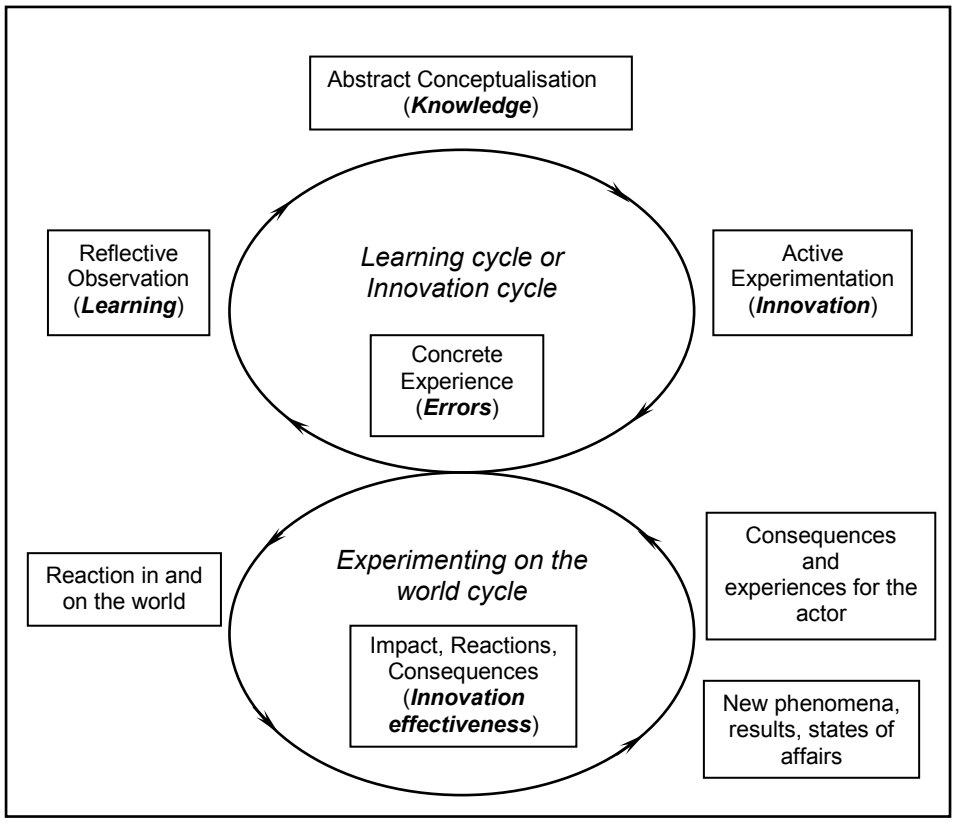


Figure 8.12 Whole innovation-learning process ~ a double-loop

The upper loop in Figure 8.12 is epistemological in approach whilst its lower loop is ontological. This figure is elaborated thus – (a) when an unexpected event is encountered as a 'concrete experience' at Stage A (for example) of innovation in the upper loop of Figure 8.12, (b) instead of moving on to 'reflective observation' in the same loop, (c) individuals/teams involved with Stage A of the innovation can now move down to 'reaction in and on the world' in the lower loop.

With this move downwards, they can tap onto deeper and wider knowledge and experiences to improve more on the innovation in relation to 'impact, reactions and consequences'; this can contribute to the effectiveness of the innovation post Stage A when the unexpected event encountered in Stage A entails an ontological shift from the epistemological plane in which the event occurs. This shift is part of the management of the unexpected event such as errors.

From the improvement registered post Stage A, the individuals/teams can advance to the next stage of innovation in the upper loop per this path – 'new phenomena, results, states of affairs' → 'consequences and experiences for the actor' → 'concrete experience' → 'reflective observation' – into Stage B, say, and other stages through more iterations that follow.

From the literature review, Figure 8.12 represents double-loop learning and when the learning continues to Stage B and beyond, triple-loop learning sets in.

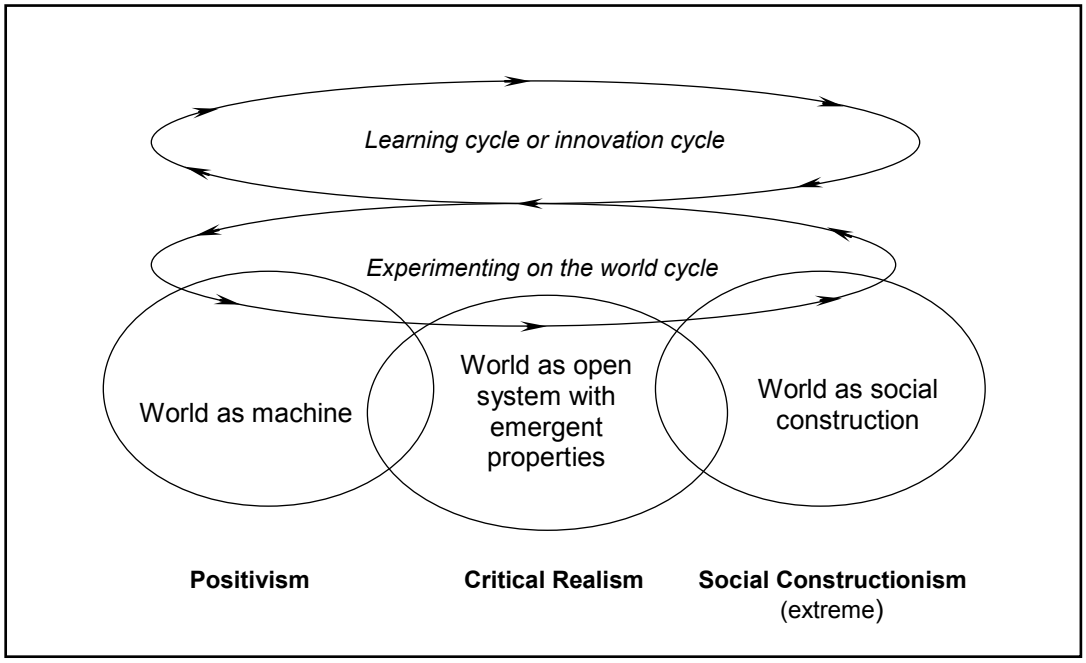
(c) *From double-loop to triple-loop learning*

Per the three levels of loop learning from Argyris and Schon, a critical realist engaged in the recommended future research can go deeper than double-loop learning; it is triple-loop learning (or deuteron learning). To put on such a critical realist thinking cap, the researcher can consider adding the double-loop of Figure 8.12 unto the three ontological views in Figure 8.5. The combined outcome is in Figure 8.13.

It is essential that organisations move into deeper triple-loop learning which questions existing products, processes and systems by strategically asking what and where they would like to be in the future. By being discontented with single- and double-loop learning, organisations ask – (a) what is wrong and (b) how to correct and prevent errors (Wang and Ahmed, 2003:13). By focussing on single- and double-

loop learning, with little or no attention given to deeper levels of learning, continuous improvements are more likely to remain the norm of each working day in organisations. This may lead to tragic stagnation as the world is forever moving on.

With only single- and double-loop learning, organisations may not be able to keep abreast or ahead of their competitors; they should strategize with deeper levels of learning that are linked to innovation (Pun and Nathai-Balkisson, 2011:218). There is a need to investigate to what extent innovation or deeper order of learning can be organisationally embedded, how this investigation can be done, and how it can be stimulated as a means to sharpen competitiveness (ibid.). It is also essential for organisations to understand why the move into deeper degrees of learning is needed for exploration and exploitation.



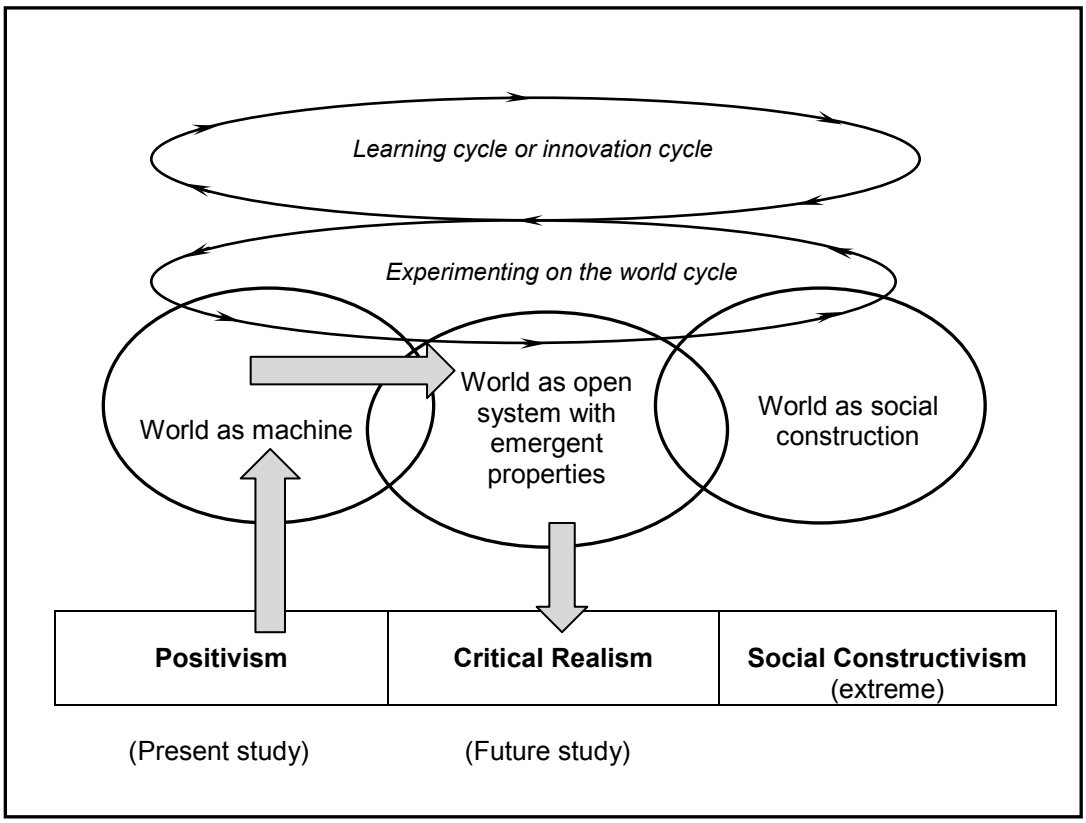
(Source: Burgoyne, 2009:155)

