The Effects of Higher-Order Thinking Dispositions, Job-Related Learning and Creativity on Innovation Behaviour

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Doctor of Philosophy in Management

December 2015
Statement of Originality

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Mark Loon
December 2015
Acknowledgements and Dedications

I would like to thank my wife Jo Bridge for all her support and understanding. In addition, I am grateful for my supervisor, Dr Gian Casimir’s help and support. He went well above the call of duty. It is his contributions that have given this study its merits, all limitations are mine alone. I would like to thank my father, Loon Weng Cheun, sisters, Thirza and Inez Loon, brother-in-law, Derrick Yeoh, and nieces Madison and Alexandra Yeoh. This dissertation is in my memory of late mother Dorothy Loon.
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ABSTRACT

Innovation is crucial for all organisations to thrive and survive. Its importance is well recognised in both practice and in academia. Innovation-based initiatives such as research and development, and design constitute the core competencies of many contemporary organisations. In the domain of academia, innovation is well researched in relation to what constitutes innovation and the different forms that innovations take. Innovation is also well researched from many perspectives such as processes and systems, leadership and group dynamics, and at different levels (e.g. organisational, group and individual).

Whilst there is a substantial amount of literature on innovation at the individual level, such as motivation and skills, there are still paucities at the intrapersonal level, specifically higher-order thinking dispositions. The role of cognition and intellect in innovation are generally well established however the subject matter of dispositions such as higher-order thinking and their relationship with innovation remains an area that may provide opportunities to gain further insight into factors that contribute to innovation. In addition, there is a growing recognition and acceptance from scholars that an evaluation of the ‘whole-person’ (e.g. cognitive and dispositional factors) provides for a better explanation of behaviours and potentially organisational outcomes.

From a practitioner perspective, higher-order thinking dispositions are crucial because they help to predict typical performance rather than maximal performance. Typical performance is crucial in organisation as ideas for innovation can occur at any time and involve multiple stages (e.g., conception, prototyping, and implementation). Individuals with higher-order thinking dispositions are arguably predisposed to conceive, recognise, act upon and further develop new ideas. Innovation behaviour, in turn, facilitates organisational performance, competitiveness, and enables organisations to not only adapt to change but also potentially shape change.

This longitudinal study involved 202 participants. The hypotheses and an overall model based on the hypotheses were tested using partial least squares analysis. The major findings are as follows: i) the relationship between each of the five higher-order thinking dispositions and creativity is partially mediated by job-related learning; ii) the relationship between job-related learning and innovation is partially mediated by creativity; iii) when the five higher-order thinking dispositions are used concurrently to predict job-related learning, multiple perspective-taking is the only significant predictor; iv) when the five higher-order thinking dispositions and job-related learning are used concurrently to predict creativity, job-related learning is the strongest predictor whilst systems thinking and multiple perspective-taking are also significant predictors; and v) when the five higher-order thinking dispositions, job-related learning and creativity are used concurrently to predict innovation, creativity is the strongest predictor whilst job-related learning and multiple perspective-taking are also significant predictors.

This study contributes to theory by extending our knowledge on innovation behaviour from a dispositional perspective, and supports the argument that both dispositional and cognitive elements are drivers of innovative behaviour. In addition, the findings also highlight the need for organisations to adjust their HR policies to recruit, select and develop those with higher-order thinking dispositions for innovation-based organisational outcomes.
1.0. CHAPTER ONE – INTRODUCTION TO THE RESEARCH PROJECT

1.1 INTRODUCTION
This chapter contains an introduction to the research project. Specifically, the background to this theory-testing research and its contribution to the literature on innovative behaviour in the workplace is discussed in Section 1.2. The justification of study is argued from both theoretical and practical perspectives in Section 1.3. In Section 1.4, the hypotheses and research objectives are outlined. A summary of the research methodology adopted is provided in Section 1.5. Section 1.6 discusses the major findings of the study. Section 1.7, discusses the limitations of the study and outlines some suggestions for future research. Finally, Section 1.8 contains an outline of the four other chapters in this thesis.

1.2 BACKGROUND AND CONTRIBUTION OF THE RESEARCH
The objective of this research is to develop and test a mechanism via which several higher-order thinking dispositions (i.e., critical thinking, problem solving, metacognition, systems thinking and multiple perspective-taking) influence innovation behaviour in the workplace. The importance of innovation cannot be understated as it is a form of renewal and signifies positive transformational change. The significance of innovation has long been recognised by many and it is a topic that has generally been well studied. Innovation has been examined from both economic and industrial perspectives. Indeed, innovation is crucial for any economy and most, if not all, governments have established special departments to monitor and support innovation: For example, the Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (DIICSRTE) in Australia and the Department for Business Innovation and Skills in the United Kingdom.

Whilst government support is crucial for innovation, nonetheless, innovation is usually more likely to be associated with and fostered in organisations from the private sector in free markets as this context allows for better incentives and autonomy (Chesbrough & Appleyard 2007). Whilst innovation is usually linked to an organisation’s output (i.e. technology, product or service) (Organisation for Economic Co-operation and Development 2013), there are other forms of innovation such as process, marketing, organisational/management and business model innovations (Organisation for Economic

As organisations are viewed as the vehicle for value creation and innovation, the sources of innovation at firm level have been well researched. Specifically, in organisational areas such as strategy, systems, organisational culture and teams (e.g. Huang et al. (2014), Mulgan and Leadbeater (2013), Pesonen (2009), and Khazanchi, Lewis and Boyer (2007). Scholars such as Sawhney (2011) argue that innovation can only be harnessed if it is an organisation-wide effort as ad-hoc and piecemeal initiatives do not work.

People are the main catalyst for innovation and many studies have established the important role that individuals play in the innovation process. Individuals play multifaceted roles in enabling innovation to occur. For example, recognising opportunities for innovation through problems (D’Zurilla, Nezu & Maydeu-Olivares 2004), having high levels of expertise in their area of specialism (Banks & McGurk 2014), being creative in coming up with new ideas (Rickards & deCock 2003), and effectively weighing the risks in promoting/implementing these ideas (Scott & Bruce 1994).

The higher-order thinking capabilities of individuals play a crucial role in enabling innovation behaviour / innovativeness. Whilst higher-order thinking abilities are crucial for innovation and thus have been well-studied, identifying the capacity to be innovative only helps to explain part of our understanding of individuals and innovation. It is argued that the propensity for ingenuity, for example, is also crucial. Individuals must have the ability and also the inclination to innovate (Ackerman & Kanfer 2004), and studying both provides a more complete picture of innovation.

This research project focuses on the role of individuals in innovation, specifically their dispositions to engage in higher-order thinking. The argument to investigate higher-order thinking dispositions and their effects on innovation behaviour is supported by Ackerman (2014) who posited that the focus on skills and intellectual abilities is too narrow and that researchers have to consider other facets of an individual such as personality traits and dispositions. Individuals with the appropriate dispositions will likely be more inclined to recognise opportunities for innovation, be more realistic and grounded about new ideas, and have broader perspectives in how new ideas and innovations may be applied in
different parts of an organisation. In addition, the recruitment and selection of individuals with the appropriate dispositions will provide a better platform for the development of innovation. The development of individuals is equally as important in helping organisations to deal with volatile, uncertain, complex and ambiguous environments (Bennett & Lemoine 2014).

This hypothesis-testing study contributes to theory by providing a theoretical rationale and empirical evidence for the view that maximal performance-orientated constructs such as skills and capabilities should be complemented with typical-performance orientated constructs such as higher-order thinking dispositions as this provides a more inclusive and accurate understanding of innovation. This study contributes to practice by informing managers to extend their psychometric evaluation of candidates to include higher-order thinking dispositions in their selection process. In addition, the profiling of employees dispositions enables organisations to provide learning and development programmes that are tailored for individual employees.

1.3. JUSTIFICATION FOR THE RESEARCH PROJECT

1.3.1. Theoretical Perspective

This section provides a rationale for the study from a theoretical perspective. There are various levels to examine innovation such as the macro and micro levels (Goffin & Mitchell 2010; Wolfe 1994b). Macro-level innovation involves examining aspects of innovation at different levels: regional (European Commission 1995), national infrastructure (Department of Industry Innovation Science Research and Tertiary Education Australian Government 2011; World Economic Forum 2012), support (e.g. incubation, education and funding), and industry/sector (Department of Business Innovation and Skills UK 2010).

The meso-level of innovation involves examining organisational aspects of innovation such as management, strategy and organisational culture (Goffin & Mitchell 2010). Micro levels such as project-level innovations examines specific processes involved in developing new types of innovation (e.g. product or service) and considers issues such as how teams are established, leadership in teams, techniques for gathering customer requirements and evaluation of innovation projects (Goffin & Mitchell 2010).
We start at the macro-level as we first review of one the earliest theories related to innovation: Adam Smith’s Invisible Hand. This is followed by a review of Kondratieff waves and Schumpeter’s theory on innovation (i.e., *Creative Destruction*), which outlines how technological innovations and economic cycles are interlinked. The literature review then proceeds to discuss the science-driven view of innovation. At the meso-level, the literature examines key theories related to innovation at the organisation-level. The two key theories reviewed are the Resource-Based View of the firm and Dynamic Capabilities. Finally, we review the state of research in innovation at the micro-level involving individuals and put forward the argument that there is a need for further research on innovation behaviour at the individual-level.

### 1.3.1.1. Adam Smith’s Invisible Hand

It is arguable that the foundation of innovation as we know it today was set by Adam Smith, specifically in his work ‘An Inquiry into the Nature and Causes of the Wealth of Nations’ published in 1776 (Brown 2012). Smith’s hypothesis that sellers and buyers should be allowed to enter to trade openly and freely without being dictated to by government set the stage for a market-based economy.

By promoting the notion of the ‘Invisible Hand’ in markets, the self-interest of both sellers and buyers would lead to both parties satisfying each other’s needs (Brown 2012). The *laissez faire* approach would allow buyers to determine the goods that sellers should sell and at what price. Sellers, in competition with one another, would endeavour to meet those needs as best as possible at the lowest price to attract customers (Brown 2012). In doing so, sellers would have to innovate to meet customers’ present and future demands more effectively, efficiently and economically than their competitors. The market economy as we know it today thrives on competition amongst firms. A competitive advantage that many firms rely on is differentiation (Porter 1985), and a key factor that gives rise to differentiation is innovation. Thus the market economy is a key factor in allowing innovation to truly flourish.

### 1.3.1.2. Kondratieff Waves

Kondratieff Waves, which are named after its founder Russian economist Nikolai Kondratieff, reflect long economic cycles of expansion, stagnation, and recession
(Korotayev, Zinkina & Bogevolnov 2011). Kondratieff postulated that economic cycles have intervals of 50 to 60 years and each cycle is characterised by the dominance of new forms of technology and other factors (Kleinknecht 1990).

Table 1 shows Kondratieff Waves. The first wave, which occurred between 1780 and 1840, was characterised by the industrial revolution and factory production. The second wave, which occurred between 1840 and 1890, was the age of steam power and railways whilst the third wave, which occurred between 1890 and 1940, was the age of electricity and steel. The fourth wave, which occurred between 1940 and 1990, was the age of the mass production of automobiles and synthetic materials, and the fifth wave, which commenced in the 1990s, is the age of microelectronics and computer networks (Freeman & Soete 2009; Freeman & Soete 1997).

Kondratieff argued that these waves or cycles were fundamental to understanding economic prosperity. An explanation of the cycles is provided by the Technology Innovation Theory, which states that changes within the cycles are a result of technological revolutions that lead to the creation of new industries and the destruction of the old industries (Perez 2002). The Technology Innovation Theory was further developed by Joseph Schumpeter (Geroski & Walters 1995).
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</tr>
<tr>
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<td>Apprenticeship, learning by doing, dissenting academic societies</td>
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<td>Industrial R&amp;D labs, chemicals and electric, national laboratories, standards laboratories</td>
<td>Large-scale industrial and government R&amp;D, mass higher education.</td>
<td>Data networks, R&amp;D global networks, lifetime education and training</td>
</tr>
<tr>
<td>Transport communication</td>
<td>Canal, carriage roads</td>
<td>Railways (Iron), telegraph</td>
<td>Railways (Steel), telephone</td>
<td>Motor highways, radio and TV, airlines</td>
<td>Information highways, digital networks</td>
</tr>
<tr>
<td>Energy systems</td>
<td>Water power</td>
<td>Steam power</td>
<td>Electricity</td>
<td>Oil</td>
<td>Gas/ oil</td>
</tr>
<tr>
<td>Cheap key factor</td>
<td>Cotton</td>
<td>Coal, iron</td>
<td>Steel</td>
<td>Oil, plastics</td>
<td>Microelectronics</td>
</tr>
</tbody>
</table>
1.3.1.3. **Schumpeter’s Creative Destruction**

Joseph Schumpeter, an Austrian economist, theorised that economies and businesses operated in cycles. He developed his own theory by building upon Kondratieff’s hypothesis. Goffin and Mitchell (2010) argue that Schumpeter revised and refined Kondratieff’s theory by identifying shorter cycles within the waves, as shown in Table 2.

**Table 2: The Kondratieff Cycles: Waves of industrial innovation (Goffin & Mitchell 2010)**

<table>
<thead>
<tr>
<th>Long waves.</th>
<th>Important innovations.</th>
<th>Schumpeter’s first phase of innovation.</th>
<th>Schumpeter’s second phase of innovation.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Prosperity</td>
<td>Recession</td>
</tr>
<tr>
<td>1.</td>
<td>The industrial revolution (division of labour, steam engine, loom).</td>
<td>1782</td>
<td>1803</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1802</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>Railroads, steel, mechanisation.</td>
<td>1845</td>
<td>1867</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3.</td>
<td>Electricity, automobiles, chemical industry, water supply.</td>
<td>1892</td>
<td>1914</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1913</td>
<td>1929</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1966</td>
<td>1973</td>
</tr>
<tr>
<td>5.</td>
<td>Information and communication technologies, biotechnologies.</td>
<td>1995</td>
<td>2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2000</td>
<td>?</td>
</tr>
</tbody>
</table>

Schumpeter (1942) described these cycles as *Creative Destruction*, which is the “process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one” (p. 83). Whilst Schumpeter’s theory is mostly associated with economics, as he describes capitalism as the “perennial gale of creative destruction” (p. 84), innovation nonetheless played a key role in his explanation of business cycles and economic progression. He conjectured that the destruction of the *old* is disruptive and transformational, but these changes ultimately result in innovation. Hence, Schumpeter was one of the first scholars to explicit recognise the importance of innovation in economic growth.
Schumpeter also theorised about innovation in the form of technological change. Technological change includes improvements and enhancements in products, production processes and corresponding management methods (Schumpeter 1947). Technological change is an all-inclusive notion of ‘innovation’ as it comprises the sources and factors of change that produce the changes, as well as the output and outcomes (actual changes). According to Schumpeter, there are three stages in technological change, which are referred to as the Schumpeterian Trilogy (Rutten 1959; Schumpeter 1947).

The first stage in the Schumpeterian Trilogy is the process of creating new ideas. The second stage is the transformation of the ideas into products or services that can be marketed. The third stage is diffusion, which involves the spread of the innovation to new markets (Rutten 1959; Schumpeter 1947). The trilogy does not assume that the process is linear. The process considers feedback especially concerning profit. For example, low expectation of profit may retard a push for diffusion, whereas high expectations may be the catalyst to further generate and introduce new innovations. The Schumpeterian Trilogy makes an explicit demarcation between invention and innovation in adopting an economic view of innovation. This means that an invention only qualifies as an innovation if it has economic utility and value.

The Schumpeterian Trilogy has many parallels to the contemporary concept of the research and development (R&D) process. Basic research is the ‘invention’, applied research and development is the innovation, and marketing is the diffusion (Mahdjoubi 1997). Schumpeter’s work and his theories of creative destruction and technological change demonstrated the value of innovation and its place in economic development, and provided the foundation for innovation to grow as a scholastic field.

1.3.1.4. Science, Research and Development

Schumpeter’s views on technological change underpinned the early views of innovation, specifically the reliance on scientific research and development in creating new technologies. Science, defined as “creation, discovery, verification, collation, reorganisation and dissemination of knowledge about physical, biological and social nature” (Kline and Rosenberg, 1986, p. 287), was observed as the foundation and key method for developing new technologies.
In the industrialisation age, research and development (R&D) was observed as the catalyst of innovation, hence R&D personified the early models of innovation (Omachonu & Einspruch 2010; Mahdjoubi 1997). Whilst innovation takes many forms and levels, innovation was generally viewed as being synonymous with scientific research and development, and by default with large enterprises as only they could afford such costs (Omachonu & Einspruch 2010; Mahdjoubi 1997). Figure 1 illustrates the R&D-based linear model of innovation.

![R&D-based linear model of innovation](image)

**Figure 1: R&D-based linear model of innovation (Organisation for Economic Co-operation Development 2002)**

R&D, also known as ‘research and experimental development’, is considered by the Organisation for Economic Co-operation Development (OECD) (2002, p. 30) to “comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications”. Omachonu and Einspruch (2010) define R&D as a “process used to create new or improved technology that can provide a competitive advantage at the business, industry or national level” (p. 116).

From the OECD’s (2002) definition, R&D activity can be divided into three distinct stages; basic research, applied research and experimental development. Basic research “is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view” (OECD, 2002, p. 30). Basic research is usually funded by
governments and the result of basic research is public good and generally ends up in scientific journals (Teece 2010). However, basic research is critical as Teece (2010, p. 185) argues that “market failures occur in the context of innovation when private business models for capturing value draw forth insufficient investment in R&D [basic and applied]”.

Applied research is “also original investigation undertaken in order to acquire knowledge but it is, however, directed primarily towards a specific practical aim or objective” (OECD, 2002, p. 30). Mahjoubi (2010) observes applied research and “industrial research and development” as synonymous concepts. Omachonu and Einspruch (2010) observe that the objective of industrial research and development is “to obtain new knowledge, applicable to the company’s business needs, that eventually will result in new or improved products, processes, systems or services that can increase the company’s sales and profits” (p. 116). Experimental development “is systematic work, drawing on existing knowledge gained from research and/or practical experience that is directed to producing new materials, products or devices, to installing new processes, systems and services, or to improving substantially those already produced or installed” (OECD, 2002, p. 30). In other words, basic research builds the stock of fundamental and general knowledge, whilst applied (or industrial) research channels its research activities and the knowledge gained from basic research for a particular purpose (Stoneman 1995). Experimental development then applies the knowledge gained from both basic and applied research to actually deliver products and services that are useful.

Omachonu and Einspruch (2010) expanded the R&D-based linear model of innovation to include the role of development and engineering, as shown in Figure 2. Omachonu and Einspruch (2010) argue that both, whilst different are complementary. They state that development is a “systematic utilization of the knowledge or understanding gained from research toward the production of useful materials, devices, systems or methods, including design and development of prototypes and processes” (p. 116), whilst engineering is the next step that “converts these prototypes into products or services that can be offered to the marketplace or into processes that can be used to produce commercial products and services” (p. 116). Their model also shows the role of design and prototypes in the innovation process in building upon the OECD’s (2002) model. This perspective of innovation is supported by Rothwell (1994) who views as key to the design
and construction of prototypes as the output from experimental development, and the role of engineering is to convert prototypes into products.

1.3.1.5. Technological Advancement: Invention, Innovation and Diffusion

Innovation involves many other factors such as the coupling of science and engineering and economics (Kline & Rosenberg 1986). There are other activities and functions that play important roles in innovation such as design and engineering (Omachonu & Einspruch 2010), marketing (Chisnall 2005) and production (Cooper, Scott & Elko 2002). In addition, knowledge from market technical research may also catalyse innovation (Bradley 2010) as with reverse engineering (Omachonu & Einspruch 2010).

Whilst the R&D-based model of innovation typifies early models of innovation, it is still relevant and is employed by many companies such as those in life-sciences, physical sciences and engineering (Omachonu & Einspruch 2010). Nonetheless, R&D is not the equivalent to innovation as the ‘outputs’ of R&D are usually inventions. Martin and Milway (2012) distinguish between invention and innovation and the differences they identify are provided in Table 3.
Table 3: Differences between invention and innovation (Martin & Milway 2012)

<table>
<thead>
<tr>
<th>Invention</th>
<th>Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A new-to-the-world discovery/creation.</td>
<td>A product/service, or process that creates new value for customers.</td>
</tr>
<tr>
<td>Driven primarily by inventor curiosity or research interest.</td>
<td>Driven primarily by a desire to add customer value.</td>
</tr>
<tr>
<td>Merit defined uniqueness.</td>
<td>Merit defined by profitable deployment.</td>
</tr>
<tr>
<td>Based primarily on scientific skills.</td>
<td>Based on broad set of strategic, marketing, operational and technical skills.</td>
</tr>
</tbody>
</table>

The R&D-based linear model of innovation is limited as innovation is much broader (Tidd & Bessant 2010) and that newness or novelty in itself is not innovation as it does not necessarily provide economic advantage or utility (Kline & Rosenberg 1986). Schoen et al. (2005) regard innovation as a cycle that is non-linear, chaotic, with processes and outcomes that are not clearly defined. The innovation cycle is unpredictable because its main constituents of basic research, invention and innovation depend on different factors. For example, basic research is dependent on the progress of science, whilst invention is dependent on technology, and innovation is dependent on societal and market contexts.

Gruber and Marquis (1969; cited in Saren, 1984) developed a model to describe technological advancement, from invention to innovation to diffusion: Figure 3 provides the model. Gruber and Marquis’ model not only illustrates the differences between invention, innovation and diffusion but also shows the linkages amongst them. Stage I is the baseline of the current state of technical knowledge and its use. Inventions progress the state of technical knowledge through the application of scientific discovery into Stage II. If the invention has economic utility and is able to satisfy demand, it develops and progresses to Stage III, which is the innovation stage and gives rise to a new level of economic use of the technical knowledge. However, if the invention does not have economic utility, the invention does not become an innovation. Nevertheless, it does progress the baseline of the state of technical knowledge and a new Stage I emerges. If the innovation is adopted and/or imitated, Stage IV materialises and, as with Stage III, gives rise to a new level of economic use of the technical knowledge.
Stage IV is not necessarily a natural flow-on from innovation. There are events/things that must take place before diffusion occurs. An example is the light bulb invented by Thomas Edison (Smithsonian 2012). In a sense, the light bulb was an invention and not an innovation because its utility was limited as electricity was a form of energy that could not be easily generated and stored during that time. Hence, the context (e.g. infrastructure) is important for an invention to be considered an innovation. Only when electricity (with other things like power sockets) became common, did people find a use for the light bulb. Also, the advent of power grids allowed electricity-powered inventions such as the light bulb to 'take off' or become diffused.

A more recent example of diffusion of a new innovation is electric-powered cars. These cars are an invention (working product) and an innovation (people see value in them, and are buying them as they generate less greenhouse gas and lower the cost of ownership to some degree). However, the extent of its diffusion can be questioned because of a lack of infrastructure of electricity power points to recharge the cars. Because this infrastructure is not widespread, people can only use them in areas where these power points are available. In sum, the diffusion of a new innovation is limited by its context (e.g. infrastructure and societal attitudes).

Nonetheless, innovation begets innovation. The knock-on effect can be observed through the rapid development and growth of the automobile industry due to the development of
new methods of petroleum refinement that has increased the types of fuels that can be used in automobiles (e.g. for power and lubrication). Other examples include the microscope and the work of Louis Pasteur, and the telescope within the field of astronomy (Kline & Rosenberg 1986). This knock-on effect also relates to the subsequent effect of an innovation. For example, Kline and Rosenberg (1986) cited John Enos’ (1958) study of the petroleum industry. Enos found that a marked difference in cost reductions between the alpha phase (the initial introduction of the new process) and the beta phase (subsequent cost reductions flowing from the initial improvement in the alpha phase) can facilitate the growth of other innovations.

1.3.1.6. Resource-Based View of the Firm

Innovation is not just a process that involves science and technology. Indeed, if innovation was just a process, all organisations would be innovative. However, this is clearly not the case. In addition, although contextual factors play a role in shaping innovation and its success (e.g. diffusion), some organisations are much more capable of managing such situational factors. Thus, why is it that some organisations are more innovative than others? Why are such organisations more innovative even though they face similar contextual factors (e.g. economic and industrial factors) and when research and development processes are well established?

A potential explanation lies within the organisations itself. For example, innovation may occur because of an organisation’s leadership, culture, systems, process and/or people. An organisation may have the ‘right mix’ of resources and competencies that enables it to be more innovative than its competitors. Its people may have the abilities and creativity, and are ‘managed’ in a way that allows individuals to help the organisation to be innovative and to innovate.

The Resource-Based View (RBV) of the firm helps to explain how unique aspects of an organisation may enable it to be competitive. Whilst, the RBV does not specifically address how innovation occurs in organisation, it provides a basic understanding of why some organisations are more competitive than others, which can be extended to understand how innovation occurs in organisations.
The RBV is a strategic management theory, and thus the level of analysis involving this theory is at the ‘organisational level’ (Barney & Arikan 2001; Newbert 2007), such as organisational processes and culture that subsumes teams and individuals. The RBV has been used to explain why some organisations are more competitive and perform better than other organisations (Hoopes, Madsen & Walker 2003). The key concept that underpins the RBV is that bundles of resources and competencies provide organisations with sustainable competitive advantages (Lockett, Thompson & Morgenstern 2009). Organisations are able to distinguish themselves from their rivals by firstly obtaining unique tangible and intangible assets, and secondly by organising and combining these assets in ways that enable it to be competitive. A potential output of these combinations may be innovation (Barney 2007).

The RBV has a history that is rooted in economics, in particular through the work of Edith Penrose (Rugman & Verbeke 2002). Penrose postulated that organisations are different from one another even though they may be in industries that are considered to be in ‘perfect competition’ (Penrose 1959). She argued that this was due to the organisation’s ‘administrative framework’ that connected, organised and directed all the activities in the organisation (e.g. transforming input into outputs). These administrative frameworks she posited are unique in all organisations, for better or worse, and thus organisations are all heterogeneous even though they may be in the same industry and use similar inputs and processes.

An administrative framework may lead an organisation to be innovative by helping it to identify and acquire distinctive bundles of resources. However, bundles of resources such as raw materials, strong financial reserves, branding, patents, partnerships and alliances are necessary but insufficient for innovation. Organisations must also have the capabilities and competencies to extract and create value from these resources. Thus, capabilities and competencies such as talented and creative staff, an entrepreneurial management team and a risk-taking culture are necessary in this value-added process. In other words, the administrative framework helps organisations to develop and ‘use’ its capabilities and competencies in a particular way that ‘maximises’ the usefulness of the firm’s bundles of resources (Rugman & Verbeke 2002). Thus, even if organisations have the same configuration of resources and capabilities, they are still heterogeneous because their administrative frameworks are unique.
Wernerfelt (1984) implies that there are strong links between the RBV and innovation. According to Wernerfelt, organisations aim to differentiate themselves from one another and maintain their competitiveness by heterogeneously sourcing and configuring resources with the aim of producing products and services that are better and distinctive. This notion is similar to that of product innovation, which may involve products with higher specification, and more features and functionality. Wernerfelt also proposed that an organisation’s resources are also used differently for innovations in marketing in enhancing awareness of the product and its benefits. The use of resources in a heterogeneous manner intimates to process innovation, for example, to create and deliver goods and services more efficiently, economically and effectively (Barney 2001).

Although the RBV does not pinpoint where innovation originates from within the organisation, it does nevertheless provide an understanding of the type of resources necessary for sustainable competitive advantage. This argument is supported by Barney (1996), who states that resources that provide genuine sustainable competitive advantage are those that are valuable, rare, inimitable and non-substitutable (VRIN). It is not too remote to envisage that a VRIN resource will not only help with innovation but will do so in a sustainable manner (e.g. long-term).

A germane theory that helps to link the RBV and innovation is that of dynamic capabilities. Dynamic capabilities stems from the RBV (Barney 2001; Teece & Pisano 1994) and it is also especially relevant to the Schumpeterian notion of competition based on innovation and creative destruction (Teece, Pisano & Shuen 1997). Dynamic capabilities in organisations play an important role in innovation as it is a response to a changing and dynamic environment that is symbolised by the rapid introduction, development and destruction of innovation in terms of products, services and technology (Teece et al. 1997).

Dynamic capabilities are a form of organisational competency. Teece and Pisano (1994) posit that dynamic capabilities enable organisations to “appropriately adapting, integrating, and re-configuring internal and external organizational skills, resources, and functional competences toward changing environment” (p. 537). Dynamic capabilities are argued to be a key factor in explaining business model innovation, as well as with
product/service and process innovations (Teece & Pisano 1994; Teece 2010). Dynamic capabilities enable organisations to use its reconfiguration skills to enhance existing business models or develop new business models so that the organisation can successfully adapt to its ever-changing external environment (Teece 2010).

Similar to the RBV, the theory of dynamic capabilities is essentially an organisational-level theory as it includes organisational artefacts such as policies and processes. Dynamic capabilities, nonetheless, are dependent on the ‘soft-skills’ of individuals in the organisation as they are, to some extent, tacit by nature. The RBV and dynamic capabilities theories, thus, also help us to appreciate the importance of individuals in innovation.

The origins of creativity have been debated by scholars. Some assert that creativity is an intellectual ability, residing within the domain of the mind (Runco 2004a). Whilst others have argued that creativity is potentially more related to personality (Batey, Chamorro-Premuzic & Furnham 2010). A similar notion to creativity is ingenuity. Ingenuity builds upon creativity as it helps to solve problems that are more complicated and complex (Homer-Dixon 2000). However, it is similar to creativity as the concept straddles across the domains of mind and personality. Others argue that creativity and ingenuity are products of the interaction between a person’s mind (abilities) and their personality (dispositions).

There are other potential explanations of innovativeness in individuals other than intellectual ability and personality. Adopting a developmental perspective, innovation behaviour can also be fostered. Like any other competency, individuals can gain knowledge and develop the necessary skills to become innovative. In addition, the social aspect of innovativeness should also not be disregarded. Working with the ‘right’ group of people can spur individuals to become more innovative (whilst the opposite can also be true as working in a team that is bureaucratic or dysfunctional would inevitably abate innovation). However, thinking dispositions are the ‘hygiene factors’ that must be considered as the main factors to be present for further development to take place.
1.3.1.7. Theoretical Justification of the Research

The previous sections have considered innovation from various perspectives; economic, industrial, process (research and development, technology advancement and diffusion), and organisational. The next section aims to underscore the importance of individuals in innovation and provides a justification for the research to be undertaken from a theoretical perspective, in particular the level and unit of analysis.

Individuals are arguably the key element to any successful innovation initiative. Individuals play various roles in innovation such as the catalyst and originators of ideas and/or the nexus that brings factors for innovation together. Tidd and Bessant (2010) identified the components of innovation in continuous (e.g. stable) or discontinuous (e.g. turbulent) conditions/environments, as shown in Table 4. One of the components they identified is ‘key individuals’. In addition to this direct role, one could also argue that individuals play a crucial role in all of the other components such as providing supportive leadership in the drive for innovation, creating a structure that facilitates innovation, embodying team spirit, advocating a creative climate, and being open and engaging with the external environment to help with innovation.

Whilst ‘people’ are the main source of innovation, it is their mental capacities (i.e. their intellect and cognitive processes) that enable them to be innovative. Specifically, it is higher-order thinking skills that allow people to go beyond the information provided to them (Torff 2003). Higher-order thinking skills include critical thinking, creative thinking, problem solving, metacognition and systems thinking (King, Goodson & Rohani 1998; Irani et al. 2007; Facione 2000; Frank 2006; Flavell 2004; D’Zurilla et al. 2004; Runco 2004a). Many of the instruments that are used to measure higher-order thinking measure the ‘ability’. However, whilst the ability to be innovative is important, the propensity to apply higher-order thinking skills might be more important.
<table>
<thead>
<tr>
<th>Component</th>
<th>Key features (continuous conditions)</th>
<th>Key features (discontinuous conditions)</th>
</tr>
</thead>
</table>
| Shared vision, leadership and the will to innovate | • Clearly articulated and shared sense of purpose.  
• Stretching strategic intent ‘top management commitment’.
|                                                 | • Top level support for difficult decisions or radical new directions.  
• Different perspectives – often coming from outside the organisation or the sector.  
• Willingness to let go of the past. |
| Appropriate structure                           | • Organisation design which enables creativity, learning and interaction.  
Not always a loose ‘skunk works’ model; key issue is finding appropriate balance between ‘organic and mechanistic’ options for particular contingencies. | • A balance between the steady-state archetype and the discontinuous-innovation archetype – the ambidextrous challenge.  
• Corporate venturing models, skunk works and other modes. |
| Key individuals                                 | • Promoters, champions, gatekeepers and other roles which energise or facilitate innovation.        | • Key roles of gatekeepers to extend peripheral vision and champions to promote risk taking.  
• New roles to facilitate internal venturing – for example Shell’s ‘Gamechangers’.  
• Emphasis on intrapreneurship. |
| Effective team working                          | • Appropriate use of teams (at local, cross-functional and inter-organisational level) to solve problems, requires investment in team selection and building. | • Increase emphasis on bringing together different perspectives and fast-forming temporary teams.  
• Increasing boundary crossing within and between organisations – virtual and dispersed team working.  
• Extensive communication; need to develop channels for unorthodox ideas to flow.  
• Need capacity to deal with ‘off message’ signals. |
| High-involvement innovation                     | • Participation in organisation-wide continuous improvement activity.                                | • Internal programmes which seek out and capture new ideas from across the organisation and harness entrepreneurial energy to take them forward. |
| Creative climate                                | • Positive approach to creative ideas, supported by relevant motivation systems.                    | • Fostering open environment receptive to new and often challenging ideas.  
• Development of intrapreneurship rather than forcing people to leave to exploit new opportunities which they see and believe in.  
• Learning organisation; increasing emphasis on ‘probe and learn’ and high failure/ fast learning.  
• Extending learning across boundaries and into networks. |
| External focus                                  | • Internal and external customer orientation.  
• Extensive networking.                           | • Extensive networking required to extend peripheral vision.  
• Move beyond existing and effective value networks to open up new options.  
• Open innovation.                               |
The application and ‘every day’ use of higher-order thinking skills depend on dispositions. Dispositions are essentially personality traits (McAdams 2009; Perkins, Jay & Tishman 1993) and refer to one’s tendencies to feel, think and act in certain ways (Perkins & Ritchhart 2004). This perspective has its benefits to organisations as there is no point in recruiting and developing employees that have the capacity to innovate but do not use these capacities. Dewey (1933) even stated that if one had to choose, it is far more important to have the attitude than the aptitude. For example, the disposition of curiosity compels individuals to learn and gain new knowledge (Fisher 1998). Also, disposition informs us of individuals’ proclivity to direct and use their intellect (Perkins et al. 1993). The adage of “chance favours the prepared mind” (Welter & Egmon 2005) is supported by Kline and Rosenberg (1986) who state that innovation processes are chaotic and the outcomes are unpredictable.

Dai and Sternberg (2004) provide three reasons why personality, intelligence and dispositions are integrated. Firstly, personality impacts on the effectiveness of cognitive processes, secondly, dispositions can facilitate or impede cognitive efforts in terms of persistence, and thirdly, dispositions sensitise us to inputs that we pick up for subsequent processing. The ‘right’ dispositions enable us to pick up the ‘right’ information. Dai and Sternberg (2004) state that “Constructs such as typical intellectual engagement, problem-based and emotion-based coping, and emotional and motivational biases in cognitive processing start to help us understand personality-related constraints on intellectual functioning. Putting intellectual functioning in the context of personality functioning is a step further from putting cognition in motivational and affective contexts…sheds light on some unique system-wide functional properties of the individual mind that are typically not addressed by the research with an exclusive focus on the interplay of motivation, emotion, and cognition itself” (p. 18)

As the preceding sections have shown through the discussion of a number of key theories that have examined innovation from various perspectives (e.g. levels of analysis) with different foci (i.e. units of analysis such as behaviour and technology). For example, Table 5 shows Wolfe (1994b) review of research on innovation at the organisational-level. Within the organisational level of analysis, research on innovation has also focused on the influence of group dynamics and individuals’ qualities, there appears to be a significant paucity at individual level.
<table>
<thead>
<tr>
<th>Research stream</th>
<th>Research questions</th>
<th>Innovation stage focus</th>
<th>Unit of analysis</th>
<th>Variables Independent</th>
<th>Dependent</th>
<th>Research model.</th>
<th>Major data collection methods.</th>
<th>Example studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diffusion.</td>
<td>What is the pattern of diffusion of an innovation through a population of potential adopters?</td>
<td>Adoption.</td>
<td>An innovation (extra-organisational focus).</td>
<td>• Organisational characteristics &lt;br&gt; • Innovation characteristics &lt;br&gt; • Promoter characteristics</td>
<td>• Diffusion pattern. &lt;br&gt; • Diffusion extent. &lt;br&gt; • Diffusion rate.</td>
<td>Logistics growth model (based on contagion within the social system and/or ‘change agent’ influence from without).</td>
<td>• Cross-sectional surveys. &lt;br&gt; • Secondary data.</td>
<td>• Teece (1980) &lt;br&gt; • Easingwood, Mahajan and Muller (1983) &lt;br&gt; • Tolbert and Zucker (1983) &lt;br&gt; • Norton and Bass (1987) &lt;br&gt; • Fischer and Carroll (1988) &lt;br&gt; • Attewell (1992)</td>
</tr>
<tr>
<td>Innovative-ness.</td>
<td>What determines organisational innovativeness?</td>
<td>Adoption or implementation.</td>
<td>Organisational .</td>
<td>• Organisational characteristics &lt;br&gt; • Innovation characteristics &lt;br&gt; • Managerial characteristics &lt;br&gt; • Environmental characteristics</td>
<td>Innovativeness: &lt;br&gt; • number or speed of adoptions</td>
<td>Variance / regression models.</td>
<td>Cross-sectional surveys.</td>
<td>• Baldridge and Burnham (1975) &lt;br&gt; • Moch and Morse (1977) &lt;br&gt; • Kimberly and Evanisko (1981) &lt;br&gt; • Ettlie (1983) &lt;br&gt; • Meyer and Goes (1988)</td>
</tr>
<tr>
<td>Process steps.</td>
<td>What are the stages organisations go through in implementing innovations?</td>
<td>Adoption through implementation.</td>
<td>Innovation process (intra-organisational focus).</td>
<td>Innovation characteristics</td>
<td>Stage: &lt;br&gt; • existence and/or sequence</td>
<td>Stage models.</td>
<td>Cross-sectional retrospective surveys.</td>
<td>• Pelz (1983) &lt;br&gt; • Ettlie (1983)</td>
</tr>
<tr>
<td>Process.</td>
<td>What factors explain the chain of events which result in innovation implementation?</td>
<td>Adoption through implementation.</td>
<td>Innovation process (intra-organisational focus).</td>
<td>Precursor Organisational context &lt;br&gt; • strategy &lt;br&gt; • structure &lt;br&gt; • resources &lt;br&gt; • technological strength</td>
<td>Outcome The innovation process (its stages, sequences, divergent and parallel paths, feedback and feed forward cycles)</td>
<td>Process models.</td>
<td>In-depth field studies.</td>
<td>• Dean Jr. (1987) &lt;br&gt; • Dyer and Page Jr. (1988) &lt;br&gt; • Schroeder et al. (1989)</td>
</tr>
</tbody>
</table>
This study adopts an integrative view of higher-order thinking skills and dispositions regarding their effects on innovation. Goff and Ackerman (1992) argue that both personality and intellect should be viewed together to better understand human behaviour. They state that “…intellectual abilities measurement cannot be divorced from motivation and personality, and that typical level of intellectual engagement can be better understood by attempting to understand the temperamental and situational motivation and volition factors that contribute to individuals’ typical intellectual performance” (p. 539). Indeed, it seems that we have come full circle as Dai and Sternberg (2004) posit that past theories of intelligence had included notions of personality traits and dispositions. Binet and Simon (1905) intimated towards the role of direction and control (similar to the concept of metacognition), Spearman (1923) conceptualised intelligence as mental energy synonymous with motivation, whilst Wechsler (1950) posited than conation should be included in the definition of intelligence.

The link between thinking dispositions and innovation is thus an important area of research, although, to the best of the author’s knowledge, there is a paucity in research in this area. The unit of analysis of this research study is on behaviour, specifically the antecedent factors of higher-order thinking dispositions and their relationship with the innovative behaviour of individuals within organisations. The level of analysis in this study is the individual.

Further discussion and justification of the integrated view of higher-order thinking skills and dispositions on innovation will be provided in the next chapter. Specifically, the argument from Perkins and Ritchhart (2004) concerning the role of disposition in ‘good thinking’ in determining individuals inclinations sensitivities is discussed. Theories and models of adult development from Ackerman (1996; 1997; 2005; 2014) will also be discussed. Specifically, the role of ‘typical intellectual engagement’, trait complexes, and the Intelligence-as-Process, Personality, Interests, and Intelligence-as-Knowledge (PPIK) model. The work of Chamorro-Premuzic and Furnham (2004) is then reviewed in particular their ‘subjective assessment of intelligence’ (SAI) model. Last, but not least, the concept of extra-cognition is explored.
1.3.2. The Value of Innovativeness and Innovation Behaviour in Practice

Section 1.3.1 justified the research from a theoretical perspective, whilst this section aims to justify the research from a practice perspective. In Section 1.3.2.1 and Section 1.3.2.2, it is argued that innovation enhances organisational performance and competitiveness, respectively. Section 1.3.2.3 discusses how innovation helps organisation to proactively adapt to and shape change. Last, but not least, Section 1.3.2.4 contains an argument for how innovation helps organisations to increase their human capital.

1.3.2.1. Improving Performance

There is a reinforcing cycle amongst innovation, business performance and growth (Wolfe 1994b; Miles 2003; Department of Business Innovation and Skills UK 2010; Department of Business Innovation and Skills UK 2009; Department of Industry Innovation Science Research and Tertiary Education Australian Government 2011; Department of Innovation Industry Science and Research Australian Government 2011). Innovation is a crucial capability for all organisations as it can result in novel and better quality products and services at lower costs, all of which provide the firm with advantages and thus enhance performance (Yalabik, Howard & Roden 2012; Sheehan, Garavan & Carbery 2014; Browning & Sanders 2012; Department of Innovation Industry Science and Research Australian Government 2011). In addition to the value proposition (e.g. better products and services), innovation may also involve more efficient ways of producing and marketing products and services, and more effective ways of managing the organisation.

A high level of business performance is not solely due to innovation as there are various factors that contribute to business performance. Nonetheless, there is evidence that innovation plays a significant role in improving firm performance. For example, a study undertaken by the then Cambridge Small Business Research Centre of 2000 small and medium-sized companies, which is by far the most authoritative and largest empirical survey done in the UK on SMEs, showed that 80% of these companies that had initiated some innovation in the last three years had recorded improvements in business performance in terms of increased profitability, increased share in current markets and/or success in penetrating new markets (CBI/NatWest 1997).

Other studies have also shown the link between innovation and business performance. For example, there is a link between R&D expenditure and increase in sales (Franko 1989), innovation initiatives and market share, profits (Geroski & Machin 1992),
number of patents, productivity and stock market value (Acs & Audretsch 1992). The outcomes of innovation are numerous such as increasing competitiveness, demand and market share, improving production and delivery, and enhancing the workplace and organisation, as show in Table 1.6 by UNESCO Institute for Statistics (2008) and the Organisation for Economic Co-operation Development (2005).

Table 6 also shows how innovation begets innovation, as organisations are able to build upon existing innovation and apply it to other products, services, processes and business models (Nohria 2012). Whilst the links discussed above do not suggest causation (Archibugi & Pianta 1994), the volume of studies that have reported positive relationships between innovation and business performance indicates that innovation plays a significant role. Whilst innovation is only one of many factors that contribute to business performance it is nonetheless a significant contributor.

1.3.2.2. Enhanced Competitiveness

Innovation helps to improve business performance in the short run and, in the long term, helps to improve an organisation’s competitiveness. Geroski (1994) argues that innovation impacts organisations in two ways. The first is that innovative products and services help the organisation’s competitiveness in terms of its products and services. The second is that in the long run, organisations will inculcate innovative internal competencies and thereby improve the organisation as a whole.

The competitive advantage gained through innovation is demonstrated through Business Week’s Innovation Index. This index tracks 25 of the most forward-thinking and innovative organisations in the world, in terms of products, services, marketing (e.g. consumer experience), process and business models. Organisations with the most innovative business models are most likely to have above-average share returns that are underpinned by higher revenue growth (Jana 2008).
Table 6: Factors relating to the objectives and effects of innovation (OECD 2005)

<table>
<thead>
<tr>
<th>Factors</th>
<th>Product innovations</th>
<th>Process innovation</th>
<th>Organisational innovations</th>
<th>Marketing innovations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Competition, demand and markets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace products being phased out</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase range of goods and services</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Develop environment-friendly products</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase or maintain market share</td>
<td>√</td>
<td></td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Enter new markets</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Increase visibility or exposure for products</td>
<td></td>
<td></td>
<td></td>
<td>√</td>
</tr>
<tr>
<td>Reduced time to respond to customer needs</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td><strong>Production and delivery</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improve quality of goods and services</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Improve flexibility of production or service provision</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Increase capacity of production or service provision</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Reduce unit labour costs</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Reduce consumption of materials and energy</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Reduce product design costs</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Reduce production lead times</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Achieve industry technical standards</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Reduce operating costs for service provision</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Increase efficiency or speed of supplying and/or delivering goods or services</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Improve IT capabilities</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td><strong>Workplace organisation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improve communication and interaction among different business activities</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase sharing or transferring of knowledge with other organisations</td>
<td></td>
<td>√</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase the ability to adapt to different client demands</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Develop stronger relationships with customers</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Improve working conditions</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce environmental impacts or improve health and safety</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td></td>
</tr>
<tr>
<td>Meet regulatory requirements</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>
Sustainable organisational competitiveness (as discussed in Section 1.3.1.6 on the RBV) involves having resources and competencies that are valuable, rare, inimitable and non-substitutable (VRIN). It was argued that VRIN resources and competencies (which include the organisation’s leadership, culture, internal processes, products and services) ultimately help the organisation to become innovative (Jain, Triandis & Weick 2010). An organisations’ innovativeness can be measured in terms of the cost-effectiveness of its products (e.g. due to innovative production process and business models), speed of time-to-market services (e.g. use of innovative technologies) and enhanced quality (e.g. innovative designs).