Figure 8.13 The deep whole innovation-learning process ~ a triple-loop

Figure 8.13 is a 'deep whole innovation-learning process' from the 'whole innovation-learning process' in Figure 8.12. Here the innovation-learning process traverses the reality of critical realism – "a synthesis of the thesis of positivism and the antithesis of social constructionism" (Burgoyne, 2009:154). This synthesis is elaborated further in the following next.

(d) *Critical realist elaboration on the 'deep whole innovation-learning process'*

This elaboration extends to Figure 8.14 which starts in the realm of positivism as it shares with critical realism the existence of a world independent of us; but this world is open system with emergent properties for the critical realists. These emergent properties can be found in the overlap portions between critical realism with each of positivism and social constructionism.



(Adapted from: Burgoyne, 2009:155)

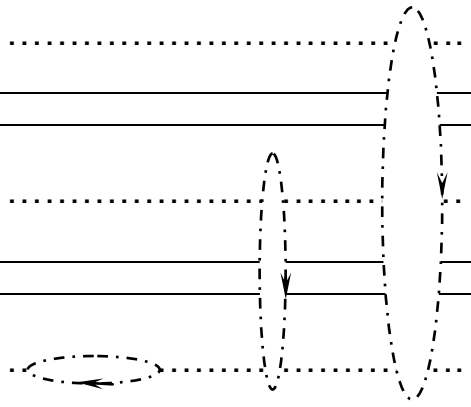
Figure 8.14 Critical realist 'deep whole innovation-learning process'

By taking the grey arrowed path in Figure 8.14, a future critical realist researcher can broach deeper into triple-loop learning where the growing number of indicators on organisational performance, such as innovation effectiveness, signal the post-modern concern for plurality and diversity (Edwards, 2009:190).

The critical realist path in Figure 8.14 is one way of developing multi-perspectival capacities in a researcher's understanding based on meta-theory which is a theory about theories. Meta-theory is used as "a portmanteau term to refer to philosophy of

science, ontology, epistemology, methodology, causality and researcher techniques" (Fleetwood and Hesketh, 2006:695).

Single-, double- and triple-loop learning lens are contained in Figure 8.14. These lenses are to be combined with developmental lenses in a future research to reflect on the variability that can occur over time as an organisation struggles to balance translational and transformational modes of learning in a sustainability context. This balance is depicted in Figure 8.15.

Loop	Cyclical iteration	Learning	Figure
Triple loop learning occurs across multiple context		Transformational learning (know-why)	8.13
Double loop learning occurs between conceptual frames		Transformational learning (know-how)	8.12
Single loop learning occurs within a conceptual frame		Translational learning (know-what)	8.10

(*Source: Edwards, 2009:198*)

Figure 8.15 Multiple loop learning

The discourse thus far in Section 8.6 touches on an account of what future research on innovation may entail in finding out the *what*, *how* and *why* for relevant research paths to be taken when errors from innovation are encountered. These encounters will not be perceived to be negative in an error tolerant culture as there are positive lessons and knowledge to be gained as innovative resources.

8.6.5 Concluding thoughts on the recommended critical realist research

A critical realist research is not prescriptive. It may not be difficult to carry it out as it can be aligned with tried and tested methodologies and methods known to bring about positive changes through re-framing. For an innovation research rooted in critical realism, real opportunities abounds for the researcher and his/her client organisation "to rethink and re-frame learning so that innovation, change and

improved performance can manifest in organisational practice" (Gray and Williams, 2011:449).

Researches on the positive aspects of unexpected events, such as the encounters of errors, can take a leaf or two from successful prior studies that feature (a) the complexity of learning distilled to factors that shape, influence and perpetuate (b) learning systems for re-framing to tap on (c) the knowledge embedded in the events.

This re-framing can be made easier when critical realism is understood and embraced as a rich philosophical repository with multifaceted, multifarious and multi-levelled possibilities.

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APPENDICES

APPENDIX 4A – MAIN QUESTIONNAIRE SURVEY

Dear Participants,

Thank you for taking part in my research study.

The research is for the dissertation required of the Doctor of Business Administration programme from Henley Management College. My dissertation is a research study done with a survey on innovation effectiveness linked to a culture on error management. This linkage is studied in association with organisational learning and knowledge management within your organisation as the unit of analysis.

In this survey, innovation is about value creation as reflected thus: -

"*To many people, the word 'innovate' conjures up images of science labs, high-tech computers, and people with a string of degrees working in a faraway place called Silicon Valley. But that is incorrect. Innovation is nothing more than coming up with good ideas and implementing them to realise their value. It is about value creation. … Throughout history of mankind and civilisations, countries and corporations, which were able to anticipate, respond and adapt to changes quickly, have triumphed over others. Those that failed to act and react quickly fell by the wayside*".
- Goh Chok Tong (Prime Minister of Singapore, 1990-2004)

The four research variables are these with their associated focus: -

Variable	Focus
Error management culture	Errors and their tolerance can leverage innovation through learning and knowledge management in organisations.
Organisational learning	Lessons from errors can positively influence innovation if there is learning organisation-wide.
Knowledge management	A combination of knowledge management enablers and processes for managing knowledge as a resource important to innovation.
Innovation effectiveness	Effective innovations are measurable with indicators reflecting their impact on organisational performance.

In the survey the words error, failure and mistake have been used interchangeably. But collectively they have this in common - they are linked to unexpected outcomes with probable negative consequences.

The research instrument is as attached and the survey is focused on your organisation as the unit of analysis. When you encounter items where you may not have your 'first choice' in rating, please have all these items rated with a choice that is 'second best' for your organisation.

Yours sincerely,

Survey on Innovation Effectiveness

You are invited to participate in a study of innovation effectiveness in a broad range of organisations by filling in this questionnaire. It should not take more than 20 minutes to complete.

If you are in between jobs, please make reference to your previous employment.

Your response will be treated in strict confidence and only aggregated data will be presented in any outputs from the study.

If you would like to receive a copy of the executive summary from this study, please provide your contact details as follows: -

Name:
……
Organisation:
……
Address:
……

……
E-mail:
……

Section 1: Introduction

All the statements apply to the actual organisation you work in and not the parent company if one exists. If you work in a public or not-for-profit organisation, please apply the statements to your division or other organisational units as appropriate.

Your inputs to the following are important background information to the survey: -

Your organisation's main activities.	
Country your organisation is based.	
Number of employees in your organisation (full-time equivalent).	
The age of your organisation.	
Industry sector your organisation is in.	
Is your organisation a subsidiary of a parent company?	
Your job title.	
Number of years you have been working with the organisation.	

To the statements in Sections 2 to 5, please indicate to what extent you disagree or agree (1 to 7) with each of them when applied to your organisation. When you think a statement is relevant, but you do not know how to rate it, please rate it as "don't know". On the other hand, if it is not applicable to your organization, please have it rated as "N.A.". Please indicate your rating with an 'X'.

Section 2: Error management culture

	Strongly disagree 1	2	3	4	5	6	Strongly agree 7	Don't know	N.A.
1. After making a mistake, people try to analyse thoroughly what caused it.									
2. In this organisation, people think a lot about how an error could have been avoided.									
3. If something went wrong, people take the time to think through how to correct it.									
4. We are concerned but there's no shame and blame when things go wrong.									
5. It is possible to admit that you're wrong without losing face.									
6. It is possible to report bad news without being blamed personally.									
7. For us, errors are very useful for improving work processes as they point us at what we can improve.									
8. An error provides important information for the continuation of our work.									
9. When mastering a task, people can learn a lot from their mistakes.									
10. When someone makes an error, (s)he shares it with others so that they do not make the same mistakes.									
11. When people are unable to correct an error by themselves, they can rely on their colleagues to continue their work.									
12. When people make an error, they can ask others for advice on how to continue.									
13. When an error has occurred, we usually know how to rectify it for restoration.									
14. When an error is made, it is corrected right away.									
15. Although we made mistakes, we do not let go of the final goal.									

Section 3: Organisational learning

	Strongly disagree 1	2	3	4	5	6	Strongly agree 7	Don't know	N.A.
1. When employees need specific information, they know who will have it.									
2. Management monitors important organisational performance variables.									
3. Management proactively addresses problems.									
4. Top management integrates information from different organisational areas.									
5. Employees are keenly aware of where their knowledge can serve the company.									
6. Employees use electronic means to communicate.									

7. Our company provides diverse IT support (telephone, e-mail, internet, and so on) for communication amongst the employees.			
8. Employees are encouraged to communicate clearly.			
9. The company collects data on all facets of performance.			
10. The company stores detailed information for guiding operations.			
11. There is a formal data management function in the company.			
12. Management encourages the use of frameworks and models to assist in decision-making.			
13. The company develops experts from within.			
14. Management learns from the company's partners (such as customers, suppliers, allies).			
15. Management assigns employees to other parts of the organisation for cross training.			
16. Management learns new things about the company by direct observation.			
17. Employees make extensive use of information systems to support their work.			
18. The company makes extensive use of IT support provided for systematic electronic storage (such as of databases, data warehousing, scanned documents).			
19. The company is slow to react to technological change.			
20. Employees retrieve archived information when making decisions.			
21. Employees keep information (such as numbers, plans, ideas) from other employees.			
22. Our employees resist changing to new ways of doing things.			
23. Employees learn about the company's recent developments through informal means (such as news, stories and gossip).			
24. The company acquires subunits (such as organisations, functions, departments) based on short-term financial gains.			
25. The company maintains a certain mix of skills among its pool of employees.			
26. The company hires highly specialised or knowledgeable personnel.			
27. Management ignores the strategies of competitor's top management.			
28. When internal capabilities are deficient, we acquire them from the outside.			

Section 4: Knowledge management

	Strongly disagree 1	2	3	4	5	6	Strongly agree 7	Don't know	N.A.
1. Our organisation members are satisfied with the willingness to collaborate across our organisation.									

2. Our organisation members are helpful with their support.			
3. There is a willingness to accept responsibility for failure.			

Our company members …	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Don't know	N.A.
4. Are generally trustworthy.			
5. Have reciprocal faith in other members' behaviours in working towards organisational goals.			
6. Have reciprocal faith in others' ability.			
7. Have reciprocal faith in others' decision toward organisational interests than individual interests.			
8. Have relationships based on reciprocal faith.			

Our company …	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Don't know	N.A.
9. Provides various formal training programmes for performance of duties.			
10. Provides opportunities for informal individual development other than formal training such as work assignments and job rotation.			
11. Encourages people to attend seminars, symposia, and so on.			
12. Provides various programmes such as clubs and community gatherings.			
13. Members are satisfied by the contents of job training or self-development programmes.			

Our company provides IT support for …	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Don't know	N.A.
14. Collaborative works regardless of time and place.			
15. Searching for and accessing necessary information.			
16. Simulation and prediction.			

Our company stresses …	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Don't know	N.A.
17. Gathering information from sales and production sites.			
18. Sharing experience with suppliers and customers.			
19. Engaging in dialogue with competitors.			
20. Finding new strategies and market opportunities by wandering inside the firm.			
21. Creating a work environment that allows peers to understand the craftsmanship and expertise.			
22. The use of creative dialogue (e.g. with metaphors) for the exchange of ideas created.			
23. The use of deductive and inductive thinking.			
24. Subjective opinions.			

25. Planning strategies by using published literature, computer stimulation and forecasting.			
26. Creating manuals and documents on products and services.			
27. Building databases on products and services.			
28. Building up materials by gathering management figures and technical information.			
29. Transmitting newly created concepts.			
30. Enactive liaisoning activities with functional departments by cross-functional development teams.			
31. Forming teams as a model and conducting experiments, and sharing results with entire departments.			
32. Searching and sharing new values and thoughts.			
33. Sharing and trying to understand management visions through communication with fellow colleagues			

Section 5: Innovation effectiveness

	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Don't know	N.A
1. Our company has produced many novel and useful ideas (services/products).			
2. Our company fosters an environment that is conducive to our own ability to produce novel and useful ideas.			
3. Our company spends much time for producing novel and useful ideas.			
4. Our company considers producing novel and useful ideas as important activities.			
5. Our company actively produces novel and useful ideas.			

Compared with key competitors, our company …	Strongly disagree 1 2 3 4 5 6 7 Strongly agree	Don't know	N.A
6. Is more successful.			
7. Has a greater market share.			
8. Is growing faster.			
9. Is more profitable.			
10. Is more innovative.			

Thank you for your attention and time taken to complete this survey. Please return the completed survey to me in the self-addressed envelope or have it e-mailed to me at mokwp@ymail.com

Mok Wee Piak
10 July 2006

Comments on the survey …

APPENDIX 4B - ORGANISATIONS OF USABLE RESPONSES

Africa	
Kenafric Industries Ltd	
Australia	
Qiuntiles Pty Ltd	
Germany	
Software AG GIS	
Holland	
Boehringer Ingelheim	Nucletron B.V.
e-office	
Indonesia	
PT. Tetra Pak Indonesia	
Israel	
Star English Services	
Singapore	
Algorithmics International Corp.	NTUC Income
Azynex Pte Ltd	NUS (School of Computing)
Behirnger Holdings Pte Ltd	OCBC Securities Pte Ltd
Building & Construction Authority	Offshore Incorporations Ltd
Building Control Authority	OSPL Securities Pte Ltd
C & H Properties Pte Ltd	Overseas Chinese Banking Corporation
C H Lim Consultants	Pan Resources Pte Ltd
Central Provident Fund	Parkway Hospitals (S) Pte Ltd
Chung Hwa Free Clinic	Pavo Trading Pte Ltd
Citibank	Qian Hu Corporation Ltd
Computer Business Services Pte Ltd	R+V Versicherung AG
CoolNLite Solar Pte Ltd	Republic of Singapore Air Force
Cytec Industries Pte Ltd	SIA Properties Pte Ltd
Development Bank of Singapore	Singapore Exchange Limited
Eastcompeace Smart Card (S) Pte Ltd	Singapore Institute of Management
Fotronics Incorporated Pte Ltd	Singapore Polytechnic
Grenidea Technologies Pte Ltd	Singapore Technology Kinetics
Hewlett Packard Asia Pacific	Singapore Technology Marine
HH Tan Dentalcare	Sirius International Insurance Corp.
Hong Chek Co. Pte Ltd	SMRT
Housing & Development Board	Standard Chartered Bank
Inland Revenue Authority of Singapore	Stifas Pte Ltd
Institute of Environmental Science & Engrg.	Straits Knowledge
Keppel FELS Ltd	Sun Microsystems Pte Ltd
Kong Meng San Monastery	Supreme Court of Singapore
LPS Learning & Performance Systems	Tetra Pak Jurong Pte Ltd
Manulife (S) Pte Ltd	Tetra Pak Technical Service Asia

Maybank Singapore	The British Council (Singapore)
Media Development Authority	The Great Eastern Life Assurance Co. Ltd
Mez Marketing	Trans Concorde Services Pte Ltd
Ministry of Foreign Affairs	TÜV SÜD PSB Corporation
Nanyang Primary School	Vopak Terminals (S) Pte Ltd
National Institute of Education	Weishen Industrial Cleaning Service
National Library Board	Welcome Real-Time ASPAC Pte Ltd
National University Hospital	World Courier Singapore Pte Ltd
Nayang Technopreneurship Centre	YCH Group
Night Safari	Yokogawa Engineering Asia Pte Ltd
Nokia Pte Ltd	
Sweden	
Food Safety & Quality Management	
Switzerland	
IBM – Global Business Services	
Thailand	
BT Securities Co. Ltd	Zuellia Pharma Ltd
Oxford Business Consulting Co. Ltd	
United Kingdom	
BT Retail Technologies	Orian Healthcare Ltd
Department of Trade & Industry	Reading Borough Council
KBR Ltd	Shell Pensioner Liaison
Kingston Business School	University of Exeter (Biosciences)
Oakland Consulting Plc	
United States of America	
Academy of Market Intelligence	Tymphany Corporation
Tessera Technologies	

APPENDIX 4C – ANALYSES OF RESPONDENTS' PROFILES

(a) *Organisations' main activities*

Activities (Code - Q1.1)	**Frequency**	**%**
Products	28	15.5
Services	153	84.5
Total	181	100.0

(b) *Countries organisations are based*

Countries (Code - Q1.2)	**Frequency**	**%**	**Details**
Singapore	144	79.5	-
UK	12	6.6	-
European	11	6.1	Holland (3), Australia (2), Canada (1), France (1), Germany (1), N. Zealand (1), Sweden (1), Switzerland (1)
USA	5	2.8	-
Asian	9	5.0	Thailand (4), Indonesia (1), Israel (1), Myanmar (1), Vietnam (1), Kenya (1)
Total	181	100.0	-

(c) *Number of employees in organisations*

No. of employees (Code - Q1.3)	**Frequency**	**%**
<100	56	30.9
100 to 199	16	8.8
200 to 299	22	12.2
300 to 500	32	17.7
>500	55	30.4
Total	181	100.0

(d) *Age of organisations*

Age (years) (Code - Q1.4)	**Frequency**	**%**
<5	12	6.6
5 to 9	29	16.0
10 to 19	29	16.0
20 to 29	45	24.9
30 to 50	30	16.6
>50	36	19.9
Total	181	100.0