Organisational competitiveness is a subject that lies within the domain of strategic management. Strategic management and organisational competitiveness are inherently connected. Innovation may help an organisation to develop a better strategy (Rothwell 1992b) such as a Blue Ocean Strategy (Kim & Mauborgne 2005) and may also help organisations to identify and position themselves in markets that have little or no competition. Innovation, however, may be the strategy albeit in specific terms such as products/services, processes or business models (e.g. a technology firm such as Apple). Either way, innovation begets innovation, and thus innovation and competitiveness go hand-in-hand.

1.3.2.3. Managing Change: Adapting to and Shaping Change

The saying that change is the only constant rings true in today’s competitive environment as Peter Drucker posited that “the only thing we know about tomorrow is that it will be different” (Drucker, 1973, p. 44). Daft, Murphy and Willmott (2010) illustrate how changes in the external environment can pose both a threat to and an opportunity for an organisation, and ultimately have a significant impact on the organisation (Figure 4).

The key external drivers for innovation are changes in the technological domain, business environment, customers demographics, needs and wants, and inter-firm rivalry (Goffin & Mitchell 2010). An example is change involving sustainability practices. In the past, changes in legislation on pollution provided the impetus for organisations to innovate in terms of their production processes (Rothwell 1992a). However, this change has grown into a more significant agenda over the past decades; the growth of sustainability as a major agenda/theme for organisations (and countries), for example, has driven many innovations (Esty & Charnovitz 2012; Deloitte Touche Tohmatsu & The World Economic Forum 2010).
Figure 4: Forces Driving the Need for Major Organizational Change (Daft et al. 2010)
Courtney, Kirkland and Viguerie (1997) assert that the effective management of organisations depends on the organisations’ leaders and managers being able to successfully navigate through changes in the external environment. They described four levels of uncertainty; a single forecast that is highly precise, alternate futures with a few discrete outcomes, a range of potential futures, and a future that is truly ambiguous (Figure 5).

![Figure 5: Four levels of uncertainty (Courtney et al. 1997)](image)

Instability in the external environment is here to stay. Whilst this may differ from sector to sector and is generally relative, the knock-on effect of change in industries and economies mean that no sector can be considered safe from the ever-changing forces from the external environment. Organisations are being challenged to manage change effectively. This is a tall challenge given that the external environment is considered to be volatile, uncertain, complex and ambiguous (VUCA) (Bennett & Lemoine 2014). Volatility refers to the unpredictability of the external environment in that it can change without warning making it almost impossible to plan too far ahead. Uncertainty is the opaqueness of the external environment and the haziness of the future. Complexity is the presence of too many factors that inter-relate with one
another that impede the identification of any meaningful trends and ambiguity is the presence of *signals* in the external environment that have multiple meanings and/or interpretations, and can be deceiving (Johansen 2007).

Organisations that are reactive to change will have their fate dictated by the external environment (whether the changes are favourable or not). For an organisation to survive and thrive, it should be innovative. Innovativeness infers that the organisation is adaptive and agile, as these are basic characteristics of innovative organisations (Omachonu & Einspruch 2010).

By becoming innovative, an organisation may be able to manage change more effectively and thereby increase its prospects of occupying a position of leadership in its sector or market. For example, Courtney et al. (1997) illustrate three scenarios, which are depicted in Figure 6. They assert that organisations facing radical change in the external environment have essentially three options; shape the future, adapt to the future or reserve the right to play.

![Figure 6: Three strategic postures (Courtney et al. 1997)](image)

*Shape the future* involves the organisation adopting a leadership role in establishing the *rules-of-the-game* in the sector. This will involve being an innovator, setting standards and being able to create demand. The second role of *adapt to the future* involves winning through speed, agility and flexibility, essentially being a *fast second*. The third role is *reserve the right to play*, which is the least ideal role. Organisations that are unable to attain either of the first two roles can invest sufficiently to stay in the
game but avoid premature commitments. This is a *wait-and-see* strategy (Courtney et al. 1997).

The roles identified by Courtney et al. (1997) show how crucial innovation is in helping organisations to become masters of their own destiny. Innovation enables organisations to lead their industry and almost dictate their own future by setting the rules and standards for the rest to follow, and by dictating the tempo of change and not have it dictated to them.

### 1.3.2.4 Human Capital and Innovation

The previous three sections have justified the need for this research from a practice perspective as it is argued that innovation helps organisations to improve their performance, competitiveness, and ability to adapt to change. This section focuses on how individuals, specifically via their thinking dispositions, contribute to the development of an organisation’s human capital and social capital, and ultimately contribute to innovation.

Kinnie et al. (2012b) argue that human, social and organisational capital are required, together with the ‘right’ human resource management (HRM) policies and practices, for innovation-related outputs such as innovative services and organisational forms (see Figure 7). Human capital is the sum of individuals’ knowledge, skills and competencies (Shaw, Park & Kim 2013), whilst social capital is relational-capital such as effective teams and (positive) social networks. Organisational capital is essentially the collective sum of human capital and social capital, including other factors such as organisational memory, reputation and processes (Kinnie et al. 2012b).
It is argued that whilst all three forms of capital are essential, human capital is the genesis (i.e. ‘where it all begins’), in particular what individuals ‘bring’ to the organisation when they are recruited (Takeuchi, Lepak & Swart 2011). The identification of thinking dispositions in individuals provides organisations with the ‘right’ ingredients to work with in developing human capital for innovation. Whilst it is recognised and acknowledged that HRM practices in areas such as learning and development are necessary to develop competencies in innovation, individuals that possess the necessary inherent dispositions will develop at a faster rate and go further in their development, and potentially contribute more significantly to an organisation’s innovation initiatives.

**1.3.2.5 Summary**

In summary, a discussion of the importance of innovation has been provided in the preceding sections. From a theoretical perspective, innovation has a long history that can be traced back to Adam Smith’s free market *invisible hand*. The role on innovation shaping economies and societies in reflection of Kondratieff Waves was discussed. The role of innovation was emphasised by Schumpeter and his notion of *creative destruction* suggest that the impetus for renewal through innovation is necessary. The traditional innovation process (i.e. R&D) and its diffusion in understanding how innovation materialises was then outlined. In justification of the research approach, this section then discussed why innovation is important using the RBV of the firm as a theoretical underpinning.
This research contributes to the literature by focusing on higher-order thinking dispositions and individuals’ behaviour as the unit of analysis. As such, the final sub-section, as part of the theoretical justification, discusses the source of innovation, specifically in individuals’ higher-order thinking dispositions as a potential antecedent of innovative behaviour.

This section also justifies the topic from a practitioner perspective. It is argued that organisations that are able to innovate will not only be able to significantly improve their performance in the medium term but also enhance their overall competitiveness in the long term. Innovative organisations also inevitably future-proof themselves as the competencies used for innovation may also be used to adapt and shape change. Organisations that innovate are also those that tend to have well developed human capital. The development of human capital and innovation reinforce one another. Organisations have to continuously develop their people to keep up with innovation. Employees who then become innovative will inevitably apply the habits of being innovative to their jobs and to their self-development.

1.4. RESEARCH OBJECTIVES, QUESTIONS AND HYPOTHESES

There is considerable evidence that higher-order thinking dispositions are related to innovation. However, the mechanism via which these dispositions influence innovative behaviour in the workplace has not received a great deal of attention. The objective of this research is therefore to develop and test a mechanism via which several higher-order thinking dispositions (i.e., critical thinking, problem solving, metacognition, systems thinking and multiple perspective-taking) result in innovative behaviour in the workplace.

Two research questions have been developed based on the research objectives and they are as follows:

Research Question 1 — *How do higher-order thinking dispositions influence innovative behaviour?*

Research Question 2 — *Are some dispositions more important than others in terms of facilitating innovative behaviour?*

It is argued in the next chapter that higher-order thinking dispositions result in innovative behaviour because they enhance job-related learning and subsequently creativity. Six hypotheses have been developed based on the research questions and are tested in this study. The hypotheses are as follows:
Hypothesis 1: *Job-related learning mediates the relationship between critical thinking and creativity.*

Hypothesis 2: *Job-related learning mediates the relationship between problem solving and creativity.*

Hypothesis 3: *Job-related learning mediates the relationship between metacognition and creativity.*

Hypothesis 4: *Job-related learning mediates the relationship between systems thinking and creativity.*

Hypothesis 5: *Job-related learning mediates the relationship between multiple perspective-taking and creativity.*

Hypothesis 6: *Creativity mediates the relationship between job-related learning and innovation.*

The hypotheses have been combined to create a theoretical model, which is illustrated in Figure 8.
Figure 8: The theoretical model
1.5. **Research Methodology**

A positivist paradigm is adopted for this research as there are hypotheses to be tested. Participants completed an online questionnaire that included self-report measures of the five thinking dispositions, job-related learning, creativity and innovative behaviour. The design of the research adheres to the guidelines set by Cavana, Delahaye and Sekaran (2001) in particular to identifying the purpose of the study, type of study, unit of analysis, time horizon, researcher’s interference, study setting and sampling.

The purpose of the study is one of hypothesis-testing that essentially concerns *explaining* the relationships between the dependent variable and the independent and mediating variables, thus it follows that the type of investigation is either causal or correlational. This study is correlational. The unit of analysis is the individual as the overall purpose of the study is to investigate the innovative behaviour of individuals in relation to the hypothesised antecedents of cognitive dispositions, job-related learning and creativity.

The time horizon is longitudinal. Data are collected at two points in time (i.e., stages) approximately 60 days apart. The constructs measured at each stage is based upon the hypothesised direction of occurrence. The purpose and nature of the study suggests that the extent of the researcher’s interference is minimal. Consistent with the research design, the setting of the study is non-contrived as no manipulation is necessary and this helps to enhance ecological validity. The non-probability sampling method of convenience sampling was used. Most All of the measures for the constructs are from peer-reviewed research articles. The scholars that established these measures all reported acceptable/satisfactory validity and reliability levels for the measures. Table 7 provides a summary of the measures used, their sources and the stage at which each measure was administered.
**Table 7: Summary of measures used, source and stage (created for this study)**

<table>
<thead>
<tr>
<th>Construct</th>
<th>Main source and author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage 1</strong></td>
<td></td>
</tr>
<tr>
<td>Demographic variables</td>
<td>NA</td>
</tr>
<tr>
<td>Critical thinking (engagement, maturity and innovativeness)</td>
<td>Irani et al. (2007)</td>
</tr>
<tr>
<td>Systems thinking (whole and interdisciplinary knowledge)</td>
<td>Frank (2010); Frank, Zwikael and Boasson (2007)</td>
</tr>
<tr>
<td>Multiple perspective-taking</td>
<td>Avolio and Bass (2004)</td>
</tr>
<tr>
<td>Problem solving (positive orientation and rational problem solving)</td>
<td>D'Zurilla, Nezu and Maydeu-Olivares (2002)</td>
</tr>
<tr>
<td>Problem solving (approach avoidance)</td>
<td>Heppner and Peterson (1982)</td>
</tr>
<tr>
<td><strong>Stage 2</strong></td>
<td></td>
</tr>
<tr>
<td>Creativity (job, team and organisation)</td>
<td>Runco, Plucker and Lim (2001)</td>
</tr>
<tr>
<td>Job-related learning</td>
<td>Loon and Casimir (2008)</td>
</tr>
<tr>
<td>Innovation behaviour</td>
<td>Scott and Bruce (1994)</td>
</tr>
<tr>
<td>Social Desirability (control variable)</td>
<td>Crowne and Marlowe (1960)</td>
</tr>
<tr>
<td>Risk Aversion (control variable)</td>
<td>Mandrik and Bao (2005)</td>
</tr>
</tbody>
</table>

The data were analysed using partial least squares (PLS) analysis. PLS was deemed to be appropriate for this study for several reasons. PLS is, firstly, more suited for this study as it is prediction-orientated, which fits the aims of the study in examining the constructs that predict innovation behaviour. The second reason relates to the flexibility that PLS affords the study, specifically because PLS does not require *a priori* relationships to be hypothesised unlike covariance-based SEM. Note that besides the hypotheses that are tested, an overall model, largely based on the hypotheses, is also tested. The third reason is because the use of PLS results in a more consistent inner structure coefficient (Cassel, Hackl & Westlund, 1999). The fourth reason is due to PLS appropriateness in analysing small samples and the fifth reason is due to its non-restrictive nature as it does not require normative assumptions of the data to hold true (Wold, 1985), in addition to not needing to adhere to the restrictive assumptions of multivariate normality (Wold, 1982). Finally, it is appropriate to use PLS when multicollinearity is present (Chin, 1998); multicollinearity is to be expected given that the independent variables are five higher-order thinking dispositions.
1.6. **Major Findings**

Control variables were used for the three endogenous variables in this study (i.e., job-related learning, creativity, and innovation). The control variables for job-related learning are years in current job and social desirability. The control variables for creativity and innovation are years in current job, risk aversion and social desirability. The major findings in relation to the six hypotheses are as follows:

i) the relationship between each of the five higher-order thinking dispositions and creativity is partially mediated by job-related learning;

ii) the relationship between job-related learning and innovation is partially mediated by creativity;

iii) when the five higher-order thinking dispositions are used concurrently to predict job-related learning, multiple perspective-taking is the only significant predictor;

iv) when the five higher-order thinking dispositions and job-related learning are used concurrently to predict creativity, job-related learning is the strongest predictor whilst systems thinking and multiple perspective-taking are also significant predictors; and

v) when the five higher-order thinking dispositions, job-related learning and creativity are used concurrently to predict innovation, creativity is the strongest predictor whilst job-related learning and multiple perspective-taking are also significant predictors.

1.7. **Limitations and Future Research**

As with all other studies, this research has a number of limitations, despite efforts to mitigate the shortcomings. The research design of this study had been revised a number of times. The original research design involved data collection from two sources, specifically from both the ‘employee’ participant and their supervisors, and involved multiple stages. However, recruiting participants for this research design proved difficult and the response rate was very low in spite of the efforts of the researcher. Given the looming deadline for this thesis, the research design was altered to only include the ‘employee’ participants, which resulted in a single data source. Despite the use of control variables, in this study, future research should address the limitation of single-source data and collect data from various sources, especially for measures such as innovation behaviour. Other data sources in addition to the participants are their supervisors, colleagues/team mates and/or performance appraisals. In addition, the longitudinal aspect of the research design may be extended.
in future research to involve more phases to reflect the different parts of the conceptual model (i.e., dispositions, learning, creativity and innovation).

Another limitation of the study is the use of convenience sampling. Given the ubiquitous nature of innovation, and in addition to how it is broadly interpreted (e.g. including innovations in improving one’s own work), employees in many occupations could participate in the survey. In addition, the sample size could have been larger (if not for attrition of participants from the first phase). Future research may address this limitation by sampling a larger group of participants. Random sampling could be applied and stratified sampling could be adopted especially to further investigate the nature and differences in innovation behaviour in different contexts such as those in turbulent environments versus those that are in relatively stable environments. Comparisons could also be made in terms of roles, occupations and sectors.

The focus of this study is on the typical performance. Whilst investigation into maximal performance was not part of the research scope, its inclusion may enrich understanding on how the phenomena and constructs interrelate with one another. Future research may adopt such a ‘balanced’ approach and compare how constructs related to typical and maximal performance, respectively, impact on innovation and other organisational outcomes, at the individual, group and organisational levels. In addition, future research may also investigate the relationship between higher-order thinking disposition and actual thinking ability, and their effects on innovative behaviour.

In terms of the dependent variable, future research may investigate the correlation between higher-order thinking dispositions and other organisational outcomes such as leadership behaviours and resistance to change. Such studies may also examine a nomological network and the relationships amongst these constructs.

1.8. Structure of the Dissertation

This dissertation is organised into six chapters. Chapter 1 has provided an overview of the entire research project, specifically in terms of outlining the background of the research, but more importantly in justifying the research from both a theoretical and a practitioner perspective. The remainder of the thesis is organised into four chapters. Chapter 2 contains the literature review, whilst Chapter 3 contains the rationale of the hypotheses. Chapter 4 involves the description and justification of the choices made in
regards to the research methodology. Chapter 5 contains a presentation of the findings of the data analysis, and finally Chapter 6 includes a discussion of the findings in light of literature and theory, and a conclusion to the entire research project. The contents of each chapter are described in more detail below.

Chapter 2 contains a literature review of innovation, which is the dependent variable in the conceptual model. The first section discusses the various facets of innovation. The section on innovation discusses the philosophy that underpins innovation followed by a review of a number of definitions of innovation in identifying the primary nature of innovation as viewed by various scholars. The different forms of innovation and the corresponding processes that support such innovations are discussed. A common thread across the innovation processes, the innovation behaviour of individuals, is identified. This leads to a discussion of the various facets at the individual level, in particular cognitive facets.

Chapter 3 contains a discussion that develops and rationalises each of the six hypotheses. This section conjectures why and how the relevant variables are related to one another. Chapter 4 contains the justification for the research paradigm, strategy and methodology that was adopted. This chapter also contains a discussion on the issues and debates concerning the key elements in the research design. Partial least squares will be used as the primary method of data analysis to test the hypotheses.

Chapter 5 contains a presentation of the findings. The descriptive statistics of the participants and the variables are first presented. This is a followed by a presentation of the analysis of the data in terms of examining the reliability and validity of the measures used. Next, the findings in regards to each hypothesis are presented.

Chapter 6 is the last chapter and contains a discussion of the findings and concludes the project. The discussion of the findings considers each hypothesis in light of relevant literature, as the findings are synthesised with existing theories. This leads to a discussion of the implications of the findings for relevant theories as well as for practice. The discussion also involves valuing the importance of a more holistic view of the individual when considering innovation behaviour that includes personality traits. In terms of the implications for practice, this study informs human resource management practices of recruitment and selection, and development. This chapter ends with a discussion of the study’s limitations and potential directions for future research.
2.0. CHAPTER TWO – LITERATURE REVIEW

2.1 INNOVATION

This chapter reviews the literature on innovation and the other constructs presented in the conceptual model in Chapter 1. The literature review supports the development of Research Question One (i.e. How do higher-order thinking dispositions influence innovative behaviour?) by exploring relevant topics. Firstly, we explore the nature of innovation by examining its philosophical underpinnings, and the definitions that have been proposed by various authors, such as academics, practitioners, government and even institutions. The understanding of innovation is further enhanced by exploring the various types (outcomes) of innovations, and how people’s behaviours are ultimately one of the most important factors in ensuring that innovation comes into fruition. The extant literature on higher-order thinking dispositions explores the two branches of cognition and dispositions as two separate streams. The discussion then converges in showing how both impact one another and an integrated view allows for better theorising. This part of the literature review shows how higher-order thinking dispositions impact overt behaviours, in particular innovation behaviour. The literature review also supports the development of Research Question Two (i.e. Are some dispositions more important than others in terms of facilitating innovative behaviour?) and in turn the six hypotheses, by examining the various types of higher-order thinking dispositions in particular critical thinking, problem solving, metacognition, systems thinking and multiple perspective-taking) that influence innovation behaviour in the workplace.

Section 2.1 discusses the main construct (dependent variable) of innovation. This section contains a discussion on the philosophical underpinning of innovation, its varied definitions, outcomes and the importance individuals’ behaviours for innovation to materialise. Section 2.2 contains a discussion of higher-order thinking dispositions. Both cognitive and socio-emotional aspects of a person are discussed on how the both complement one another, which supports this study’s perspective of an integrated view.

The subsequent section identifies and discusses the higher thinking dispositions. Section 2.3 concerns critical thinking. Whilst Section 2.4 contains an outline of problem solving. Section 2.5 discusses metacognition self-consciousness, whilst Section 2.6 explores the notion of system thinking. Section 2.7 discusses multiple
perspective-taking. Section 2.8 contains a discussion concerning job-related learning. Sections 2.9 contains a discussion on creativity.

2.1.1 Philosophical Underpinnings
The identification of the philosophical underpinnings of innovation is critical as it facilitates a better understanding of the subject matter as it explores the fundamental idea and aspects of innovation (Ridling 2001). An enquiry into the core elements of innovation may prompt the following questions:

- What is innovation?
  - What are its attributes?
  - Is innovation based on mere novelty or functionality?
- Who is the judge of what qualifies as an innovation?
  - Are inventors the judge of what is an innovation?
  - Are the recipients of an innovation a better judge of whether or not it is an innovation?
- How does an innovation come into being?
  - How does innovation thrive?
  - What impedes innovation?

The questions above generally relate to both epistemology, the theory of knowledge, and ontology, an enquiry into the existence of entities (Ridling 2001). The epistemological, ontological and axiological perspectives of innovation offer an effective starting point in understanding innovation as innovation has various forms, and the term is used to describe outcomes, processes and perspectives (The Advisory Committee on Measuring Innovation in the 21st Century Economy 2008; Teece 2010).

2.1.1.1. Pragmatism
The evaluation of what qualifies as an innovation involves a significant degree of subjectivity as it is experiential. Whilst innovation may involve some degree of research and development, and thus indicate that it is underpinned by the philosophy of science, science and technology do not necessarily always play a role in innovation (Schumpeter 1947). Something may qualify as an innovation due to its design, which suggests that innovation is perhaps underpinned by the philosophical debates in relation to design and aesthetics (Mahdjoubi 2003). For example, Teece (2010) claims that business model innovation is essentially an art form. Alternatively, an innovation may arise due to exaptation, which is the application of an existing technology in a different domain (Dew, Sarasvathy & Venkataraman 2004).
Innovation is not exclusively any of the above (e.g. research and development, design and exaptation) and may involve one or a combination of various factors. Innovation cannot be explained by one theory (Wolfe 1994b). Wolfe (1994, p. 406) rationalises that “…there can be no one theory of innovation, as the more we learn, the more we realise that ‘the whole’ remains beyond our grasp...”. It is apparent that the philosophical underpinning of innovation does not necessarily concern a permanent ontological form that is preceded by an exact consensus of its epistemological foundations. Rescher (2005) cites John Dewey and Charles Sanders Pierce’s observations of inquiry as self-correcting process such as the process of innovation, where perspectives and activities are revised in light of new knowledge and experience. The epistemological foundations of pragmatism lies in the emphasis on experience, as an extension of critical empiricism, rather than a priori reasoning (Ridling 2001). Pragmatism, nonetheless, also has similarities with phenomenology as Schiller states that reality and truth are not eternal verities but are “man-made” (Ridling 2001).

Innovation, first and foremost, is about the consequences as perceived by those who benefit from the innovation rather than its form or the type of knowledge that underpins it (e.g. novel) (Organisation for Economic Co-operation Development 2005). For example, von Hippel’s (1988) research on the employment of lead users to discover new innovations suggest that innovation is about pragmatism and utility (i.e. what users find expedient, useful and beneficial). In other words, it is the practical consequence of an application that counts, and the meaning of any concept lies in its application (Haack 2003). Haack (2003) cites Schiller, a proponent of pragmatism, in asserting that truth is what is valued by individuals and thus truth is relative as it is dependent on individuals.

The philosophical underpinning of innovation is thereby guided by the interpretation of the function that it serves (Haack 2003). This suggests that the philosophical underpinnings of innovation are best guided by axiology, which is the study of values (Searle 2003). A tradition of philosophy that corresponds to the aims of axiology is pragmatism (Ridling 2001) and its related constructs of praxis and praxeology (Molander 1998). Pragmatism, as a hyponym, is about what works and what is useful (i.e. utility) in solving contemporary problems that traditional solutions are not able to address (Blackburn 2003). The philosophy of pragmatism concerns empirical, experimental, and purposive thought premised upon experience and its application (Haack 2003). Thus, studies of innovation are generally based on praxis, the outcome
of actions (Rescher 2005), as well as praxeology (Molander 1998), which in this case is the ‘practice’ of being innovative.

As with all action and practice-based fields, context is crucial. The different approaches to the process of innovation within organisations do not undermine one another as each has its advantages and disadvantages. The appropriateness of a particular approach depends on the purpose it is to serve (e.g. praxis; (Saren 1984b). As such, a general model of innovation is neither practical nor appropriate (Rothwell 1994).

Rescher (2005) suggests that any policies, programmes, process, procedures and tools for innovation are best validated by their effectiveness in serving the purpose for which the innovation is intended. From an informal logic perspective, the claim of what is an innovation depends on whether it is warranted, which in turn depends on the contextual nature of the innovation (e.g. user and timing of the innovation) (Toulmin 1976).

Using business model innovation as an example, Teece (2010) asserts that business models are developed and created to solve problems in the real world. As problems in the real world are varied and complex, there is no single theory or paradigm that can be adopted to explain business models. Teece (2010) intimates towards the paradigm of pragmatism as he articulates the fluidity and advent of markets, and competitions that in turn impact the indefiniteness of business models when he states, “intangible products are in fact ubiquitous, two-sided markets are common, and customers don’t just want products; they want solutions to their perceived needs. In some cases, markets may not even exist, so entrepreneurs may have to build organizations in order to perform activities for which markets are not yet ready. Accordingly, in the real world, entrepreneurs and managers must give close consideration to the design of business models and even to building businesses to execute transactions which cannot yet be performed in the market.” (p. 175).

Charles Sanders Peirce, William James, Richard Rorty and James Dewey are generally observed as the key originators and contributors of pragmatism (Rescher 2005; Kögler 2005; Haack 2003). The philosophy of pragmatism reflects its roots in the US, specifically the American “go-getter” spirit and “paying off” mentality (Krugman 1999; Rescher 2005). This entrepreneurial mind set of Americans stems from the success-orientated ideology and results in the belief of practical efficacy (Rescher
Whilst many may deride pragmatism as nothing more than crass American thought and materialism, it does have some validity. Rescher (2005) postulated that pragmatism, as the term suggests, deems that practical efficacy is the test of truth, meaning and value. In other words, what works out in practice has some determination of truth, rightness and value. Pragmatists thus regard pragmatism as a valid standard and philosophy (Rescher 2005).

Pragmatism is also observed as the antithesis to the ideological controversies in European philosophy (Searle 2003). Unlike many philosophies that originate from Europe, pragmatism is a form of empirical philosophy rather than an analytical form (Kögler 2005; Searle 2003). For example, Krugman (1999) noted that the difference between the German and US economies is due to each country’s philosophical foundation; that is, the categorical imperative of Immanuel Kant in Germany and pragmatism as intellectualised by William James in the US. Krugman (1999) reasoned that Germany’s excellence in manufacturing can be attributed to the Germans’ desire for precision in rules, clarity in principles and the definitive truth. In the US, in contrast to Germany, Krugman observes Americans as philosophically “sloppy”, in that it is flexible with no clear set of rules and does not seek truth but what is practical. Krugman intimated that American entrepreneurism is potentially due to the adoption of pragmatism. Emmanuel Kant postulated that human enquiry of achieving totality will never be attained and thus sufficiency is potentially the goal that is most realistic (Rescher 2005). Pragmatism is not a quest for certainty. However, pragmatism as a philosophy may suffer from circular argumentation (i.e. it works because it does).

2.1.1.2. Praxis and Praxeology

Whereas pragmatism generally concerns “outcomes”, praxis and praxeology are concerned with the activities and practices that precede an outcome. Praxis and praxeology belong to the pragmatic tradition (Molander 1998). Praxis means “doing”, and was a general characterisation of eastern European thought, whose primary concern involved making changes in terms of economic and social life, and as well as humanistic and ethical positions (De George 2005). Praxeology is the philosophical and systematic analysis and account (logos) of human conduct and practices (praxis) (Molander 1998).

Molander (1998) states that there are three common principles to which praxeologists adhere to: i) analyses of human activities and practices provides effective insights, ii) assumptions that human activities that varied and iii) insights gained should be
carefully describe and elaborated. Whilst this may initially seem inconsistent with the positivist paradigm that is adopted in this research, praxeology is indeed coherent with pragmatism. The principles of praxeology play a critical role in the literature review in the form of identifying and organising the insights developed by other researchers in the development of the hypotheses, whilst this research aims to examine the relationships between some of the insights (Molander 1998).

The scientific method of pragmatism, and praxeology, highlights the reiterative process of science based on the three types of reasoning, abduction, deduction and induction (Haack 2003). Abduction involves postulating hypotheses premised upon the observation of some phenomena, whilst deduction is the result of the abductive hypotheses and induction is the testing of such hypotheses (Haack 2003). Haack (2003) claims that Peirce’s development and employment of abduction in pragmatism is premised upon the principle that logic should be succinct, parsimonious and economical, also referred to as Occam’s Razor\(^1\) (Blumer et al. 1987).

Praxis and praxeology are relevant to innovation as it emphasises the meticulous analyses of particular examples and cases to deduct ontological and conceptual forms (Molander 1998). In addition, it stresses the situatedness of the inquirer (De George 2005). Praxeology thus reflects the general approach in studying innovation, in both a normative and descriptive manner (Ridling 2001). There are various innovation outcomes such as products, services, processes, marketing, organisational/management and business models. The process that precedes each outcome is varied. Indeed even the process within each outcome is also very much different. Thus each inter and intra case analysis needs to be performed prior to drawing conclusions and conceptualisations. In addition, understanding the situatedness of the investigator is important as it reveals the paradigm adopted by the investigator as innovation is be investigated from various perspectives such as science, technology, psychology, behaviour and organisational culture.

The philosophical tradition of pragmatism and praxeology fits with the concept of innovation. Pragmatism, and ultimately praxeology, adopts the view that the ultimate justification of any utility in the world is those that helps with solving and/or coping with problems (Blackburn 2003). This is akin to the general adage that ‘necessity is the mother of all inventions’. Innovation is a concept that corresponds to the

\(^1\) The explanation that is most parsimonious and with the fewest assumptions is usually the most effective
philosophy of pragmatism, as well as praxeology, as both are concerned about employing critical methods in investigating problems rather synthesising knowledge in a universal manner (Ridling 2001).

2.1.2. Definitions of Innovation

Definitions are important as they enhance clarity and understanding in terms of what a concept is, what it means, and what it is not. The definition for innovation is no different and as with many other scholarly concepts, these definitions overlap to some degree but also vary significantly. Definitions of innovation have different foci. Some definitions are inclined to focus on the ‘outputs’ of innovation, and some view innovation as a process. This sub-section will review a number of definitions with various inclinations in demonstrating the robustness of the concept. The first set of definitions generally outlines the dichotomy between invention and innovation, and this is followed by definitions related to the outputs and types of innovations. The next set of definitions relate to the process and activities of innovation, with the ‘outcomes’ of innovation presented next. Finally, the last definition is one that we adopt as a working definition for this paper as it is deemed to be the most robust.

Innovation is the exploitation of ideas. Innovation is the exploitation and transformation of inventions into something that has economic utility and/or social benefit. Thus, an innovation, whilst related to, is different from an invention. Freeman (1987, p. 7) defined invention as “…an idea, a sketch or model for a new or improved device, product, process or system”. An invention, though novel and interesting, may not be useful (Freeman 1987). Freeman (1987) goes on to postulate that “an innovation in an economic sense is accomplished only with the first commercial transaction involving the new product, process, system or device…”.

Saren (1984a) supports this view in asserting that “innovation is the process by which an invention is first transformed into a new commercial product, process or service. It can be distinguished from both invention – the discovery of a new technique, and diffusion – the innovation’s adoption or imitation.” (pp.11-12). However, some researchers such as Rutten (1959) argue that invention is part of the innovation process: “refusal to identify innovation with invention does not sufficiently identify the concept of innovation.” (p. 598).

Tidd and Bessant (2010) posit that innovation does not just derive from inventions per se but also from knowledge and ideas as they assert “innovation is the process of
growing [inventions] into practical use...[whereas innovation] is the complete
development and exploitation of aspects of new knowledge, not just inventions” (p. 16). This notion is supported by von Stamm (2004) who states that “innovation is the commercially successful exploitation of ideas” (p.13). Stam (2004) acknowledges that this definition takes a narrow view of innovation and that innovation is more encompassing. Stam (2004) states that innovation is a frame of mind that involves continuously and constructively challenging the status quo and making new connections.

Innovation is also defined in terms of its outputs. Indeed, Schumpeter (1934) outlined these ‘outputs’ or innovations when he stated that innovation involved:
1. Introducing goods and services that are new to consumers, or one of increased quality than was available in the past.
2. Establishing new methods of production, which do not necessarily have to be based on new technologies or scientific discoveries. This may also involve new application, for example, the process may have already been used in other sectors.
3. Identifying and opening of new markets
4. Using of new sources of supply and/ or inputs
5. Fostering new competition, which lead to the restructuring of an ‘industry’
   (Schumpeter 1934)

The Organisation for Economic Cooperation and Development (2005, p. 45) provide the following definition of innovation: “an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations”. This definition is also adopted by the UNESCO Institute of Statistics as the basis in measuring innovation (Organisation for Economic Co-operation Development 2005), and is not too dissimilar from the view of Kline and Rosenberg (1986) who state that the ultimate criterion of what constitutes an innovation is economic utility.

Porter (1990) has a similar view of innovation as his definitions adopts a more conceptual perspective on the definition and outputs of innovation. He argues that innovation also involves organisational functions, marketing and distribution, and posits that innovation “includes both improvements in technology and better methods or ways of doing things. It can be manifested in product changes, process changes, new approaches to marketing, new forms of distribution, and new concepts of
West and Farr (1990b) extend the view on the output of innovation as they define innovation as a social process and recognise its role in society (West & Farr 1990a). They define innovation as “the intentional introduction and application within a role, group or organisation of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organisation or wider society” (p.9).

Some scholars have highlighted the process of innovation. Rothwell and Robertson (1973) state that “innovation is a logically sequential, though not necessarily continuous process which can be sub-divided into a series of functionally separate, but interesting and interdependent stages, and the overall pattern of the innovation process can be thought of as a complex net of communication paths linking the various stages of the process.” (p. 14). However, Kline and Rosenberg (1986) disagree as they argue that innovation is complicated and complex, with its process somewhat disorderly and at times in disarray as it is influenced by numerous factors.

Other definitions of innovation adopt a broad perspective of innovation associating it with intangible outcomes (instead of tangible outputs) such as change (Patterson et al. 2009b). For example, the European Commission (1995) states that innovation is essentially about change involving three activities “the renewal and enlargement of products and services and the associated markets; the establishment of new methods of production, supply and distribution; and the introduction of changes in management, work organisation, and the working conditions and skills of the workforce” (p. 2).

This view is supported by Tether (2006) who defines innovation as “major changes aimed at enhancing your competitive position, your performance, your know-how or your capabilities for future enhancements. These can be new or significantly improved goods, services or processes for making or providing them. It includes spending on innovation activities, for example on machinery and equipment, R&D, training, goods and service design or marketing” (p. 3). The National Endowment for Science, Technology and the Arts (NESTA) in the United Kingdom is explicit in tying innovation and change together as they state that “change associated with the creation
and adaptation of ideas that are new-to-world, new to nation/region, new-to-industry or new-to-firm” (Patterson et al., 2009, p. 12)

All the definitions of innovation presented above, although having different emphasis, are valid. Nonetheless, this study adopted the definition provided by the Advisory Committee on Measuring Innovation in the 21st Century Economy, which consists of academics (e.g. Harvard University) and practitioners (e.g. Steve Balmer, Chief Executive Officer of Microsoft at that time) (The Advisory Committee on Measuring Innovation in the 21st Century Economy 2008). The committee, in its investigation into the measurement of innovation, reported to the Secretary of Commerce in the U.S. Department of Commerce that “innovation is the design, invention, development and/or implementation of new or altered products, services, processes, systems, organizational structures, or business models for the purpose of creating new value for customers and financial returns for the firm.” (The Advisory Committee on Measuring Innovation in the 21st Century Economy, 2008, p. i)

Innovativeness is the propensity to both produce and/or adopt ideas that ultimately lead to some form of innovation (Axtell et al. 2000; Scott 1994). In terms of producing innovation, innovation behaviour involves being able to recognise and bring about new, novel, valuable and tangible concepts (Adams, Bessant & Phelps 2006; Bessant & Tidd 2011; Tranfield et al. 2003). From the perspective of innovation, diffusion and adoption, Rogers (2003) defines innovativeness as “the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than the other members of a system” (p. 22).

Innovativeness manifests itself behaviourally. However, this behaviour is driven by various factors. The set of factors that is of interest in this study are the qualities of an individual specifically their predispositions to think in a certain manner that influences their innovativeness.

In summary, the definitions of innovation characterise innovation in terms of the successful economic exploitation of ideas and inventions that leads to significant change. In other words, to qualify as an innovation, the idea must be relatively original and have application and utility. Innovation is multi-faceted and may be in the form of products, services, processes and organisational, and its ‘nature’ can be incremental and radical. Innovation is pervasive and is not only reserved for organisations in high-technology industries as any organisations can engage in innovation. Innovation leads
to many benefits such as increased productivity and competitiveness, and ultimately higher standards of living.

2.1.3. Innovation Outcomes
The discussion in this section shows the varied forms and types of innovation (i.e. products, services, process, marketing, technology, and organisational and business models). The purpose of this section is to demonstrate that ultimately, irrespective of the final form of innovation, innovation is ultimately grounded on the innovation behaviours of individuals, which is the dependent variable of this study. The Advisory Committee on Measuring Innovation in the 21st Century Economy (2008) identifies six outcomes of innovation in the form of “products, services, processes, systems, organizational structures, or business models” (p. 1). The Organisation for Economic Co-operation Development (2005) identifies four outcomes of innovation; product, process, marketing and organisational. This study combines and refines definitions from these two sources into seven outcomes; i) products, ii) services, iii) process, iv) marketing, v) technology (which includes systems), vi) organisational (which includes organisational structures), and vii) business models. The following sub-sections contain a brief outline of each innovation outcome.

2.1.3.1. Product Innovation
Product innovation is perhaps one of the most well-known and understood outcomes of innovation. Product innovations (as with services innovations) are organisations’ offerings to the external market (Omachonu & Einspruch 2010; Perri 1993). A product is usually a ‘complete’ artefact that is marketed and sold to end consumers. A product innovation is when newness and novelty are present in the design, aesthetics and/or functionality (feature). An example includes the iPhone when it was first released. The iPhone’s sleek design and aesthetics were quite different from its competitors (i.e. newness), and the touchscreen and applications (functionality) qualified it to be a product innovation.

The Organisation for Economic Co-operation Development (2005) defines product innovation as “the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics” (p. 48). The Organisation for Economic Co-operation Development extends the use of this definition to services.
The process of product innovation (and not necessarily process innovation) is also termed as new product development or ‘NPD’ (Goffin & Mitchell 2010). There is a long history of how product innovation takes place (Rothwell 1994; Saren 1984b; Hart & Baker 1994; Baker & McTavish 1976).

Many frameworks and models have been developed and applied. These frameworks and models are continuously evolving, and it would be beyond the scope of this sub-section to outline all the relevant literature related to product innovation. Nonetheless, this sub-section identifies the practices (i.e. best practices) that have been proven to be most relevant and effective across time and situations. A ‘best practice’ is essentially a recognition given to a practice that is deemed to be most effective (for a given outcome) (Tidd & Hull 2006).

The Product Development and Management Association (PDMA) in the United States of America surveys organisations intermittently to identify best practices (Griffin 1997). The following are a list of some of the best practices that have been adopted by successful organisations in new product development and innovation (Arthur D. Little 1991; Booz Allen and Hamilton 1968; Page 1993; Mercer Management Consulting 1994; Goffin & Mitchell 2010; Mitchell Madison Group 1995; Pittiglio 1995):

1. Link the new product development process to the organisation’s strategy
2. Measure the new product development process
3. Tangible and visible senior management sponsorship and attention
4. Provide adequate resources
5. Use a customer-centred, disciplined NPD process
6. Adopt and manage the new product portfolio
7. Early supplier involvement
8. Use multi-functional teams
9. Empower teams
10. New product development scope includes entire augmented product
11. Structured process, action-oriented phase reviews

The practices above are considered effective (i.e. best) as a number of companies sampled that have adopted some of these best practices reported a new product development success rate ranging from 58 per cent to 67 per cent (with an average of 59 per cent) (Griffin 1997). Griffin (1997) conducted a survey in 1997 and reported
new best practices (for both product and services) that had emerged in addition to those mentioned earlier:

1. Use of the stage-gate process.

2. New product development and innovation initiatives are strategic. The drive new product development and innovation initiatives at both programme and project levels through strategy of the organisation.

3. Professional and skilled project managers and champions lead new product development projects and are appointed by management team.

4. Team-based rewards are used.

5. Best practices firms expect 45 per cent of the sales to come from new products commercialised in the last three years.

6. Best practice firms also focus on improving the cycle time of their new product development and innovation cycle (at an average of 23.8 months in 1997)

The best practices listed are not static and will change as the environment changes. New product innovation best practices will evolve in sophistication on multiple fronts (e.g. skills, and the application of enabling and core technologies). There are various methods that organisations adopt to maintain their innovation process as competitive as possible. Some best practices are context specific and their applicability is dependent on situational factors. Thus, whilst there may be best practices for product innovation, how these practices are combined and implemented will also play a role in their effectiveness.

2.1.3.2. **Service Innovation**

The literature has historically focused on manufacturing and product innovation due to its tangibility and observability, hence enabling researchers to identify archetypical modes and processes of innovation in a relatively straightforward manner (Omachonu & Einspruch 2010). However, such a task is more challenging for service innovation.

Service innovation is a critical area of research given services is a major component/sector in many, if not all, of the major economies. Service innovation is about satisfying and delighting customers by engaging the customer throughout the delivery of the service. Services are economic activities that do not result in a physical or tangible output (e.g. product) but which benefit the consumer (Omachonu & Einspruch 2010).
Service in innovation is defined by the University of Cambridge Institute for Manufacturing and International Business Machines Corporation (2007) as “a combination of technology innovation, business model innovation, social organisational innovation and demand innovation with the objective to improve existing service systems (incremental innovation), create new value propositions (offerings) or create new service systems (radical innovation)” (p. 17)

From the perspective of businesses, services nowadays permeate every aspect of the value proposition of any business. Services are at the core of many organisations especially those in the public and third sector. An example of a service offered by many organisations across all sectors is the provision of online bill payment systems (Organisation for Economic Co-operation Development 2005). Even whilst a business primarily offers a (tangible) product there will be services that will be associated with delivering and maintaining that product. For example, automotive manufacturers now provide services when new cars are sold. Some services may include warranty, insurance, and buyback guarantee. Another example involves IBM, which has evolved from offering just products/technologies to offering a ‘one-stop solution’ value proposition that significantly involves services.

Similar to product innovation, the process that results in service innovation is termed new service development or ‘NSD’ (Goffin & Mitchell 2010). In understanding how NSD is different to NPD, the key differences between services and products (i.e. Goods) need to be highlighted. The key differences are intangibility, inseparability, perishability and variability (Palmer 2011). Products are tangible and can be “taken home” by customers, however consumers of services do not take ownership of any tangibles elements but they are able to derive value and benefit from goods, skills, facilities and systems (Ganz 2007). Inseparability means that the production and consumption of service usually cannot be detached from one another, whilst perishability refers to the expiration of services (Palmer 2011), for example, the opportunity to provide a service by a waiter in a restaurant is only available whilst he/she is working. Variability refers to the numerous factors that services are susceptible to in terms of the delivery of the service in meeting customer needs (Palmer 2011).

As an example, Palmer (2011) outlined the service encounter of a typical airline customer in Table 8. Palmer identified the numerous “touch points” or critical incidents that occur between an airline and its customer in the service encounter that
may lead to a customer’s satisfaction or dissatisfaction with the service. The critical incidents reveal that due to the variability, in terms of touch points and people employed by a service provider, in any service, the design and management of services are generally more challenging with services than with products.
Table 8: An example of a critical incidents between an airline and its customers
(=Palmer 2011=)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Critical incidents</th>
</tr>
</thead>
</table>
| Pre-sales                    | • Initial telephone enquiry  
  • Making reservation     
  • Issue of ticket          |
| Post-sales, pre-consumption  | • Check-in baggage  
  • Inspection of ticket  
  • Issue of boarding pass 
  • Advice of departure gate 
  • Quality of airport announcements 
  • Quality of waiting conditions |
| Consumption                  | • Welcome on boarding aircraft  
  • Assistance in finding seat 
  • Assistance in stowing baggage 
  • Reliability of departure time 
  • Attentiveness of in-flight service 
  • Quality of food service  
  • Quality of in-flight entertainment 
  • Quality of announcements  
  • Safe/ comfortable operation of aircraft 
  • Fast transfer from aircraft to terminal |
| Post-consumption             | • Baggage reclaim  
  • Information available at arrival airport 
  • Queries regarding lost baggage etc. |

The design and development of services thus needs to consider a number of factors such as the service process, service delivery time of each stage of the process, the touch points and actors at each stage, the potential visible and tangible artefacts to support the service, and the supporting (i.e. background) processes that enable the service to function.