(e) *Industry sectors of organisations*

Sectors (Code - Q1.5)	**Frequency**	**%**
High technology manufacturing (Hitech)	11	6.1
Knowledge intensive business services (KIBS)	51	28.2
Creative content (CC)	5	2.8
Non- high technology manufacturing(non-Hitech)	12	6.6
Non- knowledge intensive business services (non-KIBS)	102	56.4
Total	181	100.0

(f) *Organisations – are they subsidiaries?*

A subsidiary? (Code - Q1.6)	**Frequency**	**%**
No	75	41.4
Yes	95	52.5
Public sector	11	6.1
Total	181	100.0

(g) *Management status of respondents*

Management status (Code - Q1.7)	**Frequency**	**%**
Top management	27	14.9
Middle management	103	56.9
Non-management	51	28.2
Total	181	100.0

(h) *Number of years of employment with the organisations*

Years of employment (Code - Q1.8)	**Frequency**	**%**
<3	56	30.9
3 to 9	78	43.1
10 to 19	37	20.4
20 to 29	8	4.4
30 to 40	2	1.1
Total	181	100.0

APPENDIX 5A - CODES OF RESEARCH CONSTRUCTS, FACTORS & ITEMS

Construct	Code	Factor	Code	Item	Code
Error Management Culture	EMC_ALL	Thinking	EMC_A	1. After making a mistake, people try to analyse thoroughly what caused it.	EMC_A_1
				2. In this organisation, people think a lot about how an error could have been avoided.	EMC_A_2
				3. If something went wrong, people take the time to think through how to correct it.	EMC_A_3
		No blame culture	EMC_B	4. We are concerned but there's no shame and blame when things go wrong.	EMC_B_4
				5. It is possible to admit that you're wrong without losing face.	EMC_B_5
				6. It is possible to report bad news without being blamed personally.	EMC_B_6
		Learning or taking errors as feedback	EMC_C	7. For us, errors are very useful for improving work processes as they point us at what we can improve.	EMC_C_7
				8. An error provides important information for the continuation of our work.	EMC_C_8
				9. When mastering a task, people can learn a lot from their mistakes.	EMC_C_9
		Learning by communication	EMC_D	10. When someone makes an error, (s)he shares it with others so that they do not make the same mistakes.	EMC_D-10
				11. When people are unable to correct an error by themselves, they can rely on their colleagues to continue their work.	EMC_D_11
				12. When people make an error, they can ask others for advice on how to continue.	EMC_D_12
		Competence or knowing how to recover	EMC_E	13. When an error has occurred, we usually know how to rectify it for restoration.	EMC_E_13
				14. When an error is made, it is corrected right away.	EMC_E_14
				15. Although we made mistakes, we do not let go of the final goal.	EMC_E_15
Organisational Learning	OL_ALL	Awareness	OL_F	1. When employees need specific information, they know who will have it.	OL_F_1
				2. Management monitors important organisational performance variables.	OL_F_2
				3. Management proactively addresses problems.	OL_F_3
				4. Top management integrates information from different organisational areas.	OL_F_4
				5. Employees are keenly aware of where their knowledge can serve the company.	OL_F_5
		Communication	OL_G	6. Employees use electronic means to communicate.	OL_G_6
				7. Our company provides diverse IT support (telephone, e-mail, internet, and so on) for communication amongst the employees.	OL_G_7
				8. Employees are encouraged to communicate clearly.	OL_G_8
		Performance assessment	OL_H	9. The company collects data on all facets of performance.	OL_H_9
				10. The company stores detailed information for guiding operations.	OL_H_10
				11. There is a formal data management function in the company.	OL_H_11
				12. Management encourages the use of frameworks and models to assist in decision-making.	OL_H_12
		Intellectual cultivation	OL_J	13. The company develops experts from within.	OL_J_13
				14. Management learns from the company's partners (such as customers, suppliers, allies).	OL_J_14
				15. Management assigns employees to other parts of the organisation for cross training.	OL_J_15
				16. Management learns new things about the company by direct observation.	OL_J_16
		Environmental adaptability	OL_K	17. Employees make extensive use of information systems to support their work.	OL_K_17

				18. The company makes extensive use of IT support provided for systematic electronic storage (such as of databases, data warehousing, scanned documents).	OL_K_18
				19. The company is slow to react to technological change.	OL_K_19
				20. Employees retrieve archived information when making decisions.	OL_K_20
		Social learning	OL_L	21. Employees keep information (such as numbers, plans, ideas) from other employees.	OL_L_21
				22. Our employees resist changing to new ways of doing things.	OL_L_22
				23. Employees learn about the company's recent developments through informal means (such as news, stories and gossip).	OL_L_23
		Intellectual capital management	OL_M	24. The company acquires subunits (such as organisations, functions, departments) based on short-term financial gains.	OL_M_24
				25. The company maintains a certain mix of skills among its pool of employees.	OL_M_25
				26. The company hires highly specialised or knowledgeable personnel.	OL_M_26
		Organisational grafting	OL_N	27. Management ignores the strategies of competitor's top management.	OL_N_27
				28. When internal capabilities are deficient, we acquire them from the outside.	OL_N_28
Knowledge Management	KM_ALL	Collaboration	KM_P	1. Our organisation members are satisfied with the willingness to collaborate across our organisation.	KM_P_1
				2. Our organisation members are helpful with their support.	KM_P_2
				3. There is a willingness to accept responsibility for failure.	KM_P_3
		Trust	KM_Q	4. Our company members are generally trustworthy.	KM_Q_4
				5. Our company members have reciprocal faith in other members' behaviours in working towards organisational goals.	KM_Q_5
				6. Our company members have reciprocal faith in others' ability.	KM_Q_6
				7. Our company members have reciprocal faith in others' decision toward organisational interests than individual interests.	KM_Q_7
				8. Our company members have relationships based on reciprocal faith.	KM_Q_8
		Learning	KM_R	9. Our company provides various formal training programmes for performance of duties.	KM_R_9
				10. Our company provides opportunities for informal individual development other than formal training such as work assignments and job rotation.	KM_R_10
				11. Our company encourages people to attend seminars, symposia, and so on.	KM_R_11
				12. Our company provides various programmes such as clubs and community gatherings.	KM_R_12
				13. Our company members are satisfied by the contents of job training or self-development programmes.	KM_R_13
		IT support	KM_S	14. Our company provides IT support for collaborative works regardless of time and place.	KM_S_14
				15. Our company provides IT support for searching for and accessing necessary information.	KM_S_15
				16. Our company provides IT support for simulation and prediction.	KM_S_16
		Socialisation	KM_T	17. Our company stresses gathering information from sales and production sites.	KM_T_17
				18. Our company stresses sharing experience with suppliers and customers.	KM_T_18
				19. Our company stresses engaging in dialogue with competitors.	KM_T_19
				20. Our company stresses finding new strategies and market opportunities by wandering inside the	KM_T_20

				firm.	
				21. Our company stresses creating a work environment that allows peers to understand the craftsmanship and expertise.	KM_T_21
		Externalisation	KM_U	22. Our company stresses the use of creative dialogue (e.g. with metaphors) for the exchange of ideas created.	KM_U_22
				23. Our company stresses the use of deductive and inductive thinking.	KM_U_23
				24. Our company stresses subjective opinions.	KM_U_24
		Combination	KM_V	25. Our company stresses planning strategies by using published literature, computer stimulation and forecasting.	KM_V_25
				26. Creating manuals and documents on products and services.	KM_V_26
				27. Our company stresses building databases on products and services.	K_V_27
				28. Our company stresses building up materials by gathering management figures and technical information.	KM_V_28
				29. Our company stresses transmitting newly created concepts.	KM_V_29
		Internalisation	KM_W	30. Our company stresses enactive liaisoning activities with functional departments by cross-functional development teams.	KM_W_30
				31. Our company stresses forming teams as a model and conducting experiments, and sharing results with entire departments.	KM_W_31
				32. Our company stresses searching and sharing new values and thoughts.	KM_W_32
				33. Our company stresses sharing and trying to understand management visions through communication with fellow colleagues	KM_W_33
Innovation Effectiveness	IE_ALL	Organisational inventiveness	IE_X	1. Our company has produced many novel and useful ideas (services/products).	IE_X_1
				2. Our company fosters an environment that is conducive to our own ability to produce novel and useful ideas.	IE_X_2
				3. Our company spends much time for producing novel and useful ideas.	IE_X_3
				4. Our company considers producing novel and useful ideas as important activities.	IE_X_4
				5. Our company actively produces novel and useful ideas.	IE_X_5
		Organisational performance	IE_Y	6. Compared with key competitors, our company is more successful.	IE_Y_6
				7. Compared with key competitors, our company has a greater market share.	IE_Y_7
				8.Compared with key competitors, our company is growing faster.	IE_Y_8
				9. Compared with key competitors, our company is more profitable.	IE_Y_9
				10. Compared with key competitors, our company is more innovative.	IE_Y_10