Whilst there are many examples of service innovation such as music downloads, telecommunications, loyalty programmes and automated teller machines, it is difficult to identify prescriptive models of how service innovation takes place (Omachonu & Einspruch 2010). This difficulty is generally attributed to the innumerable external factors and various internal organisational capabilities required in making service innovation a success. Service innovation may take many forms such as new ways of delivering a service or a new way the organisations or its employees interact with customers and/or involve an entirely new service concept (Omachonu & Einspruch
However, the key issue involves integrating the various best practices, from strategic to operational perspectives, into archetypes that inform the organisation as to how best to undertake service innovations.

Omachonu and Einspruch (2010) assert that mastery of a number of fields of study is critical in ensuring that service innovation is successful. They posit that service innovations are informed by the fields of cognitive and social sciences, and the humanities. These fields of study allow organisations to understand factors related to people such as their thinking, attitudes, perceptions, behaviours, cultures, societal norms and preferences, and to enable organisations to develop services based on such knowledge (Chang 2011). In addition, such knowledge contributes to the understanding and effectiveness of innovation models such as the Response Model for Innovation.

Whilst cognitive and social sciences allow organisations to understand and develop service innovation, service organisation are, however, also significantly reliant on information technology to deliver or enable the new service to materialise (Chang 2011; Hipp & Grupp 2005). For example, the logistics industry would not be as efficient and effective as it is today without information and communications technology. It is potentially not too farfetched to claim that some service organisations develop new innovation around some technology platform.

Whilst there are challenges in developing a prescriptive model for service innovation due to the innumerable factors involved, Omachonu and Einspruch (2011) attempted to lay the foundations for such models by developing a framework that describes and links the key factors that may be involved in developing service innovations (Figure 9). They emphasise the need to gather intelligence through various means such as feedback from sales representatives and customers, and to undertake research and development informed by various fields of study especially social sciences and humanities. These inputs allow an organisation to understand consumer decision-making processes, attitudes, perceptions, expectations and behaviours.
Organisations should then convene teams, formally or informally, to assess gaps in the market and to assess if the organisation can take advantage of such opportunities by exploiting knowledge gained from their research. They posit that organisations undertaking service innovation will essentially go through three stages. The first stage is creating a service that the market needs, which is essentially to conceptualise and operationalise the service. In stage two, organisations should seek incremental improvements of the service. In stage three, organisations should innovate and devise services that customers would never envisage, which is similar to the Kano model that posits that “delighters” are qualities/attributes of a product or services that are unexpected by the customer (Chen 2012).

Omachonu and Einspruch (2011) further assert in their framework that stage three should be targeted in terms of leveraging upon existing or new technologies in delivering a new service. For example, the framework illustrates four quadrants (or permutations). Quadrant one is new services that leverage upon new technology, quadrant two is new technologies that are used to operationalize existing services, quadrant four is using existing technology to deliver a new service, and quadrant three is using existing technology to deliver exiting service. It is expected that the ideal
situations are quadrants one, two and four. Quadrant three is using existing technology to deliver existing service and thus does not qualify as a service innovation.

The design of effective models and processes for new service development is important, however, due to the innumerable types of services and factors that influence services, prescriptive typologies of new service development models may be not be possible. Service-based organisation need to develop models and process that meet their unique situations and circumstances. It is imperative that service-based organisations optimise the new service development processes as services-based organisations make up half of the world’s most innovative companies (Berg & Einspruch 2009). Organisations with a process and model in place should further develop, refine and optimise these models/processes to improve their effectiveness.

The innumerable types of services and opportunities for innovations, as mentioned in the previous sections (e.g. business-to-business, business-to-consumer, process-based and outcome-based services) are an impediment to identifying common factors that may contribute to service innovations. However, there are underlying elements within most, if not all, organisations that may help with service innovation.

Hull (2003) identified five areas within an organisation where best practices for service innovation may exist; strategy, process, organisation, tools and systems (Table 9). Practice is defined as organisational practices, which usually is in the form of tacit knowledge that is embodied in individuals that manifests itself as skills and competencies and contributes to social capital (Szulanski 1996; Nelson & Winter 1982; Kogut & Zander 1992a), whilst “best practice” means that the practice usually results in superior performance (Szulanski 1996).

The best practices in terms of strategy involves adopting a ‘middle-of-the-road’ approach focussing on incremental innovations rather than be caught in the two extremes of being overly cautious or overly optimistic by investing heavily in radical innovations (Hull 2003). Process-related best practices involves adopting appropriate methodologies such as Quality Function Deployment (QFD), which outlines steps in obtaining, translating and integrating customer requirements into services, whilst “organisation” involves putting in place suitable structures, defining new roles and designing effective work systems such as team-based working (Hull 2003).
In addition “tools” generally refers to information and communications technologies that are used to assist in innovation. Examples of tools are simulations, expert systems and decision support systems (Hull 2003; Rothwell 1994). Finally, “systems” involve identifying and enhancing interconnections amongst actors within and outside of the organisation, and with other innovation-enabling artefacts such as information and knowledge systems and databases (Hull 2003).
Table 9 Strategy, Process, Organisation, Tools and System (SPOTS) concept and example of best practices in service innovations (Hull 2003)

<table>
<thead>
<tr>
<th>Area of best practice.</th>
<th>Description and examples.</th>
</tr>
</thead>
</table>
| **Strategy.**         | **Description:**  
  *A middle of the road, process approach for executing short, repeat development cycles to continuously improve existing products, services and processes instead of a conservative strategy of maintenance or a risk strategy of radical innovations.* |
| **Process.**          | **Description:**  
  *Product and service development controls for guiding product development in a flexible and enabling manner. This includes model development processes for identifying customer requirements and translating them into value-added products and services.* |
  - Example:  
    - External reconnoitring e.g. benchmarking, gap analyses, Quality Function Deployment (QFD).  
    - Internal controls e.g. model plans, standards, and documentation.  
    - Continuous improvement methods e.g. knowledge reuse, repeated loops, lessons learned. |
| **Organisation.**     | **Description:**  
  *Cross-functional teams working on development projects that cut across hierarchies of authority to integrate activities along the value chain, including upstream sources of supply and downstream customers.* |
  - Examples:  
    - Early Simultaneous Influence e.g. downstream functions co-involved at early steps.  
    - Cross-functional teeming e.g. project organisation with integrated teams.  
    - Collocation – physical e.g. eye contact among team mates.  
    - Collocation – virtual e.g. electronic and audio-visual communications.  
    - Group rewards e.g. recognition of teams, 360-degree evaluations.  
    - Integrative leadership roles e.g. coaches, product champions.  
    - Flattened hierarchy e.g. fewer levels to reach common reports.  
    - Generalist and specialist roles e.g. overlapping responsibilities, reduced hand-offs.  
    - Supplier relationships e.g. win/ win partnerships with suppliers.  
    - Customer relationships e.g. win/ win partnerships with customers. |
<table>
<thead>
<tr>
<th>Area of best practice.</th>
<th>Description and examples.</th>
</tr>
</thead>
</table>
| Tools. | Description:  
*Computer programmes for modelling strategic options, products and processes as well as enabling development plans to be continually updated and shared among cross-functional team members regardless of distance.*  
Examples:  
- Information management systems e.g. project management software, distributed database, groupware.  
- Analytical tools e.g. expert systems, decision support systems.  
- Transformation technology e.g. automated equipment.  
- External linkages e.g. electronic data-interchange (EDI) with suppliers and customers. |
| Systems. | Description:  
*Mutual adjustment among stakeholders along the value chain to optimise system-wide capabilities for generating and deploying resources in alignment with customer needs.*  
Examples:  
- Reciprocal interdependence e.g. collective responsibility involving mutual adjustments.  
- Knowledge acquisition e.g. external and internal knowledge sought and shared. |

The best practices identified by Hull are, however, not a panacea as some practices cannot be immediately or readily be transferred from one service organisation to another. Indeed, Szulanski (1996) posits that the transfer of best practices is usually difficult. A “transfer” is an event and is a form of replication of practice from one organisation to another, with successful replication dependent on the situational factors of the two parties. Transfer is akin to a “push” of practices on to the recipient. This indicates that replication is unpredictable due to the possibility of the recipient rejecting the practices. A transfer is unlike diffusion, where replication is gradual, and is akin to a “pull” with the recipients attracted to practices, and thus is more predictable (Szulanski 1996), and thus more likely to be successful.

Tidd and Hull (2006) extend Hull’s (2003) work as they identified 36 factors that influence service innovation (Table 10), however, this list should not be considered as exhaustive as there are other factors that also play a significant role in influencing how service innovations materialise. Nevertheless, Tidd and Hull’s (2006) list provides more detail and potentially a more useful prescription of factors that may facilitate service innovation in organisations in the form of a checklist.
Table 10: Factors influencing the effectiveness of service innovations (Tidd & Hull 2006)

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>Level of customer focus.</td>
</tr>
<tr>
<td>3.</td>
<td>Degree of recognition of planned opportunism.</td>
</tr>
<tr>
<td>4.</td>
<td>Clarity of strategic objectives.</td>
</tr>
<tr>
<td>5.</td>
<td>Types of core business competencies.</td>
</tr>
<tr>
<td>6.</td>
<td>Types of core technology competencies.</td>
</tr>
<tr>
<td>7.</td>
<td>Depth of market assessment.</td>
</tr>
<tr>
<td>8.</td>
<td>Effectiveness of requirements management.</td>
</tr>
<tr>
<td>9.</td>
<td>Degree of cross functionality deployment.</td>
</tr>
<tr>
<td>10.</td>
<td>Depth of development planning.</td>
</tr>
<tr>
<td>11.</td>
<td>Types of design standards.</td>
</tr>
<tr>
<td>12.</td>
<td>Level of documentation.</td>
</tr>
<tr>
<td>13.</td>
<td>Breadth of product/service reviews.</td>
</tr>
<tr>
<td>14.</td>
<td>Degree and focus on continuous improvement.</td>
</tr>
<tr>
<td>15.</td>
<td>Degree of external partnering.</td>
</tr>
<tr>
<td>16.</td>
<td>Degree of project orientation.</td>
</tr>
<tr>
<td>17.</td>
<td>Extent of cross functional teaming.</td>
</tr>
<tr>
<td>18.</td>
<td>Degree and type of co-location.</td>
</tr>
<tr>
<td>19.</td>
<td>Level of ambidexterity.</td>
</tr>
<tr>
<td>20.</td>
<td>Type of team rewards for innovation.</td>
</tr>
<tr>
<td>22.</td>
<td>Breadth of team boundaries.</td>
</tr>
<tr>
<td>23.</td>
<td>Level and type of coaching for innovation.</td>
</tr>
<tr>
<td>24.</td>
<td>Depth of market analysis.</td>
</tr>
<tr>
<td>25.</td>
<td>Degree of sophistication of information systems.</td>
</tr>
<tr>
<td>26.</td>
<td>Scale of process control.</td>
</tr>
<tr>
<td>27.</td>
<td>Type of analytical methods employed.</td>
</tr>
<tr>
<td>28.</td>
<td>Scale of flexibility in processes and delivery.</td>
</tr>
<tr>
<td>29.</td>
<td>Degree of computer automated processes and delivery.</td>
</tr>
<tr>
<td>30.</td>
<td>Types of electronic data interchange employed.</td>
</tr>
<tr>
<td>31.</td>
<td>Use of “voice of customers”.</td>
</tr>
<tr>
<td>32.</td>
<td>Use of “voice of suppliers”.</td>
</tr>
<tr>
<td>33.</td>
<td>Degree of leverage on knowledge capital.</td>
</tr>
<tr>
<td>34.</td>
<td>Extent of service development controls.</td>
</tr>
<tr>
<td>35.</td>
<td>Scale of system integration.</td>
</tr>
<tr>
<td>36.</td>
<td>Extent of system agility.</td>
</tr>
</tbody>
</table>

Both Hull’s (2003), and Tidd and Hull’s (2006) work should be observed as a starting point in terms of being a prompt for both creating awareness and reviewing practices for service innovation in organisations. Indeed, organisations serving other businesses (e.g. management consulting firms) have to consider other additional aspects such as the role that the client plays in the delivery of the service (e.g. the clients disposition to participate) and the clients’ readiness to participate in terms of capacity and ability (Martin, Horne & Schultz 1999). Moreover, the factors identified by Tidd and Hull (2006) have different levels of importance that are contingent on an organisation’s circumstances (e.g. type of business and breadth of locations served).
Although service-based organisations have more innovation opportunities, due to the numerous service encounters and critical incidents as mentioned in the previous sections, service innovation is still a challenge even with the recognition of the best practices mentioned. In essence, organisations need frameworks and models that indicate “how” service innovation should and can take place, in addition to the “what” as indicated by the best practices.

2.1.3.3. **Process Innovation**

Process innovation is focussed on improving the specific methods, practices and other internal capabilities in producing and creating a product and/or service (Omachonu & Einspruch 2010; Johne & Davies 2000). The Organisation for Economic Co-operation and Development (2013) defines process innovation as “the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software” (p. 49).

Process innovation may involve an efficient process that decreases the unit cost of production (in the case of products) or delivery (in the case of product and service) (Organisation for Economic Co-operation Development 2005). Process innovation may also involve new process that enable an organisation to deliver new products or services (thus going hand-in-hand with product/service innovation). Process innovation may be enabled by the application of existing or new technologies (see Technology Innovation) to an existing process.

An example of process innovation is Aravind Eye Hospital in India, which undertakes eye operations at a fraction of what it would cost in many Western countries (Goffin & Mitchell 2010). The hospital was founded by Dr. Govindappa Venkataswamy who wanted to give the poor in India affordable eye care and address the severe problem of blindness in India. He was also fascinated by the process efficiency in McDonalds and used the same principles that McDonalds uses to prepare their burgers (Goffin & Mitchell 2010).

Process innovation is also associated with concepts such as business process reengineering (BPR) that involves radical change of processes within an organisation (Davenport 1992). These processes may be directly involved in producing the product or service, or it may involve ‘back-office’ processes (e.g. in finance and accounting, human resource and facilities management). BPR is different from the everyday
business-as-usual (BAU) continuous process improvement initiatives. Table 11 below illustrates the differences between BPR and continuous process improvement.

Table 11: Comparing continuous process improvement with business process innovation (Davenport 1992)

<table>
<thead>
<tr>
<th>Basis of comparison</th>
<th>Continuous process improvement</th>
<th>Business process reengineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of change</td>
<td>Incremental</td>
<td>Radical</td>
</tr>
<tr>
<td>Starting point</td>
<td>Existing process</td>
<td>Clean state</td>
</tr>
<tr>
<td>Frequency of change</td>
<td>One-time/ continuous</td>
<td>One-time</td>
</tr>
<tr>
<td>Time required</td>
<td>Short</td>
<td>Long</td>
</tr>
<tr>
<td>Participation</td>
<td>Bottom-up</td>
<td>Top-down</td>
</tr>
<tr>
<td>Typical scope</td>
<td>Narrow, within functions</td>
<td>Broad, cross functional</td>
</tr>
<tr>
<td>Type of change</td>
<td>Cultural</td>
<td>Cultural/ structural</td>
</tr>
<tr>
<td>Primary enabler</td>
<td>Statistical control</td>
<td>Information technology</td>
</tr>
<tr>
<td>Risk</td>
<td>Moderate</td>
<td>High</td>
</tr>
</tbody>
</table>

There is a link between product innovation and process innovation (Goffin & Mitchell 2010; Johnson, Whittington & Scholes 2011). As Figure 10 illustrates, product innovation usually precedes process innovation as the focus for the organisation at the initial stage (Stage 1) is the product itself (e.g. design, features, functionality and aesthetics). As a dominant design of the product emerges (in Stage 2), the experimentation (or rate of innovation) of the product will start to decrease. At this stage, the focus of the organisations is redirected to developing new processes to support the efficient production/delivery of the new product/service, thus the likelihood of process innovation starts to emerge (Rothwell 1994). In Stage 3, taking a market perspective, related/complementary products also begin to standardise and there is more integration with other complementary products/services. At this stage, organisations start to focus on improving specific/individual features of the product.
The key challenge in innovation management is for organisations to identify the dominant (or most in-demand) design, and then to reorganise production processes to manufacture the product efficiently and economically. From this perspective, process innovation becomes a priority during the later stages of innovation (Kline & Rosenberg 1986). Similar to product or service innovation, there is no standard ‘template’ for process innovation. Nonetheless, a crucial aspect of process innovation pertains to its ability to be implemented successfully: That is, it allows and enables the efficient and effective production and delivery of products and services.

A method of assessing the level of development of a new process in an organisation is a maturity model. A mature model allows for transparency and thus helps to influence the efficiency and effectiveness of process innovation (Bullinger, Klaus-Peter & Meiren 2003; Rapaccini et al. 2012). Maturity models are stages in evaluating the capabilities of an organisation, with higher levels of maturity indicating higher capability levels (Rapaccini et al. 2012; Zhou et al. 2012). The most influential maturity model is the Capability Maturity Model developed by the Software Engineering Institute at Carnegie Mellon (Rapaccini et al. 2012). Maturity models have been applied to many domains such as business process reengineering, supply chain management, new product development, quality management and project management (Rapaccini et al. 2012).
Goffin and Mitchell (2010) provide an example of the stage of maturity, which is presented in Table 12. There are four general stages that organisations may experience through the evolution of its new product innovation process. In its infancy, an organisation may not have any formal new product innovation processes. As it endeavours to develop one, it will experience the trials and tribulations of setting a formal process in place. This second stage results in a process being put in place but it is neither consistent nor respected by employees as a standard. As the organisation endeavours to make the process more consistent, clarity emerges in terms of defined roles and responsibilities as well as consistency. Finally, the process reaches maturity when the process is culturally ingrained, and there are regular and formal reviews of the process to improve it.

Table 12: Maturity of new product innovation process (Goffin & Mitchell 2010; Fraser, Farrukh & Gregory 2003)

<table>
<thead>
<tr>
<th>Stage</th>
<th>Characteristics</th>
</tr>
</thead>
</table>
| 1     | No formal new product innovation process.  
|       | - Resource conflicts across projects.  
|       | - No documented procedure.  
|       | - Successful outcomes due to heroics and individual skill.  
|       | - Frequent time-cost overruns and rework. |
| 2     | A process exists, but:  
|       | - It is not respected and is used inconsistently.  
|       | - It is often ignored by project teams.  
|       | - It is over-bureaucratic and seen as a burden not an aid.  
|       | - Still frequent overruns and rework. |
| 3     | Process used and understood.  
|       | - Clear roles and responsibilities.  
|       | - Process moderately well understood by all.  
|       | - It is not bureaucratic.  
|       | - It supports consistent new product innovation. |
| 4     | Continuous Process Improvement.  
|       | - Metrics exist for performance of products and process.  
|       | - Regular process reviews.  
|       | - Learning stimulated at all stages and disseminated to other teams.  
|       | - Process is culturally ingrained and understood across the business. |

Another maturity model developed by Rapaccini et al. (2012) is more granular and detailed, having five stages instead of four. The five levels of maturity are; initial stage, repeatable, defined, managed and optimised (Rapaccini et al. 2012). In applying the maturity process (for process innovation) in the context of new service in development Rapaccini et al. (2012) identified ten elements; degree of importance and relevance of new service development to an organisation, the formality of roles,
management practices, budget allocation, tools and methods applied, skills, involvement of customers, suppliers and other stakeholders, feedback systems (satisfaction, acceptance and impact of new services) and establishment of key performance indicators (KPIs). These elements are derived from the four dimensions of new service development. Rapaccini et al. (2012) created a rubric in describing each stage of maturity (Table 13).

In the context of service innovation processes, an organisation in the initial stage of the maturity model does not place any importance on new service development and this is reflected by the absence of any activity related to new service development. At the repeatable stage, an organisation will possess some ad-hoc, reactionary processes to new service development. At the defined stage, there is more formality to the new service development model but it is still lacking in terms of adopting best practices. In the managed stage, new service development is at the forefront of an organisation’s priorities and this is reflected by the allocation of budgets and application of tools, methods and skills. In the optimised stage, an organisation may be viewed as a leader in this new service development. Applying Bullinger, Klaus-Peter and Meiner’s (2003) service typology to the maturity model, some service innovation models may reach maturity (i.e. optimisation stage) sooner than others (i.e. “Service type A”) due to low contact intensity and variability of services, and thus have less factors (e.g. up skilling, and training and development) to consider and incorporate.
Table 13: Rubric of key dimensions and elements capability maturity model of process innovation in the context of new service development  
(Rapaccini et al. 2012)