APPENDIX 5B - DESCRIPTIVE ANALYSIS RESULTS

Item code	N	Mean	Std. Dev.	Skewness	Kurtosis
EMC_A_1	181	5.16	1.379	-.934	.566
EMC_A_2	178	4.84	1.506	-.551	-.469
EMC_A_3	181	5.17	1.331	-.722	.205
EMC_B_4	178	4.65	1.638	-.478	-.573
EMC_B_5	177	4.60	1.666	-.502	-.530
EMC_B_6	174	4.71	1.612	-.612	-.288
EMC_C_7	179	5.09	1.555	-.785	.116
EMC_C_8	179	5.11	1.461	-.732	.218
EMC_C_9	179	5.53	1.251	-1.054	1.198
EMC_D-10	180	4.62	1.617	-.555	-.467
EMC_D_11	173	4.54	1.612	-.380	-.570
EMC_D_12	179	5.26	1.308	-.848	.712
EMC_E_13	179	4.98	1.265	-.574	.066
EMC_E_14	180	4.87	1.376	-.447	-.355
EMC_E_15	178	5.63	1.252	-1.223	1.794
OL_F_1	181	5.04	1.374	-.574	-.342
OL_F_2	169	5.44	1.326	-1.096	1.308
OL_F_3	175	5.01	1.470	-.767	.080
OL_F_4	166	5.02	1.384	-.724	.232
OL_F_5	176	4.74	1.398	-.552	-.227
OL_G_6	176	5.83	1.207	-1.423	2.312
OL_G_7	177	6.02	1.042	-1.224	1.518
OL_G_8	179	5.78	1.129	-1.111	1.618
OL_H_9	167	5.07	1.354	-.696	.157
OL_H_10	170	4.97	1.403	-.675	-.047
OL_H_11	164	4.98	1.529	-.678	-.213
OL_H_12	162	4.74	1.578	-.456	-.475
OL_J_13	174	4.92	1.488	-.692	.207
OL_J_14	166	4.93	1.512	-.781	-.039
OL_J_15	170	4.46	1.734	-.271	-1.018
OL_J_16	158	4.76	1.499	-.431	-.576
OL_K_17	176	5.14	1.380	-.733	-.149
OL_K_18	165	5.25	1.524	-.794	-.107
rOL_K_19*	177	4.64	1.593	-.305	-.804
OL_K_20	166	4.49	1.504	-.322	-.593
rOL_L_21*	165	4.36	1.542	-.416	-.598
rOL_L_22*	177	4.46	1.588	-.146	-.963
rOL_L_23*	174	4.03	1.637	.064	-1.026
rOL_M_24*	109	4.66	1.657	-.388	-.818
OL_M_25	172	5.02	1.304	-.752	.483
OL_M_26	170	5.01	1.269	-.761	.629
rOL_N_27*	134	4.63	1.707	-.478	-.766
OL_N_28	169	5.27	1.303	-1.128	1.454
* These negatively worded items are SPSS recoded.					
KM_P_1	167	4.87	1.341	-.815	.430
KM_P_2	177	5.10	1.271	-.832	.478

KM_P_3	176	4.47	1.515	-.448	-.572
KM_Q_4	181	5.49	1.133	-.926	1.819
KM_Q_5	175	5.12	1.297	-.834	.408
KM_Q_6	175	5.11	1.263	-.685	.298
KM_Q_7	170	4.83	1.368	-.628	.057
KM_Q_8	169	4.99	1.309	-.638	.272
KM_R_9	177	5.23	1.441	-.805	.052
KM_R_10	177	4.98	1.367	-.590	-.106
KM_R_11	172	5.09	1.544	-.755	-.276
KM_R_12	169	4.49	1.622	-.424	-.669
KM_R_13	162	4.70	1.365	-.401	-.095
KM_S_14	154	5.00	1.428	-.559	-.137
KM_S_15	162	5.06	1.315	-.435	-.426
KM_S_16	141	4.38	1.588	-.215	-.931
KM_T_17	135	4.93	1.494	-.716	-.019
KM_T_18	155	4.68	1.468	-.349	-.659
KM_T_19	140	3.74	1.652	.043	-.917
KM_T_20	140	4.12	1.548	-.324	-.676
KM_T_21	168	4.64	1.373	-.473	-.275
KM_U_22	158	4.39	1.513	-.254	-.568
KM_U_23	157	4.66	1.361	-.433	.084
KM_U_24	164	4.45	1.380	-.473	-.089
KM_V_25	151	4.60	1.479	-.529	-.372
KM_V_26	164	4.95	1.405	-.786	.078
KM_V_27	162	4.84	1.328	-.507	-.263
KM_V_28	159	4.79	1.434	-.662	-.022
KM_V_29	155	4.62	1.415	-.608	-.280
KM_W_30	155	4.70	1.364	-.366	-.263
KM_W_31	150	4.42	1.577	-.408	-.581
KM_W_32	169	4.79	1.513	-.677	-.136
KM_W_33	173	4.83	1.500	-.694	-.127
IE_X_1	167	5.01	1.533	-.864	.469
IE_X_2	167	4.73	1.542	-.466	-.362
IE_X_3	162	4.44	1.638	-.379	-.538
IE_X_4	164	5.03	1.425	-.673	.144
IE_X_5	164	4.68	1.558	-.543	-.314
IE_Y_6	161	4.94	1.400	-.567	.018
IE_Y_7	152	4.69	1.497	-.357	-.399
IE_Y_8	150	4.61	1.553	-.247	-.598
IE_Y_9	139	4.60	1.443	-.586	.129
IE_Y_10	153	4.67	1.551	-.468	-.199

APPENDIX 6A – OUTCOMES OF THE 18-COMPONENT FACTOR ANALYSIS

Rotated Component Matrix (a)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
KM_Q_6	.858																	
KM_Q_5	.829																	
KM_Q_8	.787																	
KM_Q_7	.785																	
KM_P_2	.746																	
KM_P_1	.690																	
KM_Q_4	.672																	
KM_P_3	.665																	
OL_F_5	.481																	
EMC_E_13	.426						.404											
KM_R_13																		
KM_V_26		.842																
KM_V_27		.797																
KM_V_28		.752																
KM_V_29		.664																
KM_U_23	.431	.592																
KM_V_25		.588																
KM_W_33	.418	.538																
KM_W_30		.535																
KM_U_22		.515																
KM_S_16		.513		.429														
KM_W_32	.404	.499	.424															
KM_T_21		.472	.403															
KM_W_31		.463												.426				
KM_R_11		.440																
OL_H_12																		
OL_F_4			.602															
OL_J_16			.573															
OL_F_3	.498		.557															
OL_H_9			.544															
KM_T_17			.530															
OL_F_1	.483		.506															
OL_J_14			.490															
OL_M_25			.449						.419									
KM_R_10																		
KM_S_15				.713														
KM_S_14				.704														
OL_K_18				.672														
OL_H_11				.565														
OL_H_10			.487	.530														
OL_K_17				.475														
OL_F_2				.460														
EMC_C_7					.860													
EMC_C_8					.859													
EMC_C_9					.670						.451							
EMC_A_1			.401		.426													
EMC_D_10					.410													
OL_K_20						.736												
KM_T_19						.703												
KM_T_20		.402				.653												
OL_J_13						.493												
OL_J_15						.406			.402									
EMC_E_14						.405												
EMC_B_5							.860											
EMC_B_6							.713											
EMC_B_4	.464						.537											
EMC_E_15					.414		.439											
OL_G_6								.834										
OL_G_7								.773										
KM_R_12									.707									
KM_T_18									.629									
KM_R_9									.405									
OL_M_26										.798								
OL_N_28										.721								
EMC_D_11											.716							

EMC_D_12											.706							
rOL_N_27												.837						
rOL_M_24												.580						
rOL_L_23	.416											.490						
KM_U_24													.826					
EMC_A_3	.405				.445									.548				
EMC_A_2					.409									.487				
rOL_L_21															.876			
rOL_L_22																.760		
rOL_K_19																	.791	
OL_G_8		.403																.620

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
(a) Rotation converged in 30 iterations.

APPENDIX 6B - NINE FACTOR ANALYSIS ASSUMPTIVE INDICATORS

The nine indicators are verified step-wise as per their implications in Table N.1.

Table N.1 Evaluation and acceptability of factor analysis assumptive indicators

Indicator	Implication of the indicator
1. Item correlations	If a substantial number of correlations is lower than 0.30, factor analysis is probably inappropriate (Hair *et al*, 2006:114).
2. Significance of factor correlations	If statistical significance is absent, it would not be worthwhile to go on to conduct a factor analysis (Bryman and Duncan, 2001:263)
3. Kaiser-Meyer-Olkin measure of sampling adequacy of construct (KMO)	This measure provides some insight of how relevant factor analysis is for the data collected. The greater the KMO, the more effective the factor analysis is likely to be. The minimum acceptable KMO value is 0.5 (Remenyi *et al*, 2000:223).
4. Bartlett test of sphericity	It is a test for the overall significance of all correlations within a correlation matrix (Hair *et al*, 2006:102). A statistically significant Bartlett test (sig. > .05) indicates sufficient correlations exist among the variables (Hair *et al*, 2006:115).
5. Anti-image correlation	It is a reflection on partial correlation. A partial correlation is the correlation that is unexplained when the effects of other items are considered. For 'true' factors, the partial correlation should be small (Hair *et al*, 2006:114).
6. Measure of sampling adequacy (MSA) of items	The significance of MSA, as the diagonal values of the anti-image correlation matrix, can be assessed thus (Hair *et al*, 2006:114) - ≥0.8 (meritorious), ≥0.7 (middling), ≥0.6 (mediocre), ≥0.5 (miserable) and <0.5 (unacceptable).
7. Communality	An item's communality is the estimate of its common variance among the items in the extracted factors. There is no statistical guideline on what communality levels are acceptable, but Hair *et al* have adopted a lower level of 0.5 for communality based on practical considerations (2006:149).
8. Total variance explained	It is ≥ 60% of the total variance extracted
9. Scree plot	The results from a scree plot must be consistent with the rotated component matrix.