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Organisational approach</td>
<td>Importance and relevance of new service development</td>
<td>No relevance, focus on day-to-day activities.</td>
<td>Focus on current service development, new service elements added as occasional.</td>
<td>Focus on new services development and supplementary services.</td>
<td>Focus on integrated development of services (with other services and other aspects of the organisation).</td>
<td>Focus on developing customer solutions or holistic service systems.</td>
</tr>
<tr>
<td>Roles</td>
<td>No formal or informal roles.</td>
<td>Project-based teams, extemporaneous, ad hoc identification of participants.</td>
<td>Project-based recognised teams, inter-functional Perspective.</td>
<td>Formal role responsible of new service development projects and project-based teams.</td>
<td>Formal role or function and project-based teams. Roles (e.g. quality) dedicated to the evaluation and improvement of methodological aspects.</td>
<td></td>
</tr>
<tr>
<td>Management practices</td>
<td>No formal procedures, chaotic and non-systematic approach.</td>
<td>Basic project management.</td>
<td>Advanced project management.</td>
<td>Standard advanced project management (standard = shared between the resources; advanced = uses specific project management tools).</td>
<td>Standard advanced project management and benchmark procedures for continuous improvement.</td>
<td></td>
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<td>-------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Resources</td>
<td>Budget</td>
<td>New service development not seen as requiring budget.</td>
<td>Minimal budget for ad hoc projects.</td>
<td>Specific budget (allocated yearly).</td>
<td>Specific budget allocated according to mid-term plans.</td>
<td>Budget consistent with the objective to achieve the best performance for new service development.</td>
</tr>
<tr>
<td>Tools and methods</td>
<td>No methods and tools.</td>
<td>No standard approach (ad-hoc, project-defined). General purpose tools.</td>
<td>General purpose tools.</td>
<td>New service development methods/framework in place, development process formalised. Specific supporting tools.</td>
<td>New service development methods/framework in place. Development process formalised. Specific supporting tools for the different phases (idea generation, service and process design, testing). Best-of-breed tools, continuous improvement of methods (customisation/declination of existing methods to the specific company needs).</td>
<td></td>
</tr>
<tr>
<td>Skills</td>
<td>No awareness of the skills required to develop new services.</td>
<td>Self-training of involved people. Ex post, informal evaluation of competence gaps.</td>
<td>Formal training activities (general purpose, e.g. project management).</td>
<td>Investment in training in specific new service development-related skills. Recruitment focused on critical skills for successful new service development.</td>
<td>Skills assessed periodically. Investment in training in specific new service development-related skills. Recruitment focused on critical skills for successful new service development.</td>
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<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Customers, suppliers and other</td>
<td>Customers</td>
<td>Customers not involved.</td>
<td>Some customers are occasionally involved in the definition of requirements.</td>
<td>Customers are surveyed for market analysis and requirements definitions.</td>
<td>Customers are also involved in verification and testing of new services</td>
<td>Some customers are also involved as co-producers/co-designers, even for</td>
</tr>
<tr>
<td>stakeholders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>prior to definitive launch.</td>
<td>broader-scope solutions.</td>
</tr>
<tr>
<td>Suppliers and other stakeholders</td>
<td>Stakeholders are not</td>
<td>Stakeholders are not involved in new service development projects (e.g.</td>
<td>Only internal representatives of impacted functions are involved in (or</td>
<td>Internal stakeholders that can be helpful (e.g. in defining the market</td>
<td>Both internal and external parties that could be interested in/impacted</td>
<td>Both internal and external parties that could be interested in/impacted</td>
</tr>
<tr>
<td></td>
<td>involved in new service</td>
<td>requirements definition, process blueprinting). No attention of possible</td>
<td>listened to) new service development projects.</td>
<td>requirements, in designing the service contents, in modelling the delivery</td>
<td>by the new services are identified and involved. Relationships with</td>
<td>by the new services are identified and involved. Relationships with</td>
</tr>
<tr>
<td></td>
<td>development projects</td>
<td>contribution of and impact on other supply chain actors.</td>
<td></td>
<td>process, etc.) are involved in the new service development projects. Some</td>
<td>process to improve the new service development processes and management</td>
<td>highly skilled external parties (i.e. research centres, consultants) are</td>
</tr>
<tr>
<td></td>
<td>(e.g. requirements</td>
<td></td>
<td></td>
<td>external stakeholders (e.g. delivery network) may be listened to prior to</td>
<td>system.</td>
<td>established, maintained and exploited to improve the new service</td>
</tr>
<tr>
<td></td>
<td>definition, process</td>
<td></td>
<td></td>
<td>proceeding to detailed tasks.</td>
<td></td>
<td>development processes and management system.</td>
</tr>
<tr>
<td></td>
<td>blueprinting)</td>
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<tr>
<td>Performance management</td>
<td>Feedback systems (satisfaction, acceptance and impact of new services)</td>
<td>No feedbacks are collected; corrective actions are based on subjective intuitions rather than on objective data analysis.</td>
<td>Even if data are collected, feedbacks are poorly used. Corrective and preventive actions are performed according to internal procedures rather than being totally aware of the reported issues.</td>
<td>Feedbacks are achieved and discussed. Due to the poor understanding of the field/customer phenomena, feedback-based decisions are always disputable. Nevertheless, there is consistent use of monitoring systems for assessing the new services.</td>
<td>Feedbacks are systematically used to identify the weaknesses of the newly developed services, in order to make robust the design of service contents and delivery processes. Improvements and innovations are performed in a systematic way.</td>
<td>Feedbacks are systematically used, to identify new service development process weaknesses and to improve the new service development organisation and management system. Continuous improvement and innovation are carried out throughout the organisation.</td>
</tr>
<tr>
<td>Key performance indicators (KPIs)</td>
<td>No measures in place.</td>
<td>Few and ad hoc measures, mainly related to costs and productivity, in order to point out cost savings opportunities.</td>
<td>Standard KPIs dashboard. Cost and time measures are mainly considered.</td>
<td>Balanced measures, considering internal, external, customer and financial orientation.</td>
<td>Ad hoc balanced measures for new services, considering internal, external, customer and financial orientation.</td>
<td></td>
</tr>
</tbody>
</table>
Maturity models allow for new processes to be compared (Rapaccini et al. 2012; Abreu & Harris 2008). However, there may also be variations in the maturity models adopted by organisations (e.g. more/less levels or stages, different description of each level/stage, variability in terms of dimensions and elements that are important to an organisation). These variations are justifiable as each organisation is different. Organisations should not just develop new processes but they should also define their own maturity stages by employing a number of design principles. Roglinger, Poppelbub and Becker (2012) suggest nine design principles as shown in Table 14.

Table 14: General design principles for maturity models (Roglinger, Poppelbub & Becker 2012)

<table>
<thead>
<tr>
<th>3. Design Principles for a Prescriptive Purpose of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>*DP 3.1 Improvement measures for each maturity level (and level of granularity)</td>
</tr>
<tr>
<td>DP 3.2 Decision calculus for selecting improvement measures</td>
</tr>
<tr>
<td>DP 3.3 Target group-oriented adoption methodology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Design Principles for a Descriptive Purpose of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP 2.1 Inter-subjectively verifiable criteria for each maturity level (and level of granularity)</td>
</tr>
<tr>
<td>DP 2.2 Target group-oriented assessment methodology</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1. Basic Design Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP 1.1 Provision of basic information</td>
</tr>
<tr>
<td>DP 1.2 Definition of central constructs related to maturity and maturation</td>
</tr>
<tr>
<td>DP 1.3 Definition of central constructs related to the application domain</td>
</tr>
<tr>
<td>DP 1.4 Target group-oriented documentation</td>
</tr>
</tbody>
</table>

*DP: Design Principle

The design principles are intended as a step-by-step guide by first establishing the most fundamental and important information deemed by an organisation (e.g. the levels of maturity and dimensions to be assessed), the second involves describing each
area to a point that is understood by those involved (e.g. target group) leaving no room for ambiguity, and the third involves providing detailed instructions in terms of how each dimension at each stage of maturity may be measured (Roglinger et al. 2012). Whilst maturity models and the principles that underpin them do not directly help with process innovation *per se*, they do nonetheless directly contribute to making new processes more effective and efficient. This is equally crucial as coming up with the idea of a new process in the first place as an innovation must bring economic utility. In the case of processes innovation this would mean enabling work and activity to be carried out more rapidly and successfully.

2.1.3.4. **Marketing Innovation**

The success of a product innovation depends on its marketing. Organisations need to possess effective and deep knowledge of market conditions to optimally price the products, and to launch the products at the right time (Kline & Rosenberg 1986). The Organisation for Economic Co-operation Development recognises marketing innovation as a distinctive form of innovation in itself. They define “*a marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing*” (Organisation for Economic Co-operation Development 2005) (p. 49). Whilst marketing innovation is unique, there are nonetheless, some overlaps with other forms of innovation such as product innovation.

The ‘Four Ps’ of marketing (i.e. product, placement, promotion and price) are adopted in discussing and providing examples of marketing innovation. Marketing innovation may occur with any combination of the Four Ps. A change in the design of a product such as its appearance does not alter (e.g. increase) its functionalities or features but may be considered a marketing innovation. Innovation due to product design may also include packaging that gives the product a distinctive look and subsequently makes it more appealing to a (relatively) new market (Organisation for Economic Co-operation Development 2005).

Placement as a source of marketing innovation may include new sales channels such as online platforms, direct sales and franchising agreements. Placement provides organisations the opportunity to further penetrate existing markets or serve new markets.
Promotion may be a source of marketing innovation due to its potential to make a product more appealing to other markets by attracting attention through the use of novel means such as flash mobs that involves a large gathering of people that performs something unusual such as dancing in a seemingly random manner and then quickly disperses (Vellar 2012). Promotions that are innovative are those that are able to draw the attention of consumers and/or change their attitude towards a product/service.

The way in which organisations ‘structure’ their price may also be a source of innovation. Pricing that gives consumers more visibility in making informed decisions as well as paying for only what they need may be considered innovation (as with pricing based on seasons and according to demand). However, new pricing primarily to differentiate and recognise customer segments are not considered innovations (Organisation for Economic Co-operation Development 2005).

In addition to the Four Ps, innovative marketing may include leveraging upon other innovation concepts such as crowdsourcing (Whitla 2009). Crowdsourcing, as a form of open innovation, is essentially the outsourcing of work that was once performed in-house to a large network of people in the form of an open call (Whitla 2009; Howe 2006). Whitla (2009) found that some companies have used crowdsourcing in advertising and promotion, and marketing research. In the area of advertising and promotion, some firms have asked crowdsourcers to write product reviews and to post it to various websites (Whitla 2009). Organisations have also used crowdsourcers as “trend-spotters” and to contact the organisation if they observe anything that may be of interest to the organisation (Whitla 2009).

Whilst there are a number of models and frameworks to guide product and service innovation, only a few that are dedicated to marketing innovation. Many models of marketing innovations are grouped together with services marketing (Palmer 2011). To some extent, the marketing of services compels organisations to critically and meticulously design and implement coherent value propositions that address the Seven Ps of marketing. In addition to product, promotion, place and price, the other Ps of marketing are ‘people’ (e.g. who provide the services), ‘process’ (e.g. what customers have to do as part of the services) and ‘physical evidence’ (e.g. aspects of the service that the customer can feel and hold).

Organisations are able to innovate their marketing, through services as an example, by adopting a number of approaches such as ‘blueprinting’. Figure 2.11 illustrates an
example of a service blueprint of a restaurant and how the various factors play a role in ensuring that customers are satisfied with the service. In Figure 11, Palmer (2011) illustrates the typical stages of service of a customer in restaurant, and the target time to fulfil each stage (e.g. greeting customer, seating customer, taking order and serving the food) to maintain customer satisfaction. At stage of the process, the blueprint outlines touch points between waiters and the customers, and the potential critical incidents. In addition, the blueprint also shows the physical evidence (e.g. menu and cutlery) that are visible to the customers, thus highlighting that these artefacts need to be clean, organised and possible aesthetically pleasing. Finally, the blueprint also emphasises the potential supporting processes that need to be in place to enhance each of the factors mentioned above (e.g. customer service and menu knowledge training for waiters, procurement cutlery and preparing food in a timely manner).
Figure 11: An example of a customer service blueprint – a simplified application to the purchase of a meal in a restaurant (Palmer 2011)
In addition to the concept of service blueprints, Palmer (2011) also suggests that the concept of ‘servicescape’ as a tool in providing another perspective of services in view of making marketing (of services) more effective. The term ‘servicescape’ is derived from the words ‘service’ and ‘landscape’ and refers to the features of the service that are visible to the customers during the provision of the service (Boom & Bitner 1981). Marketing of the services is the primary aim as it takes into consideration how organisations attract customers, encourage customers to spend and how to urge customers to leave once they have completed their purchases, in order to expedite the turnaround of customers to increase sales volume (Boom & Bitner 1981).

Figure 12 illustrates a conceptual framework of a servicescape. In attracting customers to its premises, organisations need to pay careful attention to the design of its building (e.g. layout and furnishings), signage (e.g. with functional directions and emotional messages), processes (e.g. visibility of the service process such as some restaurants with the kitchen at the front of the restaurant in showcasing the food and its preparation) and sensory cues (e.g. aesthetic visuals and pleasing background music).

The servicescape will play a role in the customers’ overall perception of the service and ultimately their decision as to whether or not to enter the premises. After deciding to enter the premises, the customers move into the approach stage. However, at this stage, employees in the service organisation must ensure that the customer feels adequately comfortable to stay long enough to make a purchase. This can be done by greeting the customer and by offering assistance to the customer (e.g. informing them about potential discounts to reduce the barrier of entry). The next stage is the exploration stage, which involves informing the customers of other purchases that they may want to make (e.g. cross-selling). Finally, the exit stage involves persuading customers, explicitly or implicitly, to leave once they have completed their purchases to make room for other customers.
Figure 12: An example of a servicescape in marketing innovation (Palmer 2011)
Both blueprints and servicescape provide different perspectives of and marketing opportunities (and innovation) for a service. The use of these concepts compels organisations to consider different factors when designing and marketing their services. Ultimately, both service blueprint and servicescape allow organisations to “map” customers’ experience against every aspect of the service and the physical environment that the customer encounters. An example of such a map is illustrated in Figure 13, which shows the potential variability of a customer’s feelings, in a continuum from “delighted” to “terrible”, owing to their entire experience when dining in a restaurant (e.g. from the visuals of the restaurant, greeting, placing an order, using the lavatory and paying the bill).

The notion of ‘service encounters’ supported by the concepts of service blueprinting and servicescapes highlights both the challenges and opportunities in the service innovation. SERVQUAL (i.e. service quality) is another diagnostic tool that aims to identify the gap between expectations and perceptions of a service. In reference to Figure 14, gaps can be found between the organisation’s and customer’s specifications of quality (gap one), management’s concept of the product/service (gap two), the organisation’s specification of quality and the actual quality of the product or service (gap three), the quality of the actual product or service and its general image in the marketplace (gap four) and the customer’s own perception and expectation (gap five).
Figure 14: The SERVQUAL gap model (Slack, Chambers & Johnston 2007)

The five gaps highlight the areas that organisations need to pay attention to and to address. To address Gap 1, organisations should pay attention to market research to accurately identify customer’s specifications of quality. Gap 2 can be addressed by improving the quality of internal processes that capture and translate management requirements into product or service specifications. Gap 3 can be addressed by improving the design and new product/service development processes, whilst Gap 4 can be addressed by improving the marketing and advertising of the product or service. Finally, Gap 5 can be addressed by routinely obtaining feedback from customers for suggestions for improvement. ‘Services’ is used to highlight the opportunities for marketing innovation as the variability in services provides a significant breadth of scope, as demonstrated by the use of the blueprinting, servicescape and SERVQUAL models.
2.1.3.5. Technological Innovation

Technological innovations have been partially covered in the previous sections, in particular Kondratief’s identification of the advent of new application of sciences and technologies in the form of chemicals and materials sciences, and microelectronics that have occurred over the last 200 years (Freeman & Soete 1997; Freeman & Soete 2009). Technological innovation is also a key ‘outcome’ of the R&D-based model of innovation, specifically as an ‘invention’. Technological innovations are at times ‘inventions’ in themselves and are embedded in products, services and/or process. Technology is a key enabler of these innovations. Technological innovations are thus usually not visible to the end-user although their benefits can nevertheless be experienced by customers (e.g. silicon chips in personal computers that enhance speed and performance).

Although it is a ‘behind-the-scenes’ innovation, technology innovation is nevertheless crucial. For example, innovations in air transport in terms of the aircrafts built is largely due to metallurgical improvements that enable aircrafts to be significantly lighter and stronger (Kline & Rosenberg 1986). Such improvements in building materials have made aircrafts more economical to build, safer and more fuel efficient. In addition, the advancement of electronics has enabled more efficient and effective planning and scheduling of flights, though the determination of optimal flight paths. This has enabled more flights to be offered to consumers by reducing flight times (Kline & Rosenberg 1986).

Technology may also be a product in itself (especially from a business-to-business perspective) such as computer-aided design and computer-aided manufacturing software systems. Whilst technology can be packaged as a product, it is often behind-the-scenes and assists manufacturers to design and manufacture products more efficiently and effectively (Rothwell 1994). Technology innovations may also facilitate process innovations such as simulations (Rothwell 1994). Rothwell (1994) posit that Rolls Royce Aero used simulations to enhance the efficiency of its product development processes. This simulation activity allowed Rolls Royce Aero to negate the cost of “trial-and-error” and allowed the organisation to use a more scientific-based approach in developing their product development processes. Technology helps to improve components used in all kinds of goods and also in discovering new substitutes such as more economical materials (Kline & Rosenberg 1986).
Freeman and Soete (2009) emphasise the importance of knowledge in technological innovation as the underpinning factors in the science-technology-innovation equation. Technology innovation is inherently knowledge-intensive. For example, being able to use and further develop mathematical algorithms is crucial in the development of advanced software for better navigational systems. Knowledge is critical in innovation as it can be observed as “guided empiricism”, for example, organisations start with available knowledge, then apply it to a potentially workable design, then build and test the design, and learn from the success and failures and reiterate the process to the point of ad nauseam (Kline & Rosenberg 1986). Knowledge is also important due to the transition to a knowledge intensive economy for most countries as exemplified in some areas of the service sector that tend to employ individuals who have above-average qualifications (Hipp & Grupp 2005).

Knowledge is the epistemological state of knowing (i.e. being aware of) (Hofer & Pintrich 2012). An example of the importance of knowledge is illustrated by Omachonu and Einspruch (2010), and Miles (2003). As shown in Figure 15, Omachonu and Einspruch (2010) depict knowledge in a traditional sense of the academic specialty such as physical sciences, life sciences, engineering, social sciences, humanities and cognitive science, and show how these academic areas contribute to the state of knowledge in organisations’ research and development efforts, serving as a basis for R&D departments to develop new inventions and innovations.
Figure 16 illustrates the importance of knowledge to technology innovation, which in turn is crucial to inventions (and patents) and innovations (Mahdjoubi 2009). Technologies go through different stages of development (Goffin & Mitchell 2010). These phases are ‘emerging’, ‘pacing’, ‘key’ and ‘base’. As technologies moves from one phase to another (bearing in mind some technologies may not be pursued and thus do not progress to the next stage), it inherently means that organisations will start to invest more in further developing technologies that should ‘perform’ better. Technological advancement or sophistication in products do not guarantee success. For example, the Concorde was an engineering feat in its time as it was able to cross the Atlantic in about half the time compared to other aircrafts, however, the Concorde was not commercially viable as the fuel cost per passenger mile was 15 times greater than the average aircraft (Kline & Rosenberg 1986). An illustration of the relationship between these phases, performance levels and organisational investment is depicted in Figure 16.
Table 15 highlights the typical action and focus of both R&D departments and the organisation as a whole at each stage of technological advancement. As a technology progresses from one stage to another, the scope of work and activity undertaken increases from merely involving just the technology to involving product portfolios and processes within the entire organisation.
Table 15: How technical and commercial focus evolves as technology matures
(Goffin & Mitchell 2010)

<table>
<thead>
<tr>
<th>Technology phase</th>
<th>Typical R&amp;D focus</th>
<th>Typical company focus</th>
</tr>
</thead>
</table>
| Emerging         | • Technical understanding  
|                  | • Patents and intellectual property rights  
|                  | • Find early adopters  
|                  | • Gain practical experience  
|                  | • Publicise capability  |
| Pacing           | • Demonstrate capability  
|                  | • Establish standards  
|                  | • Explore variations  
|                  | • Understand limits  
|                  | • Respond to early market feedback  
|                  | • Flexibility  
|                  | • Readiness to learn  |
| Key              | • Performance improvement  
|                  | • Customer focused features  
|                  | • Technical mastery  
|                  | • Design for manufacture  
|                  | • Product performance improvement  
|                  | • Market share  
|                  | • Exploit niches and applications  |
| Base             | • Reliability  
|                  | • Cost effectiveness  
|                  | • Design and ergonomics  
|                  | • Scan for new technologies  
|                  | • Reliable and respected supplier  
|                  | • Brand image  
|                  | • Quality  
|                  | • Value  
|                  | • Complementary product/services  
|                  | • Business process improvement  |

Sood and Tellis (2005) expand on the types of technology innovation as they assert that there are three types; platform, component and design. Using the technologies in storage devices as an example, they define platform innovation as emerging technologies that are distinctly different from other existing technologies. They cite the advent of compact disks as an example. They further propose component innovation such as the use of new parts within the same platform innovation. They cite the case of floppy and zip disks as component innovations that are dependent on the platform innovation of magnetic recording. Finally, they state design innovation is the reconfiguration of the layout of the components that are within the same technological
platform. They cite the example of the different sizes of disks (e.g. 3.5 inches in 1985 to 2.5 inches in 1989) (Christensen & Raynor 2003).

Platform innovation is the most radical form of technology innovation and has far reaching consequences (Meyer & Mugge 2001). Chesbrough (2003) in his argument for open innovation states that it is essential to provide an architectural ‘backbone’ for new technologies as it helps new innovations to emerge more rapidly and effectively.

Table 16 provides examples of organisations that are originators of platforms (architectural ‘backbone’) that enabled them to set technical standards:
### Table 16: Companies that Own Technical Standards (Grant 2012)

<table>
<thead>
<tr>
<th>Company</th>
<th>Product Category</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft</td>
<td>PC operating systems</td>
<td>Windows</td>
</tr>
<tr>
<td>Intel</td>
<td>PC microprocessors</td>
<td>X86 series</td>
</tr>
<tr>
<td>Sony/Philips</td>
<td>Compact disks</td>
<td>CD-ROM format</td>
</tr>
<tr>
<td>ARM (Holdings)</td>
<td>Microprocessors for mobile devices</td>
<td>ARM architecture</td>
</tr>
<tr>
<td>Oracle Corporation</td>
<td>Programming language for web apps</td>
<td>Java</td>
</tr>
<tr>
<td>Rockwell &amp; 3Com</td>
<td>56K modems</td>
<td>V90</td>
</tr>
<tr>
<td>Qualcomm</td>
<td>Digital cellular wireless communication</td>
<td>CDMA</td>
</tr>
<tr>
<td>Adobe Systems</td>
<td>Common file formats for creating and viewing documents</td>
<td>Acrobat Portable Document Format</td>
</tr>
<tr>
<td>Adobe Systems</td>
<td>Web page animation</td>
<td>Adobe Flash</td>
</tr>
<tr>
<td>Adobe Systems</td>
<td>Page description language for document printing</td>
<td>PostScript</td>
</tr>
<tr>
<td>Bosch</td>
<td>Antilock braking system</td>
<td>ABS &amp; TCS (Traction Control System)</td>
</tr>
<tr>
<td>IMAX Corporation</td>
<td>Motion picture filming/projection system</td>
<td>IMAX</td>
</tr>
<tr>
<td>Apple</td>
<td>Music downloading system</td>
<td>iTunes/iPod</td>
</tr>
<tr>
<td>Sony</td>
<td>High definition DVD</td>
<td>Blu-ray</td>
</tr>
<tr>
<td>NTT DoCoMo</td>
<td>Mobile phone payment system in Japan</td>
<td>Osaifu-Keitai</td>
</tr>
</tbody>
</table>

Technological innovations occur in various ways within organisations such as intramural (in-house) R&D. Organisations may also acquire R&D expertise in an extramural form (outsourcing) by purchasing such services from public/private sector providers. In addition, organisations may also acquire patents and licenses for specific technologies/inventions to be applied to their own products (e.g. inclusion of Bluetooth technology into smartphones) (UNESCO Institute for Statistics 2008; Organisation for Economic Co-operation Development 2005). The variety of
approaches provides organisations with the flexibility to undertake technology innovation.

2.1.3.6. Management/ Organisational Innovation

Management /organisational innovation are new and better ways of doing things within the organisation. It involves questioning the status quo and ‘business as usual’ practices within the organisation. Internal practices may range from indirect operations to administration. Some changes may be minor and incremental such as changing the way performance appraisal takes place to more radical approaches such as how IBM broke down silos within the organisation to encourage cross-department/division team work (Gerstner Jr 2002).

The Organisation for Economic Co-operation Development (2005) defines organisational innovation as “the implementation of a new organisational method in the firm’s business practices, workplace organisation or external relations” (p. 51). Kline and Rosenberg (1986) state that management/organisational innovation is simply the introduction of new instruments and methods for undertaking innovation. Omachonu and Einspruch (2010) cite West and Farr’s (1990a) definition of organisational innovation as the “intentional introduction and application (within a group or organization) of ideas, processes, products [outcomes] or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, organization or wider society” (p. 111). This definition implies that management and organisational innovation can be far-reaching and as impactful as technology innovation (West & Farr 1990a).

Hamel (2007) asserted that “management innovation is anything that substantially alters the way in which the work of management is carried out or significantly modifies customary organisational forms and by doing so advances organisational goals” (p.19). Hamel (2007) postulated that management is an invention in itself as it was created to improve the efficiency of enterprises during the industrial era. Examples of “innovations” derived from management include pay-for-performance, task design, division of labour, brand management and capital budgeting (Hamel 2007).

Management and/or organisational innovation can also be observed in a military context. Hamel (2007) cites the example of the growth of the British Empire that used a regimental system that allowed it to embrace local loyalties and cultural values. This
system was a success compared to the Prussian military way that subjugated locals as mere administrative devices. Some contemporary multinational corporations have had to innovate the way the organisation is structured. For example, IBM has organised itself as a seven-dimensional matrix, with business organisations designed around three major sectors (i.e. hardware, software and global services), geographic reach (i.e. by region and country), distribution channels, customer-focused groups (e.g. health and transport sectors) and new business development (Galbraith 2005; Grant 2008).

Hamel (2007) cites a number of novel cases of management innovation. Firstly, he refers to HCL Industries, an IT company in India, which uses a management model named reverse accountability. This model enables employees to rate their bosses and their boss’ bosses, with the ratings published online and available to everyone in the company. Secondly, he references the case of Best Buy, where employees are asked to purchase imaginary stocks of new products and services, which then allowed the organisation to predict the potential success or failure of new offerings. Thirdly, he cites the case of Microsoft that uses gamification to increase productivity and promote innovation. Gamification applies the principles found in the traditional games in non-game situations to create a sense of fun and enjoyment. Finally, Pfizer allows its employees to outsource those parts of their jobs that they regard as boring without asking for permission.

There are several other contemporary management innovations. Toyota’s production system, Google’s management model of “brink of chaos” that includes allowing employees to spend twenty per cent of their time on personal projects, Whole Foods Market whose management model includes a principle that executives cannot earn more than 19 times the average employee’s compensation, P&G’s systemisation of brand management, Motorola’s six-sigma methodology, the Virgin Group’s “branded venture capital model” and the balanced scorecard (Grant 2008). In addition, other management organisational innovations may include just-in-time processes and quality oriented processes (e.g. quality circles) (Rothwell 1994).

Hamel (2007) argues that management/organisational innovation is critical due to three mega-trends: rapid changes, hyper competition and the commoditisation of knowledge. He goes further and asserts that management innovation is at the apex of all innovations as he argues that the competitive advantage from product innovation is not sustainable if the product is not patented, whilst process innovation is easily
diffused (e.g. best practice shared by management consultants and when staff leave the organisation) and business models can be decoded and imitated.

Some management/organisational innovations have been crucial in helping organisations to address the challenges that Hamel (2007) stated. An example of such an innovation is scenario planning, which is a planning (Peterson, Cumming & Carpenter 2003; Schoemaker 1995) and decision making tool (Chermack 2004). Scenario planning is defined as “a process of positing several informed, plausible and imagined alternative future environment in which decisions about the future may be played out, for the purpose of changing current thinking, improved decision making, enhancing human and organizational learning and improving performance” (Chermack and Lynham, 2003, p. 16)

Scenario planning is an important innovation as it helps organisations to more effectively deal with external environments that are dynamic and unpredictable. The key idea of scenario planning is not to predict or project an accurate, single outcome but to compel management to consider a number of possible future states, which includes important variables that are relevant to the organisation and/or its industry in both a direct and indirect manner (Peterson et al. 2003). In other words, scenario planning helps management to confront uncertainty and to enable management to have some control or influence on their environment. By careful construction of various scenarios of the future, management may be able to gain insight into the drivers and impacts of change, the potential trajectory of events due to this change and potentially reveal options in terms of possible actions to be taken by management (Peterson et al. 2003).

Scenario planning is a strategic tool that is used for more than just hedging risk and contingency planning. Whilst scenario planning is essentially a tool, it is nonetheless based on robust methodological steps (e.g. scenario building, identifying stakeholders, identifying trends and themes) that make it more effective than other tools such as forecasting and sensitivity analysis. Organisations that have used scenario planning are Shell, SRI International, Interpublic (an advertising firm) and Anglo-American in South Africa (Peterson et al. 2003; Schoemaker 1995).

Some outcomes of innovation are inherently linked to certain departments such as the R&D department (as a source of innovation, product and/or service), marketing (such as pricing innovations), and operations (as a source of process innovation). However,
innovation is not exclusive to only certain departments/divisions. Other departments such as finance and accounting, and human resource management can and have been innovative. For example, the finance and accounting department may establish innovative ways to cost and price products, whilst the human resource department may develop innovative ways of hiring, training and motivating employees (Goffin & Mitchell 2010).

Indeed, departments, divisions, and business units within organisations also have to change and innovate to meet present and future challenges. For example, the human resources function in some large companies have had to change and innovate in the way they work as they assume other responsibilities such as communications, community relations, corporate reputation, organisational change and organisational design (Lawler III 2011). The uniqueness and complexity of some businesses and those of their partner networks means that the application of “best practices” is usually not possible and thus new ways of working have to be developed (Marchington, Rubery & Grimshaw 2011). Other innovations from the field of human resource management is the use of expatriates (personnel assigned from headquarters to a foreign subsidiary for a fixed period) and inpatriates (personnel sent from a foreign subsidiary to headquarters to for a fixed period) for the critical activity of knowledge transfer that in turn facilitates further innovation (Reiche 2011).

2.1.3.7. Business Model Innovation

Magretta (2002) posits that “creating a business model is, then, like writing a new story” (p. 4). She goes to state that the story must answer a number of critical questions such as “Who is the customer, and what does the customer value? It also answers the fundamental question that all managers must ask: How do we make money in this business? What is the underlying economic logic that explains how we deliver value to customers at an appropriate cost?” (p. 4). Thus a business model is an abstract concept that weaves together different elements and components in narrating how an organisation will make money (Magretta 2002). In addition, the narration or story of the business model must also be underpinned by numbers. Magretta (2002) asserts that a sound business model must pass both the “narrative test” and the “numbers test”. However, this story does not include competitors as its competition is within the domain of strategy (Magretta 2002). Wal-Mart is an example how a sound business model complements an effective competitive strategy. Wal-Mart’s business model is that of hard-discounter, a retailer that offers steep discounts for its goods by relying on high customer volume and reduced level of services to customers thereby
allowing it to cut costs. Costs are also reduced as the volume of customers helps to significantly spread its fixed costs. The hard discounter retail business model was successful even though there were many players in the market (Magretta 2002).

Sam Walton, founder of Wal-Mart, complemented this business model with its own unique strategy by serving a different set of customers outside of metropolitan areas. He established Wal-Mart stores in small rural towns of populations between 5,000 and 25,000 that were big enough to cater for only one hard discounter thereby discouraging competition from setting up in the same town (Magretta 2002). In addition, as the small towns were approximately only four hour’s drive from the nearest city, most customers from the city would drive to Wal-Mart stores located in small towns to do their weekly shopping as parking was easier and prices were generally lower than city-based hard-discounters (Magretta 2002). This unique strategy, combined with an established and sound business model, enabled Wal-Mart to grow significantly (Magretta 2002; Teece 2010).

Although its importance has generally been recognised, ‘business model’ is one of the most misunderstood terms and concepts in business and management (Linder & Cantrell 2000; Osterwalder, Pigneur & Tucci 2005; Chesbrough 2011; Afuah & Tucci 2003). The importance of business models in innovation is emphasised by Casadesus-Masanell and Ricart (2010) when they state that “much of the recent managerial literature on innovation is concerned with altering business models” (p. 212). Chesbrough (2007, p. 12) reasons that a “better business model often will beat a better idea or technology”. He rationalises this by asserting that whilst relatively high-value and high priced technology will most likely earn an organisation profits, customers may, however, not want to pay a high price for the new technology. The better option is to change the business model (e.g. a leasing model for the technology rather than outright purchase). George and Bock (2010) asserted that understanding and developing sound business models are imperative in innovation-driven sectors and industries.

Business models are associated with entrepreneurship (Doganova & Eyquem-Renault 2009) and technology (Günzel & Wilker 2012). In particular, as a form of market device that is used as a conduit to communicate a new venture, specifically those that are technology-intensive and technology-advancing. In addition, as a market device, business models are used to gauge the feasibility and acceptability of a new venture from potential customers and investors. Thus, business models may be regarded as an
exploration device (Doganova & Eyquem-Renault 2009). Business models may also be a communication tool for internal consumption within organisations as Zott and Amit (2010) assert that business models are a “language” and should be used as a tool that adopts a system-level view (over partial optimisation). This is supported by Doganova and Eyquem-Renault (2009) who posit that business models are ‘market and exploration devices’ used to gauge the feasibility of the business. Business model innovation concerns commercialisation innovation, which is different from both product/service and process innovation (George & Bock 2011; Günzel & Wilker 2012).

Osterwalder, Pigneur and Tucci (2005) attempted to clarify the concept of business model by evaluating the meaning of two terms, business and model. Osterwalder, Pigneur and Tucci (2005) posit that a business involves “the activity of providing goods and services involving financial, commercial and industrial aspects” (p. 5) and a model is “a simplified description and representation of a complex entity or process” (p. 4). In consideration of the two definitions, they define a business model as “a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm. Therefore we must consider which concepts and relationships allow a simplified description and representation of what value is provided to customers, how this is done and with which financial consequences” (p. 5). Osterwalder and Pigneur (2010) later refined this definition to “the rationale of how an organisation creates, delivers and captures value” (p. 14). This definition demonstrates the two key elements in a business model, value creation and value capture (George & Bock 2011).

Teece (2010, p. 172) asserts that “the essence of a business model is in defining the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit. It thus reflects management’s hypothesis about what customers want, how they want it, and how the enterprise can organize to best meet those needs, get paid for doing so, and make a profit”. In addition to the above, other researchers have attempted to define the concept of business model. Table 17 illustrates recent and selected definitions from seminal research outputs since the year 2000.
Table 17: Selected definition of business models (Brettel, Strese & Flatten 2012)

<table>
<thead>
<tr>
<th>Author (year)</th>
<th>Definition.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amit and Zott (2012)</td>
<td>“A system of interconnected and interdependent activities that determines the way the company “does business” with its customers, partners and vendors. In other words, a business model is a bundle of specific activities – an activity system – conducted to satisfy the perceived needs of the market, along with the specifications of which parties (a company or its partners) conduct which activities, and how these activities are linked to each other.” (p. 2)</td>
</tr>
<tr>
<td>Casadesus-Masanell and Ricart (2010)</td>
<td>“Business Model refers to the logic of the firm, the way it operates and how it creates value for its Stakeholders.” (p. 196).</td>
</tr>
<tr>
<td>Chesbrough (2010)</td>
<td>“[... ] a business model fulfils the following functions: Articulates the value proposition [... ]; Identifies a market segment and specify the revenue generation mechanism [... ]; Defines the structure of the value chain required to create and distribute the offering and complementary assets needed to support position in the chain; Details the revenue mechanism(s) by which the firm will be paid for the offering; Estimates the cost structure and profit potential [... ]; Describes the position of the firm within the value network linking suppliers and customers [... ]; and formulates the competitive strategy by which the innovating firm will gain and hold advantage over rivals.” (p. 355).</td>
</tr>
<tr>
<td>Demil and Lecocq (2010)</td>
<td>“[... ] the way an organization operates to ensure its sustainability.” (p. 231).</td>
</tr>
<tr>
<td>Mahadevan (2000)</td>
<td>“A business model is a unique blend of three streams that are critical to the business. These include the value stream for the business partners and the buyers, the revenue stream, and the logistical stream.” (p. 59).</td>
</tr>
<tr>
<td>Mitchell and Coles (2003)</td>
<td>“A business model comprises the combined elements of ‘‘who’’, ‘‘what’’, ‘‘when’’, ‘‘why’’, ‘‘where’’, ‘‘how’’ and ‘‘how much’’ involved in providing customers and end users with products and services.” (p. 16).</td>
</tr>
<tr>
<td>Morris, Schindheutte and Allen (2005)</td>
<td>“A business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets.” (p. 727).</td>
</tr>
<tr>
<td>Teece (2010)</td>
<td>“[... ] a business model defines how the enterprise creates and delivers value to customers, and then converts payments received to profits.” (p. 173).</td>
</tr>
</tbody>
</table>

The term ‘business model’ is used to substitute the term ‘industry’. Indeed new business models may result in the establishment of new industries (Teece 2010). Types of industries such as manufacturing, financial services, retail and media are a useful way of grouping and describing the different industries within which
organisations operate. However, at present, many organisations are operating across the lines of traditional industries and markets. For example, Amazon.com operates as a retailer (as it interfaces directly with the customer), technology company (it has its own e-book reader in the form of Kindle), and also offers logistics services to other producers through its Fulfilment-by-Amazon service (Akan, Ata & Lariviere 2011).

The usefulness of the term ‘business model’ has its doubters. One criticism is that it is too vague and not adequately grounded (Porter 2001). Porter (2001, p. 73) argued that the vagueness of business models are ‘an invitation for faulty thinking and self-delusion’. Another criticism is that business models are too complex for practitioners and academics to capture in a holistic form. In addition, ex post business models provide only a static view of business models, which does not do business models any justice as it is highly fluid especially in dynamic environments (Günzel & Wilker 2012).

Business model innovation can nonetheless help organisations to improve their performance. An organisation with an effective business model for an existing product may yield higher returns than a competitor selling the same product but with an ineffective business model. Dell did not bring any new improvements to the personal computer but it gained higher revenue than its competitors because of its business model that combined suppliers and its own distribution system in a more effective manner (Teece 2010).

Business model innovation is critical in the present business environment due to the ever-rising development of technologies, the entry of low-cost rivals that reshape an industry and that capture some of the market share, thus threatening the status quo for incumbent organisations (Casadesus-Masanell & Ricart 2011; George & Bock 2011). Innovation in business models allows organisations to capture market share in chaotic and dynamic environments (Casadesus-Masanell & Ricart 2011; George & Bock 2011). Products and technologies have shortened life-spans as organisations cannot rely upon them for long enough to earn satisfactory profits before the products and technologies become commodities (Chesbrough 2007). Chesbrough (2007) cite the case of Dell and Southwest Airlines, whose business models were the centre of their success but their products and technologies became commonplace in their respective industries.
Teece (2010) argues that business model innovation is the epitome of all other innovations (e.g. product, services, technology, marketing and management/organisational) as these other innovations act as a catalyst for organisations to change (i.e. innovate) their business models. Business model innovation, as an outcome of all other innovations, contributes to an organisation’s competitive advantage, especially if the business model is adequately differentiated and difficult to replicate. Teece (2010) claims that business models must adapt to their changing environments, competitions and technologies. He cites the example of the music industry that has changed over time in terms of performers’ revenue streams that range from the sale of physical records, singles, concerts and promotions. The predominant revenue stream, and thus business model, of performers’ have changed over times. For example, a primary revenue stream for performers was concerts, and this evolved to record sales, and then to sales of singles and promotion sponsorships. Indeed, in the present day, the revenue stream varies from performer to performer depending on the business model the performer adopts (Teece 2010).

Business model innovation is especially ubiquitous in start-ups or growing organisations that are either in high-velocity or capital-intensive sectors (Günzel & Wilker 2012). Business model innovation is more important than product/service or technology innovation as the competitive advantage enabled by these innovations can be replicated whilst, business model innovation is more difficult to replicate (Amit & Zott 2012).

Amit and Zott (2012) quoted a senior corporate executive who stated that “you’re always one innovation from getting wiped out by a new competing innovation that eliminates the need for your product.” (p. 2). In addition, the Economist Intelligence Unit reported that 54% of senior executives found business model innovation to be a better source of competitive advantage compared to the other types of innovation (Economist Intelligence Unit 2005). This survey is in addition to a survey undertaken by the IBM Institute for Business Values’ Global CEO in 2009 that showed 7 out of 10 CEOs are undertaking business model innovation, with at least 98% adapting their business models to some degree (Casadesus-Masanell & Ricart 2011).

Amit and Zott (2012) quoted a CEO whom explained why business model innovation is critical; “In the operations area, much of the innovations and cost savings that could be achieved have already been achieved. Our greatest focus is on business model innovation, which is where the greatest benefit lie. It’s not enough to make a
difference on product quality or delivery readiness or production scale. It’s important to innovate in areas where our competition does not act.” (p. 1).

Organisations should develop business model innovations to complement rather than replace product/service or technology innovation as business model innovation can help organisations to resolve necessary trade-offs (e.g. cost and benefit) that they need to make in the delivery of new product/service or technology innovations (Amit & Zott 2012). The key quotes provided above suggest that business models are usually an underutilised source of competitive advantage. Business models are more difficult to replicate in their entirety and thus are more sustainable. In addition, they are more effective in addressing threats outside of an organisation’s industry (as threats usually come from outside an organisation’s industry such as Apple and the music industry) (Amit & Zott 2012).

Business model innovation concerns the dynamic capabilities of organisations (George & Bock 2011; Teece & Pisano 1994) that are linked to the organisations core competencies (Prahalad & Hamel 1990). Santos, Spector and Van der Heyden (2009) support this view as they state that business model innovation is about reconfiguring the way the organisation operates and define business model innovation as a “reconfiguration of activities in the existing business model of a firm that is new to the product/service market in which the firm competes” (p. 14). Table 18 contains a typology of reconfiguration ‘activities’ that can be regarded as business model innovation.
### Table 18: Typology of business model innovation: Reconfiguring a firm’s activities (Santos et al. 2009)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Type</th>
<th>What changes?</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relinking: altering the linkages between units performing activities.</td>
<td>Re-governing.</td>
<td>The governance of transaction among units.</td>
<td>An arms-length relation with a supplier becomes an alliance.</td>
</tr>
<tr>
<td></td>
<td>Re-sequencing.</td>
<td>The order in which activities are performed.</td>
<td>Design and procurement activities become mutually reciprocal instead of sequential.</td>
</tr>
<tr>
<td>Repartitioning: altering the boundaries of the focal firm by moving activities and the units that perform activities.</td>
<td>Insourcing.</td>
<td>Moving inside activities that were once performed outside the focal firm.</td>
<td>A manufacturer opens its own retail stores to supplement its dealers.</td>
</tr>
<tr>
<td></td>
<td>Outsourcing.</td>
<td>Moving outside activities that were once performed inside.</td>
<td>A firm outsources its information technology activities.</td>
</tr>
<tr>
<td>Relocating: altering the (physical, cultural and institutional) location between units performing activities.</td>
<td>Off-shoring.</td>
<td>Moving activities from a unit in the firm’s home country to a foreign country.</td>
<td>A bank moves back-office activity to a foreign subsidiary</td>
</tr>
<tr>
<td></td>
<td>On-shoring.</td>
<td>Moving activities from a foreign country into the home country of the firm.</td>
<td>A call centre is moved back to the original home country.</td>
</tr>
<tr>
<td>Reactivating: altering the set of activities performed by the firm.</td>
<td>Augmenting.</td>
<td>Adding a new activity in the firm.</td>
<td>A free give-away newspaper includes/adds people to hand out the paper at subway stops.</td>
</tr>
<tr>
<td></td>
<td>Removing.</td>
<td>Removing an activity from the firm.</td>
<td>An airline removes cooking hot meals from its service.</td>
</tr>
</tbody>
</table>

Table 18 illustrates how organisations are able to reconfigure their business models by relinking, repartitioning, relocating and reactivating different ‘parts’ of the organisations internally (e.g. with other business units) or externally (e.g. with partners). As an example of reactivating and relinking, Taco Bell in the US centralised its cooking processes in its local headquarters (reactivating). This initiative named ‘K-
minus’ (Schlesinger, Delong & Applegate 2001) enabled the organisation to attain economies of scale and standardise the food quality. This activity ultimately meant that some ‘relinking’ was required in the form of logistics of ingredients to headquarters and the transport of food to the restaurants (Santos et al. 2009).

2.1.4. Innovativeness: Innovation Behaviours
Despite the attention given to innovation and its antecedents, Van de Ven (1986) argued that ultimately it is people who “develop, carry, react to, and modify ideas” (p. 592). He further stated that rather than the attainment of innovativeness being the issue, it was complacency and maintaining focus on innovation that was the problem. He argued that many organisations start out with some innovation and have some degree of innovativeness within the organisation. However, most organisations tend to become complacent. The real challenge is to maintain the hunger for the innovation amongst members of the organisation. This argument further supports the view that disposition plays an important role in innovation.

Creativity and innovation have been used interchangeably and perhaps justifiably as they have overlapping aspects. However, the two are distinct in many ways. Firstly, creativity generally only involves the production of novel and useful ideas (Nijstad & Paulus 2003; Simon 2001) whilst innovation involves the production, adoption, and/or implementation of ideas (Kanter 1988; Van de Ven 1986; Scott & Bruce 1994; von Stamm 2008). Secondly, whilst creativity is primarily a solitary and internal process (i.e. within the individual) and involves an idea or knowledge that is new to the world or individual (Boden 2004), innovation may require external help and require some adaptation of the idea with the external environment so that it can be actualised, for example, in the form of a product or service (Scott & Bruce 1994). Thirdly, it is recognised that innovation is a multistage process that is susceptible to many influences such as social factors (Kanter 1988). Innovation is a far more complex and varied concept than creativity (Axtell et al. 2000). Innovation has many steps that are reiterative and embodies many perspectives (West & Farr 1990a). Van de Ven, Angle and Poole (1989) support this view as they state that innovation is a social process as it is heavily reliant on the involvement of others.

Scott and Bruce (1994) argue that there are essentially three primary steps involved in individual innovation. The first involves developing ideas, recognising problems and generating solutions that are either novel or adopted. The second step involves the innovative individual attempting to gain support and sponsorship for the idea. This
involves establishing a coalition and obtaining sponsorship from senior management. The third step involves developing some form of prototype of the new innovation. However, Scott and Bruce (1994) state that because innovation is a characterised by discontinuous activities, individuals may be involved in any of these activities at any one time. Scott and Bruce (1994) posit that “true innovators are people who can use a problem solving style that is appropriate to the stage of the innovation cycle in which they are involved” (p. 601) thereby implying that innovators require metacognitive abilities.

Innovation is not just the reserve of the R&D department nor does it relate only to product or process innovation. Innovation is pervasive throughout an organisation and can be performed by anyone. Innovation, as discussed in Section 2.13, may also appear in other forms such organisational innovation. Innovation is also no longer purely implicit as in some cases it may be an explicit expectation. Even as far back as in the 1990s, such expectations were starting to grow. John Towers, who was the former Managing Director of Rovers (UK), when he said “Everyone now has two jobs. First to build a car, second to find ways of doing the jobs better” (cited by Axtell et al., 2000, p. 265).