Each of the indicators in Table N.1 is looked into singularly in the following sections per the order they appear in the table. For indicators 1 to 7, the verification is on items from single independent constructs; but for the last two indicators, the verification has these three constructs considered together.

(a) *Item correlations and their significance*

The correlation frequency of the construct items are in Table N.2 with their significance levels included.

Table N.2 Frequency of item correlations and significance level

Items from … (no.)	Total no. of correlations	No. of correlations >0.3	% of correlations >0.3	No. with significance …		
				0.01	0.05	>0.05
EMC (15)	105	102	97.1	105	-	-
OL (28)	388	212	54.6	273	31	84
KM (33)	528	504	95.5	523	5	-
IE (10)	45	45	100	45	-	-

The items from EMC, KM and IE have high numbers and percentages of correlations >0.3 within each construct. More than 99% of the correlations are significant at the 0.01 level.

However, OL ranks last at the fourth position with only 54.6% of its item correlations >0.3. There are many correlations <0.3 linked to the negatively worded OL items. From its relatively poor correlations, OL appears to be the weakest amongst the three independent constructs.

(b) *Kaiser-Meyer-Olkin and Barlett test outcomes*

In Table N.3 are the KMO and Barlett outcomes of the constructs' final factor analysis solutions.

Table N.3 KMO and Bartlett test results of final factor analysis solution

Construct	KMO	Bartlett test of sphericity		
		Chi-Square	df	Significance
EMC	.896	1538.304	105	.000
OL	.843	1727.191	378	.000

KM	.892	2826.021	528	.000
IE	.902	1164.918	45	.000

All the KMO results are higher than the minimum value of 0.5. As for the Bartlett sphericity test, all the correlations of the items are significant at the .000 level. Thus the data from the survey items are relevant for factor analysis.

(c) *Anti-image partial correlations*

In Table N.4 are the anti-image correlation values of the constructs per their factor solutions.

Table N.4 Anti-image correlation spread of final factor analysis solution

Constructs	Total no. AIC	Frequency per range of anti-image correlations (AIC)				% of AIC <0.3
		≥0, <0.2	≥0.2, <0.3	≥0.3, <0.5	≥0.5	
EMC	105	91	7	6	1	93.3
OL	388	307	49	28	4	91.8
KM	528	387	96	39	6	83.0
IE	45	34	9	1	1	95.6

From the above table, a majority of the correlations are close to the value of zero. At least 83% of the anti-image correlations are <0.3. Thus there this little correlation that is not explained.

(d) *Measure of sampling adequacy (MSA)*

This measure is interpreted with some categorical guidelines from Hair *et al* (2006:114). The MSA outcomes from the factor analyses, considered together with the guidelines, are in Table N.5.

Table N.5 Measure of sampling adequacy spread of each construct

Construct (no. of items)	Frequency per range of MSA and interpretation				
	<0.5	≥0.5, <0.6	≥0.6, <0.7	≥7, <0.8	≥0.8
	Unacceptable	Miserable	Mediocre	Middling	Meritorious
EMC (15)	-	-	-	-	15
OL (28)	-	2	4	2	20
KM (33)	-	-	-	-	33
IE (10)	-	-	-	-	10

From Table N.5, the MSA results are all 'meritorious' for EMC, KM and IE. It appears that the OL items pale in comparison with their spread from 'mediocre' to 'meritorious' although they are acceptable.

(e) *Communality*

In Appendix N.1 are the communalities of all the 86 items from the four factor analysed constructs. From this appendix, the spread of the communalities per each construct is found in Table N.6.

Table N.6 Communality spread of each construct

Construct	No. of items	Frequency per range of communality			
		≥0.5, <0.6	≥0.6, <0.7	≥0.7, <0.8	≥0.8
EMC	15	2	2	8	3
OL	28	4	7	12	5
KM	33	3	5	16	9
IE	10	-	-	4	6

All the constructs in Table N.6 have their communalities in order as they are >0.50; this threshold is a guideline from Hair *et al* based on practical considerations.

(f) *Total variance explained*

With eigenvalues that are just greater than 1, the total variance of the three independent constructs after their '18-components' factor analysis is 83.0% as shown in Table N.7. Also found in the table is the total variance for IE at 81.6%

Table N.7 Eigenvalues and total variance of the four constructs after factor analysis

Construct	No. of components	Eigenvalues	Total variance %
EMC, OL & KM	15	1.107	83.0
IE	2	1.821	81.6

Their cumulative percentages in Table N.7 are in acceptable order as they are above the satisfactory level of 60% variance for social sciences.

(g) *Scree plots*

A scree plot is a graph drawn of "the descending variance accounted for by the factors initially extracted" (Bryman and Cramer, 2001:266). The factors to be retained are those which lie at the point where the eigenvalue is approaching the latent root criterion of more than 1.

In Figure N.1 and N.2 are found the SPSS scree plots from the factor analyses of EMC, OL & KM and IE respectively.

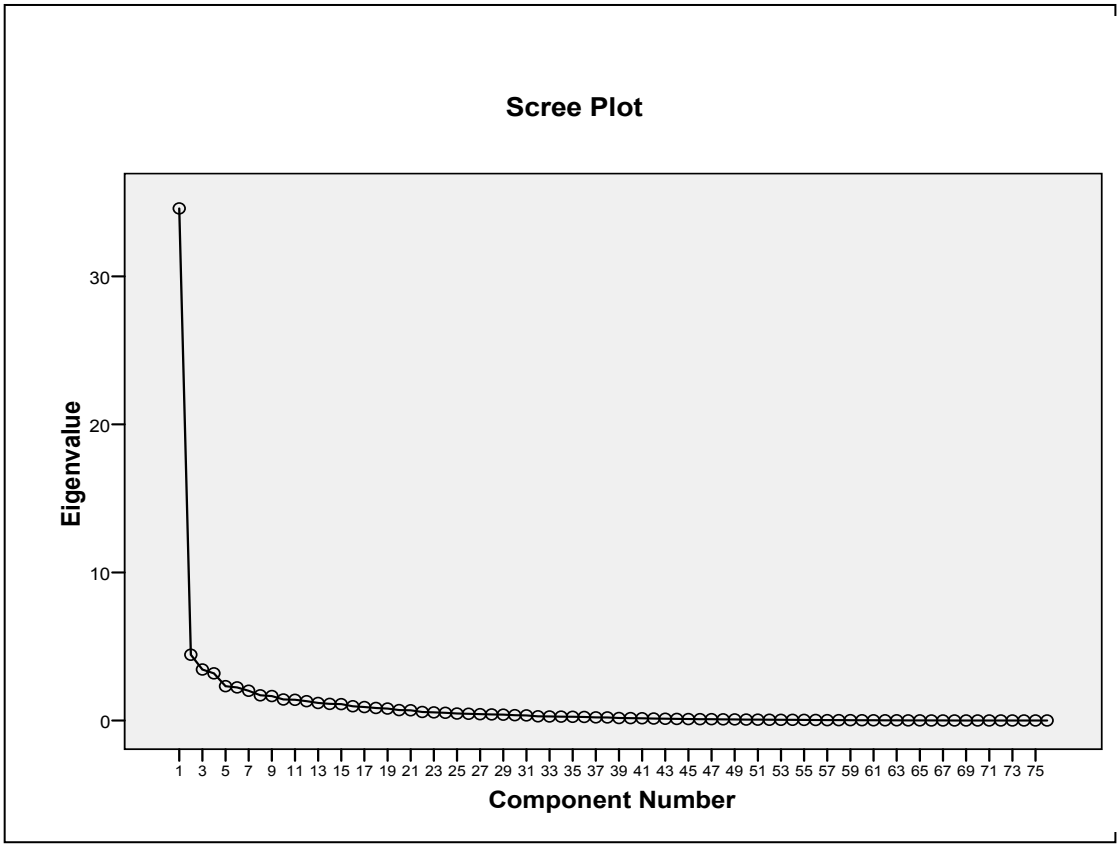

Figure N.1 Factor analysis scree plot of EMC, OL and KM

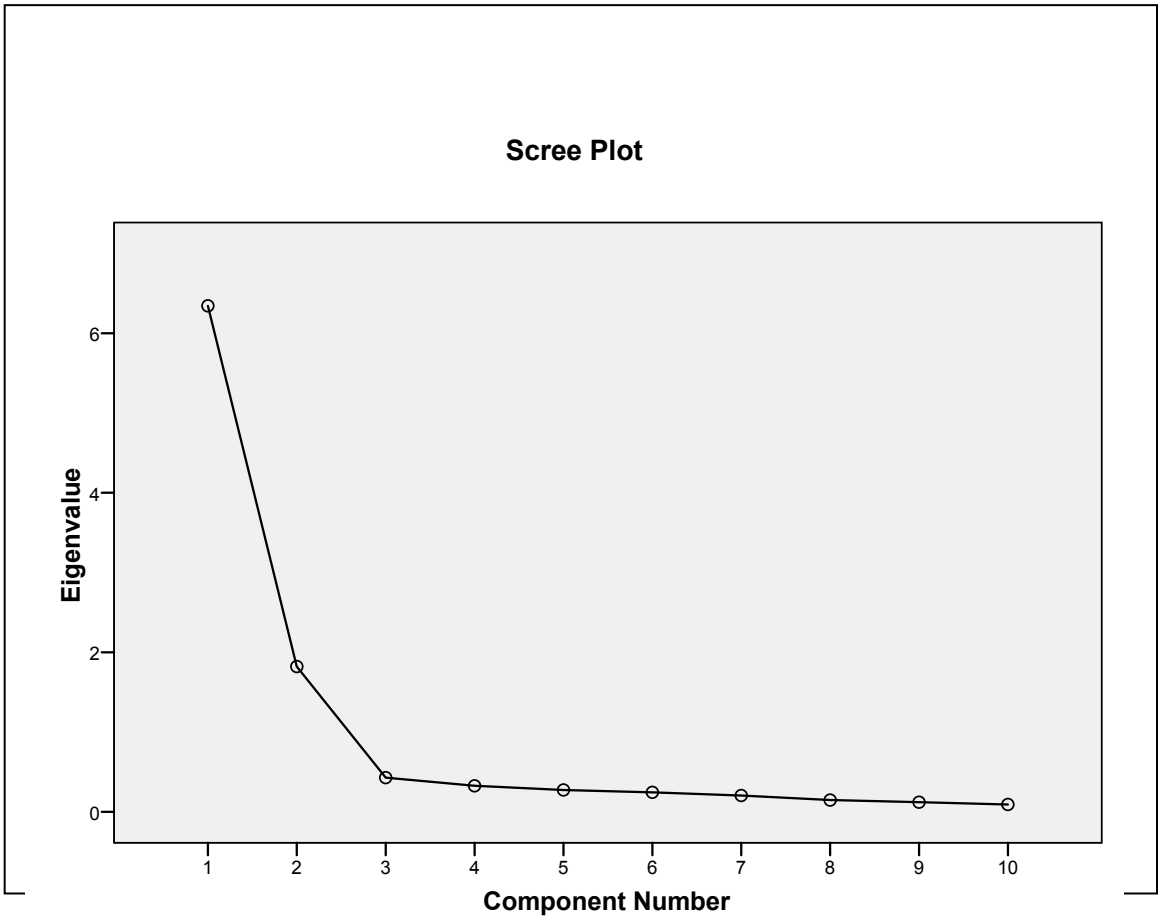

Figure N.2 Factor analysis scree plot of IE

From the scree plots, the expected number of factors to be extracted appears at the point when a plot shows a break between the steep slope of the initial factors and the more flat slope of subsequent factors. It is at this point that the eigenvalue is approaching the value of 1. These expected numbers compare well with the components associated with the total variance output of Table N.7.

APPENDIX N.1 COMMUNALITIES OF THE FACTOR ANALYSED ITEMS

Item	Extraction		Item	Extraction
EMC_A_1	.729		KM_P_1	.718
EMC_A_2	.727		KM_P_2	.804
EMC_A_3	.731		KM_P_3	.727
EMC_B_4	.751		KM_Q_4	.778
EMC_B_5	.845		KM_Q_5	.865
EMC_B_6	.737		KM_Q_6	.822
EMC_C_7	.837		KM_Q_7	.807
EMC_C_8	.896		KM_Q_8	.775
EMC_C_9	.783		KM_R_9	.688
EMC_D_10	.575		KM_R_10	.528
EMC_D_11	.772		KM_R_11	.659
EMC_D_12	.784		KM_R_12	.754
EMC_E_13	.529		KM_R_13	.603
EMC_E_14	.624		KM_S_14	.741
EMC_E_15	.640		KM_S_15	.787
			KM_S_16	.735
OL_F_1	.649		KM_T_17	.583
OL_F_2	.808		KM_T_18	.757
OL_F_3	.863		KM_T_19	.789
OL_F_4	.695		KM_T_20	.765
OL_F_5	.793		KM_T_21	.778
OL_G_6	.804		KM_U_22	.689
OL_G_7	.834		KM_U_23	.800
OL_G_8	.580		KM_U_24	.518
OL_H_9	.790		KM_V_25	.656
OL_H_10	.820		KM_V_26	.765
OL_H_11	.785		KM_V_27	.735
OL_H_12	.732		KM_V_28	.842
OL_J_13	.757		KM_V_29	.803
OL_J_14	.720		KM_W_30	.720
OL_J_15	.740		KM_W_31	.708
OL_J_16	.762		KM_W_32	.800
OL_K_17	.753		KM_W_33	.821
OL_K_18	.601			
rOL_K_19	.730		IE_X_1	.791
OL_K_20	.572		IE_X_2	.833
rOL_L_21	.750		IE_X_3	.873
rOL_L_22	.559		IE_X_4	.749
rOL_L_23	.666		IE_X_5	.879
rOL_M_24	.692		IE_Y_6	.876
OL_M_25	.637		IE_Y_7	.831
OL_M_26	.703		IE_Y_8	.762
rOL_N_27	.620		IE_Y_9	.812
OL_N_28	.528		IE_Y_10	.760

(Extraction method: Principal Component Analysis)

APPENDIX 6C – REVISED RESEARCH CONSTRUCTS, FACTORS & ITEMS

Construct	Code	Factor code	Item	Code
Error Management Culture	EMC_ALL	EMC_C1	7. For us, errors are very useful …	EMC_C_7
			8. An error provides important information …	EMC_C_8
			9. When mastering a task, people can …	EMC_C_9
		EMC_C2	4. We are concerned but there's no shame …	EMC_B_4
			5. It is possible to admit that you're wrong …	EMC_B_5
			6. It is possible to report bad news without …	EMC_B_6
			15. Although we made mistakes, …	EMC_E_15
		EMC_C3	11. When people are unable to correct …	EMC_D_11
			12. When people make an error, they can …	EMC_D_12
		EMC_C4	2. In this organisation, people think a lot …	EMC_A_2
			3. If something went wrong, people take …	EMC_A_3
Organisational Learning	OL_ALL	OL_C1	1. When employees need specific …	OL_F_1
			14. Management learns from the company's …	OL_J_14
			16. Management learns new things about …	OL_J_16
			25. The company maintains a certain mix of …	OL_M_25
		OL_C2	3. Management proactively addresses …	OL_F_3
			4. Top management integrates information …	OL_F_4
			9. The company collects data on all facets …	OL_H_9
		OL_C3	6. Employees use electronic means to …	OL_G_6
			7. Our company provides diverse IT support …	OL_G_7
		OL_C4	2. Management monitors important …	OL_F_2
			10. The company stores detailed information ...	OL_H_10
			11. There is a formal data management …	OL_H_11
		OL_C5	13. The company develops experts from …	OL_J_13
			15. Management assigns employees to …	OL_J_15
			20. Employees retrieve archived information …	OL_K_20
		OL_C6	23. Employees learn about the …	rOL_L_23
			24. The company acquires …	rOL_M_24
			27. Management ignores the strategies of …	rOL_N_27
Knowledge Management	KM_ALL	KM_C1	4. Our company members are generally …	KM_Q_4
			5. Our company members have reciprocal faith in … working towards organisational goals.	KM_Q_5
			6. Our company members have reciprocal faith in others' ability.	KM_Q_6
			7. Our company members have reciprocal faith in others' decision toward organisational …	KM_Q_7
			8. Our company members have relationships ...	KM_Q_8
		KM_C2	29. Our company stresses transmitting …	KM_V_29
			30. Our company stresses enactive …	KM_W_30
			31. Our company stresses forming teams …	KM_W_31
			32. Our company stresses searching and …	K,_W_32
			33. Our company stresses sharing and …	KM_W_33
		KM_C3	26. Our company stresses creating manuals …	KM_V_26
			27. Our company stresses building …	KM_V_27
			28. Our company stresses building up …	KM_V_28

		KM_C4	17. Employees make extensive use of …	OL_K_17
			18. The company makes extensive use of IT …	OL_K_18
			14. Our company provides IT support for collaborative …	KM_S_14
			15. Our company provides IT support for searching …	KM_S_15
		KM_C5	1. Our organisation members are satisfied …	KM_P_1
			2. Our organisation members are helpful …	KM_P_2
			3. There is a willingness to accept …	KM_P_3
		KM_C6	16. Our company provides IT support for simulation …	KM_S_16
			23. Our company stresses the use of deductive and …	KM_U_23
			25. Our company stresses planning strategies by using …	KM_V_25
		KM_C7	21. Our company stresses creating a work …	KM_T_21
			22. Our company stresses the use of …	KM_U_22
		KM_C8	9. Our company provides various formal training ...	KM_R_9
			12. Our company provides various programmes …	KM_R_12
			18. Our company stresses sharing …	KM_T_18
		KM_C9	19. Our company stresses engaging in …	KM_T_19
			20. Our company stresses finding new ...	KM_T_20
Innovation Effectiveness	IE_ALL	IE_C1	1. Our company has produced many novel …	IE_X_1
			2. Our company fosters an environment that …	IE_X_2
			3. Our company spends much time for ...	IE_X_3
			4. Our company considers producing novel …	IE_X_4
			5. Our company actively produces novel and ...	IE_X_5
		IE_C2	6. Compared with key competitors, our company is more successful.	IE_Y_6
			7. Compared with key competitors, our company has a greater market share.	IE_Y_7
			8. Compared with key competitors, our company is growing faster.	IE_Y_8
			9. Compared with key competitors, our company is more profitable.	IE_Y_9

APPENDIX 6D – FACTOR ANALYSIS OUTCOMES

(a) Independent factors

Factor code	Loading	Item
KM_C1	.876	5. Our company members have reciprocal faith in other members' behaviours in working towards organisational goals.
	.816	4. Our company members are generally trustworthy.
	.809	6. Our company members have reciprocal faith in others' ability.
	.777	8. Our company members have relationships based on reciprocal faith.
	.743	7. Our company members have reciprocal faith in others' decision toward organisational interests than individual interests.
KM_C5	.736	1. Our organisation members are satisfied with the willingness to collaborate across our organisation.
	.731	3. There is a willingness to accept responsibility for failure.
	.671	2. Our organisation members are helpful with their support.
KM_C2	.803	32. Our company stresses searching and sharing new values and thoughts.
	.770	33. Our company stresses sharing and trying to understand management visions through communication with fellow colleagues
	.769	31. Our company stresses forming teams as a model and conducting experiments, and sharing results with entire departments.
	.736	30. Our company stresses enactive liaisoning activities with functional departments by cross-functional development teams.
	.643	29. Our company stresses transmitting newly created concepts.
KM_C3	.812	26. Our company stresses creating manuals and documents on products and services.
	.736	27. Our company stresses building databases on products and services.
	.724	28. Our company stresses building up materials by gathering management figures and technical information.
KM_C7	.775	22. Our company stresses the use of creative dialogue (e.g. with metaphors) for the exchange of ideas created.
	.666	21. Our company stresses creating a work environment that allows peers to understand the craftsmanship and expertise.
KM_C6	.509	23. Our company stresses the use of deductive and inductive thinking.
	.804	25. Our company stresses planning strategies by using published literature, computer stimulation and forecasting.
	.725	16. Our company provides IT support for simulation and prediction.
OL_C1	.812	1. When employees need specific information, they know who will have it.
	.758	16. Management learns new things about the company by direct observation.
	.612	25. The company maintains a certain mix of skills among its pool of employees.
	.610	14. Management learns from the company's partners (such as customers, suppliers, allies).
OL_C2	.846	9. The company collects data on all facets of performance.

	.701	3. Management proactively addresses problems.
	.620	4. Top management integrates information from different organisational areas.
KM-C4	.837	18. The company makes extensive use of IT support provided for systematic electronic storage (such as of databases, data warehousing, scanned documents).
	.831	15. Our company provides IT support for searching for and accessing necessary information.
	.826	14. Our company provides IT support for collaborative works regardless of time and place.
	.726	17. Employees make extensive use of information systems to support their work.
OL_C4	.853	2. Management monitors important organisational performance variables.
	.852	10. The company stores detailed information for guiding operations.
	.647	11. There is a formal data management function in the company.
EMC_C1	.860	7. For us, errors are very useful for improving work processes as they point us at what we can improve.
	.859	8. An error provides important information for the continuation of our work.
	.670	9. When mastering a task, people can learn a lot from their mistakes.
OL_C5	.833	13. The company develops experts from within.
	.830	15. Management assigns employees to other parts of the organisation for cross training.
	.630	20. Employees retrieve archived information when making decisions.
KM_C9	.862	19. Our company stresses engaging in dialogue with competitors.
	.831	20. Our company stresses finding new strategies and market opportunities by wandering inside the firm.
EMC_C2	.860	5. It is possible to admit that you're wrong without losing face.
	.713	6. It is possible to report bad news without being blamed personally.
	.537	4. We are concerned but there's no shame and blame when things go wrong.
	.439	15. Although we made mistakes, we do not let go of the final goal.
OL_C3	.834	6. Employees use electronic means to communicate.
	.773	7. Our company provides diverse IT support (telephone, e-mail, internet, and so on) for communication amongst the employees.
KM_C8	.707	12. Our company provides various programmes such as clubs and community gatherings.
	.629	18. Our company stresses sharing experience with suppliers and customers.
	.405	9. Our company provides various formal training programmes for performance of duties.
KM_C10	.798	26. The company hires highly specialised or knowledgeable personnel.
	.721	28. When internal capabilities are deficient, we acquire them from the outside.
EMC_C3	.716	11. When people are unable to correct an error by themselves, they can rely on their colleagues to continue their work.

	.706	12. When people make an error, they can ask others for advice on how to continue.
OL_C6	.837	27. Management ignores the strategies of competitor's top management.
	.580	24. The company acquires subunits (such as organisations, functions, departments) based on short-term financial gains.
	.490	23. Employees learn about the company's recent developments through informal means (such as news, stories and gossip).
EMC_C4	.548	3. If something went wrong, people take the time to think through how to correct it.
	.487	2. In this organisation, people think a lot about how an error could have been avoided.

(b) Dependent factors

Component	Loading	Item
IE_C1	.857	Our company has produced many novel and useful ideas (services/products).
	.887	Our company fosters an environment that is conducive to our own ability to produce novel and useful ideas.
	.913	Our company spends much time for producing novel and useful ideas.
	.843	Our company considers producing novel and useful ideas as important activities.
	.886	Our company actively produces novel and useful ideas.
IE_C2	.902	Compared with key competitors, our company is more successful.
	.886	Compared with key competitors, our company has a greater market share.
	.813	Compared with key competitors, our company is growing faster.
	.882	Compared with key competitors, our company is more profitable.

APPENDIX 8A – TERMINOLOGIES PER CRITICAL REALIST DISCUSSIONS

Terminologies	Deliberations
Empiricism	It states to the effect that our knowledge are derived from or justified in terms of *sense-experience* (Remenyi *et al*, 2000:282). Generally it is characteristic of positivism. It is also the basis for phenomenological research which relies on the observation of evidence.
Idealism	It holds the view that the world (reality and real objects) does not exist independently of minds" (Schwandt, 2001:121). It stands in opposition to both realism and strict empiricism (ibid.).
Logical positivism	It emphasises the use of logic (Remenyi *et al*, 2000:284) and it rests on the notion that there are only two legitimate forms of scientific inquiry that yield genuine knowledge: logical analysis and empirical research (Schwandt, 2001:151).
Modernism	It is described as having elevated faith in reason (Ackroyd and Fleetwood, 2000:4). The world is seen as a system which becomes increasingly under human control as our knowledge of it increases" (ibid.). The common term for this kind of belief are positivism, empiricism and science" (ibid.).
Phenomenology	It is a view that advocates the study of direct experience taken at face value; and one which sees behaviour as determined by the phenomena of experience rather than by external, objective and physically described reality" (Remenyi *et al*, 2000:286).
Positivism	It was expresses the idea that phenomena are real, certain, and precise (Remenyi *et al*, 2000:287). All knowledge consists in the description and coexistence and succession of such phenomena" (ibid.). It is a theory of the nature, omnicompetence and unity of science as understood in the physical world. It is used generally to designate any approach that applies scientific method to the study of human action.
Post-modernism	To the postmodernists, modernism is a form of intellectual imperialism which ignores the fundamental uncontrollability of meaning (Ackroyd and Fleetwood, 2000:4). To them what is supposedly 'out there' is constructed by our discursive constructions of it. These conceptions are collectively sustained and continually re-negotiated in the process of making sense. The role of language in constituting reality is therefore central, and our attempts to discover truth should be seen for what they are – forms of discourse.
Post-structuralism	It is anti-metaphysical and anti-humanist, and it accepts the fact that language plays a central role in the constitution of subjectivity and social reality (Schwandt, 2001:203). Whereas structuralism was informed by the constructive scientific vision of identifying both social and linguistic order, post-structuralism is resolutely deconstructive in intent;
Realism	It defines the world as a real structure that exist independently of our experience with it, our knowledge of it, and the conditions that allow us access to it (Schwandt, 2001:121). It asserts that many entities exist independently of us and our investigations of them (Ackroyd and Fleetwood, 2000:5-6). Many of these entities are disputed and not directly observable (and hence refractory to quantification). But this does not rule them out of consideration for analysis. Such a position distances realist- from empiricist- or positivist-oriented analysis; That these disputed entities exist independently of our investigations of them distances realism from postmodernism.

Relativism	It denies that there are universal truths" (Schwandt, 2001:225). It holds that knowledge is relative to the limited nature of the mind and the conditions of knowing" (Remenyi *et a*l, 2000:288).
Scientism	It takes the view that the methods found successful in the leading areas of science should be applied to positivist-oriented enquiries (Ackroyd, 2004:141). Because the leading sciences proceed in particular ways, and use particular methods, all branches of science must do the same or approximate these methods the best they can. Scientism is defined as "loosely referring to the employment of methods and techniques allegedly similar to (some aspects of) natural science, without actually specifying what these methods and techniques are and why they are appropriate to social science" " (Fleetwood and Hesketh. 2010:306).
Social constructionism	It believes reality is determined by people rather than by objective and external factors (Easterby-Smith *et al*, 2002:30). It tries to understand and explain why people have different experiences, rather than search for external causes and fundamental rules to explain their behaviours. There are weak and strong versions of social constructivism (Schwandt, 2001:32-33). Weak social constructivism "does not deny reality in the ordinary commonplace sense of that term" (ibid.). Strong social constructivists "do appear to deny any ontology of the real whatsoever" (ibid.).

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