Axtell et al. (2000) state that the type and degree of innovative behaviour by individuals depend on the context. For example, suggestions on how to improve a job depends on an individual’s personal traits and job characteristics, whereas the implementation of innovative ideas depends on group and organisational characteristics.

Axtell et al. (2000) state that there are many antecedents of innovation at the individual level such as role competence, creativity, intrinsic motivation, self-efficacy and ‘felt responsibility’ through their roles, especially those that are orientated towards innovation (e.g. risk taking). Initiatives such as job expansion are also helpful in promoting individual innovation as the more employees know about different parts of their organisations, the more relationships and interconnections they ‘see’ and the more likely it is that ideas will flow (Herzberg 1966).

Axtell et al. (2000) argue that whilst these are general factors that may predict innovation behaviour, there are also other contextual factors that may play a role. For example, individuals in professional jobs (e.g. engineers) may have more autonomy at work and this may increase their propensity to innovate. In contrast, individuals who
work on the shopfloor may not have that level of independence and thus may not be able to exercise any innovativeness.

Welbourne, Johnson and Erez (1998) state that whilst innovation may not be a formal part of one’s job, it is nevertheless tending to be an expectation, that is both implicit and explicit. Welbourne et al. (1998) posit that the innovator role not only involves individuals applying their creativity to their jobs but also includes their contribution to enhancing the adaptability and thus effectiveness of the organisation. Examples of behaviours that can be found in the innovator role are coming up with and implementing new ideas, findings better ways to do things such as creating more efficient process and routines (Welbourne et al. 1998).

Organisations have been progressively moving towards the notion of ‘roles’ rather than ‘jobs’ (Welbourne et al. 1998; Belbin 2010), which are essentially based on competencies (Jackson & Chapman 2012). ‘Roles’ have been given eminence due to the recognition of non-job components that significantly contribute to both job and organisational performance (Austin & Villanova 1992). Welbourne et al. (1998) cite the example of organisational citizenship behaviour, which refers to voluntary behaviours that are not necessarily required by the organisation but which undoubtedly improve organisational performance (Bateman & Organ 1993).

Welbourne et al. (1998) used Role Theory and Role Identity to identify the different roles employees must undertake to perform at a high level. They identified five key roles (job, career, team, organisation and innovation) that need to be assumed for the successful performance of a job. Welbourne et al. (1998) argue that Role Theory explains the multidimensionality of work performance whilst Identity Theory helps to distinguish which of these roles is most important.

Role theory suggests that individuals’ roles expectations are shaped by themselves and the organisational context, thus a myriad of permutations may arise. Role performance is determined by psychological (the individual) and social (team and organisational) factors. In addition, Identity Theory indicates that the more saliency that is given to a particular role by an organisation, “the more meaning, purpose and behavioural guidance the individual should derive from its enactment” (Thoits, 1991, p. 106). Thus innovative behaviour will be more pronounced if organisations recruit individuals who are innovative, and at the same time emphasise the importance of that role.
2.2. **HIGHER-ORDER THINKING DISPOSITIONS**

This section provides a discussion of the concept of higher-order thinking dispositions. As the term suggests, there are two major parts, thinking (i.e. cognition) and dispositions (e.g. personality traits). These sections contain overviews of the key concepts related to these parts, including arguments for adopting an integrated view. The first section ‘Mental Process: Intelligence, Cognition and Thinking’ discusses the concepts and theories concerning intellectual processes. The section ‘Socio-emotional Processes: Personality, Traits and Dispositions’ discusses the enduring, non-intellectual traits of individuals, whilst the third section ‘An Integrated View’ contains a number of propositions, theories and models that provide arguments for a unified perspective. This section plays an important role in the development of the research questions and model as it discusses the meaning of the concept of “higher-order thinking dispositions” and shows how this concept is premised upon two fields of research: That is, intelligence and cognition, and traits and dispositions. This section provides empirical evidence (e.g. Good Thinking, Typical Intellectual Engagement and Subjective Assessed Intelligence) to demonstrate the merits of adopting an integrated view of both fields.

2.2.1. **Mental Processes: Intelligence, Cognition and Thinking**

This section contains a discussion on mental processes. The first sub-section discusses the concepts of intelligence and cognition. Intelligence and cognition are considered to be the science behind the concept of ‘thinking’. The discussion concerns how intelligence and cognition are distinct yet interrelated. This leads us to the application of intelligence and cognition in the form of thinking. The discussion concerning thinking contains two parts; low-level and higher-order thinking. Examples of both levels of thinking are provided.

2.2.1.1. **Intelligence and Cognition**

This section discusses the concepts of intelligence and cognition (there are schools of thought in unifying both). Intelligence and cognition are two disciplines in cognitive psychology (Cronbach 1957) although Nęcka and Orzechowski (2005) posit intelligence is a structural form of cognition and intelligence is the process that explains how such a structure comes into being. This is the basis of the theory of intelligent thinking that essentially concerns how intelligence is activated when dealing with complex problems (Frensch & Sternberg 1989). Chiu, Hong and Dweck (1994) broadly conceptualise intelligence as i) mental operations ii) skills and knowledge and iii) instigated for adaptive behaviour (e.g. problem solving).
Intelligence can be understood from different perspectives; biological, educational, evolutionary, cognitive psychology, neuropsychology and anthropology (Lohman 2005). Indeed many factors contribute to the development of intelligence but none more so than biological and socio-environmental factors with a 7:3 ratio, respectively (Eysenck 1994). Dai and Sternberg (2004) support this view as they posit that effective reasoning abilities are both an endowment and an outcome of effective education. Eysenck (1994), nonetheless, argues that the definition that is frequently assumed is synonymous with psychometric intelligence (i.e. IQ, intelligence quotient), which was first developed by Binet and Simon (1905). Spearman (1904), then Cattell (1943) put forth the idea of general intelligence (G), which is divided into two parts, fluid intelligence (Gf) and crystallised intelligence (Gc). Gf is the efficiency of cognitive processes, whilst Gc is the knowledge possessed (Ackerman 1996). Both are interconnected. The more efficient the GF, the more knowledge one accumulates. The accumulation of knowledge may involve more efficient reasoning ‘approaches, methods or techniques’ (e.g. analogies and metaphors) that contribute to the repertoire of Gf functioning. Another slightly different conceptualisation is the Cattell-Horn model of intelligence that suggest that there three broad abilities fluid intelligence (Gf), crystallised intelligence (Gc) and spatial-visual intelligence (Gv) (Horn & Noll 1994).

Gf reflects reasoning abilities, as Dai and Sternberg (2004) state that intelligence is associated with higher-order thinking such as reasoning. Inductive reasoning is commonly used in intelligence tests due to its association with fluid intelligence (gf) as Sternberg (1986) states “An interesting finding that emerges from the literature attempting to relate cognitive task performance to psychometrically measured intelligence is that the correlation of task performance and IQ seems to be a direct function of the amount of reasoning involved in a given task, independent of the paradigm or label given to the paradigm. ... Thus, reasoning ability appears to be central to intelligence” (pp. 309–310).

Carroll (1993) states that there are three types of reasoning; sequential, inductive and quantitative reasoning. Sequential is essentially deductive (or logical) reasoning, inductive reasoning primarily involves identifying rules and/or patterns and quantitative reasoning is measured using both deductive or inductive reasoning on quantitative concepts. Bruner (1957) argues that reasoning is essentially going beyond the information given. He states that to do so one must “Attempt to infer (either
automatically or deliberately) concepts, patterns, or rules that best (i.e., most uniquely) characterize the relationships or patterns they perceive among all the elements (words, symbols, figures, sounds, movements, etc.) in a stimulus set. Better reasoning is characterized by the use of concepts or rules that simultaneously satisfy the opposing needs for abstraction (or generalization) and specificity. Such concepts or rules tend to be at least moderately abstract yet precisely tuned. Put differently, a poor inference is often vague and captures only a subset of the relationships among the elements in the set. The judgment of what constitutes better reasoning is in part dictated by the shared knowledge and conventions of particular communities of discourse and in part by the precision and generality of the inference” (p. 245).

Intelligence is as much behavioural as it is cognitive (Nęcka & Orzechowski 2005). Other scholars such as Guilford (1967) (whose work is discussed in the ‘Creativity’ section) and Sternberg (1985) developed their own models of intelligence. For example, the premise of Sternberg’s Triarchic Theory of Intelligence is that intelligence essentially concerns adapting to the environment and changes. He suggested that there are three aspects of intelligence that helps people to do this; componential, experiential and contextual/practical. Each is explained in Table 19.

<table>
<thead>
<tr>
<th>Aspects of Intelligence</th>
<th>Focus</th>
</tr>
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<tbody>
<tr>
<td>Componential</td>
<td>• Metacomponents to organise and monitor one’s thinking&lt;br&gt;• Performance components to recognize and perform&lt;br&gt;• Knowledge-acquisition to organize and comprehend information</td>
</tr>
<tr>
<td>Experiential</td>
<td>• Ways to confront new and unfamiliar situations&lt;br&gt;• Ways to cope with novel or unfamiliar situations&lt;br&gt;• Automatisation of familiar task behaviours to reduce demands for mental&lt;br&gt;• Capacity during problem-solving operations</td>
</tr>
<tr>
<td>Contextual/ Practical</td>
<td>• Ability to adapt, select, or shape the environment in order to succeed</td>
</tr>
</tbody>
</table>

A similar notion is claimed by Piaget (1972) who states that adaptation is the essence of intelligence. Adaptation is learning from the environment, specifically in learning to address changes and challenges in the environment. He argues that individuals also need to adjust to their environment. Adjustment has two inter-related and complementary processes, assimilation and accommodation. Assimilation involves absorbing new information and fitting it into the existing knowledge structures and schemas. Accommodation is forming new cognitive structures to accommodate new
information and knowledge. It is claimed that the accommodation process is responsible for the ‘aha’ moment when insights are gained (Hunt 2005). Piaget argues that these two processes need to be held in equilibrium in a balancing act. Pretz and Sternberg (2005) argue that individuals with high intelligence are also generally better learners who are more effective at adapting.

Many other scholars use similar, if not the same, criteria in defining intelligence. For example, Raab and Gigerenzer (2005) also suggest that intelligence is about adaptation and include social and ecological perspectives. Indeed, they suggest that social intelligence (with its twin being Machiavellian intelligence) is an important feature of general intelligence, as it is the ability to handle social situations in an intelligent manner (Raab & Gigerenzer 2005). Similarly, Goleman (1996) put forth the idea of emotional intelligence, which involves awareness and control of one’s own emotions, and the ability to recognise the emotions in others, whilst Sternberg et al. (2000) conceptualised the construct of practical intelligence that concerns ‘everyday’ intelligence and combines creativity.

Wenke, Frensch and Funke (2005) argue that the defining quality of intelligence is the ability to solve problems in any domain such as problems from the mathematical and social domains. Rolfhus and Ackerman (1999) add that experts have an advantage over novices because of their domain specific knowledge, specifically in terms of problem solving. Thus, if a criterion of intelligence is problem solving, domain specific knowledge must be given its due credit in the conceptualisation of intelligence. Although Nęcka and Orzechowski (2005) define intelligence as “the ability to solve complex problems” (p. 122) in adapting to new situations efficiently they however emphasise that it is ‘complex problems’ that are more commonly used as the criterion for intelligence, and not just problems such as puzzles. Thus a real ‘test’ of intelligence should involve problems rather than puzzles. Puzzles, however, can be used provided they are designed with elaborate items as a long series and if there were some priming involved as intelligent problem solving usually involves overcoming mental traps (i.e. fixation) (Nęcka & Orzechowski 2005). Intelligence and complex problem solving go hand-in-hand as there is a relationship between the two such as working out rules in reasoning (Newell & Simon 1972) and task mental representation (Hayes 1981).

The perspective from Wenke et al. (2005) and Nęcka and Orzechowski (2005) is consistent the notion of multiple intelligences suggested by Gardner (1983). Gardner
(1983) stated that there are seven types of intelligence such as linguistic-verbal, logical-mathematical, musical, spatial, bodily-kinesthetic, interpersonal and intrapersonal. A description of each of these seven types of intelligence is provided in Table 20.
### Table 20: Multiple intelligences (Gardner 1983)

<table>
<thead>
<tr>
<th>Types of Intelligence</th>
<th>Abilities and Forms</th>
</tr>
</thead>
</table>
| Linguistic-verbal     | Sensitive use and awareness of language.  
Language, rhythms, inflections, meaning, and order of words (stories, books, humour, rhymes, songs) |
| Logical-mathematical  | Reason, recognize, and manipulate logical-mathematical patterns.  
Reasoning with strings and patterns of symbols (pattern blocks, activities to form numbers and letters, building, measuring, cooking, gardening, other math-logic applications) |
| Musical               | Appreciate and produce musical pitch, melody, and tone.  
Pitch, melody, tone, and sound movements in time (rhythm sticks, varieties of music, interaction with musicians, dance exercises) |
| Spatial               | Perceive and transform perceptions.  
Visual perception, transformation, modification, and creations (colours, shapes, spaces, games with movement and coordination) |
| Bodily-kinesthetic     | Use and control the body and objects.  
Body motion and manipulation of objects (games with movement and manipulation, hands-on projects, dance exercises, sports, tactile activities) |
| Interpersonal         | Sense needs, thoughts, and feelings of others.  
Relationships with others (cooperative games or exercises, peer or paired activities, public performances, conversation, exercises to focus on sensitivity to diverse needs) |
| Intrapersonal         | Recognize and respond to one’s own needs, thoughts, and feelings.  
Knowledge of self (exercises to express and acknowledge feelings, possibly journals or speeches or drawings; resources and exercises to identify and analyse one’s own thinking processes, skills, interests, and feelings) |

Anderson (2005) states that intelligence and cognition are synonymous with one another as cognitive psychology concerns understanding the entire human cognitive system, which includes the psychology of intelligence. He notes the intentions of Cronbach (1957) in unifying the disciplines as he states “Perhaps even more fundamentally, Cronbach was correct in wanting to merge the two psychologies because there is only one mind, and it must be one and the same mind that underlies both our universal capacities and the ways in which we systematically differ” (p. 277).
Dai and Sternberg (2004) argue that whilst the intellectual level is concerned with intention (e.g. problem solving), the cognitive level is about operations of the mind. King et al. (1998) state that cognition is the “mental operations involved in thinking; the biological/neurological processes of the brain that facilitate thought” and “all of our mental processes, such as perception, memory, and judgment” (p. 34), whilst Jensen (2005) suggests that cognition concerns mental chronometry (i.e. the speed of processing). Reasoning can be observed as one of the overlapping constructs that bind both cognition and intelligence together. Together with reasoning, Pretz and Sternberg (2005) also emphasise the role of knowledge (crystallised intelligence) in determining the level of intelligence in an individual. “Reasoning researchers have long observed the effect of knowledge on reasoning performance. To the extent that intelligence tests rely on reasoning abilities, knowledge should affect intelligence scores as well. Reasoning ability and knowledge reside on a two-way street. Not only is reasoning on a particular task affected by previous knowledge, but also the acquisition of knowledge itself is affected by reasoning ability” (p. 314). This is generally supported by Nęcka and Orzechowski (2005) who define higher-order cognition as an “information processing phenomena in which the metacognitive factors of monitoring and control play the fundamental role” (p. 122). They assert that cognition is one form of intelligence that is related to the neural capacity for information processing, and the metacognitive skills for monitoring and control (Metacognition is further discussed in its own section).

Ackerman (2005) explains the link between intelligence and cognition in the context of skill development. He states that people generally go through three-stages in developing skill, “The first stage (called “cognitive”) occurs when the learner first confronts the task. At this stage, the learner must encode rules and develop strategies for task accomplishment. This stage is highly dependent on the kinds of specific abilities that underlie general intellectual abilities (such as memory, reasoning, and particular content abilities, such as verbal, spatial, or numerical abilities, depending on the task content). Performance during this stage of skill acquisition is slow, effortful, and error-prone. The second stage is the “associative” stage. That is, once the learner has mastered the general rules for task accomplishment, he/she seeks to make the process of performance more efficient, for example, by eliminating inefficient or unnecessary steps. During this stage of skilled performance, the task is accomplished much more quickly than in the first stage, but there are occasional errors as the learner tries to streamline the procedures for task accomplishment. Effort is still needed to perform the task, and effort is further needed to make
additional refinements and improvements to the skill. The third stage of skill acquisition was referred to as the “autonomous” stage. Performance at this stage is fast and characterized by few errors. Learners who reach this stage of skilled performance can frequently perform the task almost or completely effortlessly, even when attention is diverted to other activities. The task of driving an automobile provides a good example of these stages of skill acquisition” (p. 143).

Thus, intelligence generally relates to the first two stages identified by Ackerman (2005), as stage three is mostly a bodily-kinaesthetic/psychomotor process. Stage one is similar to the process of adaption as described by Hunt (2005), whilst the second stage concerns perceptual speed, which is linked to the concepts of information processing speed posited by Nęcka and Orzechowski (2005) and Jensen (2005). Thus intelligence helps one to learn, conceptualise task requirements and adapt but does not necessarily predict skilled performance, which is dependent on other factors such as cognitive information processing. Kyllonen and Christal (1990) expands on this and posits that skill attainment depends on i) declarative knowledge ii) procedural knowledge iii) memory capacity and iv) processing speed (encoding and retrieving information to and from memory).

Pretz and Sternberg (2005) argue that overall there are two approaches that characterises research into cognition and intelligence; bottom-up and top-down. The bottom-up approach involves identifying basic cognitive processes through traditional psychometric tests, whilst the top-down approach researches the relationship between intelligence and other processes such as problem solving, decision making and transfer of learning. Cognition is essentially a part of intelligence and plays different roles. The lower-order cognitive approaches to intelligence relates to processing speed of information although this approach has a modest correlation with intelligence with coefficients of between .2 and .3, whilst working memory explains 35% of the variance in intelligence (Pretz & Sternberg 2005).

The higher-order cognitive approach to intelligence concerns control and flexibility, rather than just processing efficiency. Cognitive control is also argued to be related to intelligence as it involves selecting the most appropriate cognitive strategies to solve problems and to suppress potentially erroneous automatic responses. Flexibility refers to the use of strategy (Hunt 2005). Individuals with higher intelligence are able to switch from one strategy to another. Intelligent individuals use heuristics in a smart
way, that is knowing when and which heuristics to use. This ‘skill’ is dependent on the individuals’ level of metacognitive skills (Pretz & Sternberg 2005).

### 2.2.1.2. **Higher-Order Thinking**

Nęcka and Orzechowski (2005) posit that from an ontological perspective, *thinking* and *intelligence* are both forms of *cognition*, with *thinking* being a fluid cognitive process, whilst *intelligence* being a solid structure that determines ability. Thus thinking may be viewed as the application of the science of cognitive psychology (Hunt 2005; Pretz & Sternberg 2005). Hunt (2005) states that cognitive psychology is concerned about both lower levels of thinking (e.g. memory), and higher levels of thinking (e.g. solving logical and mathematical problems). Thinking is at the representational-level as it is the product of the brain’s information-processing capacity and the individual’s environment (Hunt 2005).

Thinking is a human endeavour and is a way of reasoning (Markman & Gentner 2001) and conceptualising (Cabrera, Colosi & Lobdell 2008) that is underpinned by an array of other mental functions. Thinking can be defined in many ways such as argumentation (Toulmin 1969) and structural alignment, (e.g. cognitive mapping, imagery and metaphors) (Markman & Gentner 2001). Argumentation is generally the ability to provide a sound basis of a proposition/claim. Toulmin’s model provides a comprehensive framework on how thinking can be reflected as an argument in positioning a claim or contention (Toulmin 1969) as shown in Figure 17.

![Figure 17: Toulmin’s argumentation structure (Hart 2003)](image-url)
Toulmin’s argument structure comprises of a claim, which is an arguable statement premised upon evidence (e.g. data) used in support of the claim. Both the claim and evidence are supported by a warrant which is a normative expectation that provides the link between the evidence and claim. The three constructed (claim, evidence and warrant) are the basic components of any argument. However, more advanced and thus stronger arguments are constructed when a backing (to the warrant) and a qualifier are included. A backing to a warrant is the context and assumptions used to support the validity of the warrant and evidence. A qualifier determines the ‘scope’, relevance and applicability of the claim (Toulmin 1976). A rebuttal is a counter claim that can also consist of the same constructs.

Structural alignment involves the identification of fundamental commonalities between situations to infer a similar effect to the present situation from a previous situation. A related notion of cognitive mapping is the mental association made between concepts and propositions (Markman & Gentner 2001). Markman and Gentner (2001) also claim that imagery, which is a mental abstraction and representation utility that includes the use of analogies and metaphors, is another form of thinking.

Analogies and metaphors are cognitive strategies that enable individuals to draw comparisons and relationships from different contexts to further understand a new situation/problem. Analogies and metaphors are useful tools as they are efficient and simple methods for structuring a problem into one that is cognisable and consistent with an individual’s understanding of the world (Markman & Gentner 2001). The analogy identified in the Chinese saying of ‘give a man a fish, and he eats for a day, teach a man to fish, and he eats everyday’ succinctly provides a prescription of how education and learning is important to one’s independence and survival.

There are limits to human thinking, nonetheless, such as heuristics (which are further discussed in the ‘Critical Thinking’ section), bounded rationality and automacy. Heuristics is the establishment of ‘rules for making rules’ (Von Der Weth & Frankenberger 1995). These rules are abstract and are used when routine references are not available to resolve an issue or problem. Although heuristic rules are independent of a subject matter and has its uses (von der Weth & Frankenberger, 1995), it is nonetheless premised upon inherent fallacies such as biases, representativeness (stereotyping to predict outcomes), anchoring (using a subjective moment in one’s life as a main reference point in estimating the probability of an
outcome) and availability (tendency to reference experiences that are in memory) (Tallman & Gray 1990). Bounded rationality infers to the inherent cognitive limitation that inclines individuals to simplify a problem when encountered with extensive information and an almost infinite number of alternatives (Tallman & Gray, 1990). In addition, the process of simplification creates another set of barriers in terms of factors that are either disregarded or trivialised. Thinking is also significantly influenced by memory and knowledge. Individuals have a propensity to rely on previous knowledge and memory in solving problems, termed as automaticity (Markman & Gentner 2001). Automaticity is not necessarily a negative concept as most problems faced by individuals are solvable with reference to similar situations. However, the solver needs to be aware when automaticity occurs as the mind tries to economise as thinking is a taxing endeavour. Automaticity may result in the identification of casual, non-sustainable and erroneous solutions that may accentuate a problem.

Previous concepts introduced are just some general aspects of thinking. There are distinctions made between lower-level and higher-order thinking (Bloom & Krathwohl 1956). Lower-level thinking is usually related to simple analysis (e.g. backing up a claim using argumentation – although it should be noted that Toulmin’s model caters for simple and advanced argumentations) and comprehension (e.g. using analogies). Higher-order thinking means going beyond the information provided, and involves advanced cognitive processes such as analysis, synthesis and evaluation (Anderson & Krathwohl 2001; Haladyna 1997), critical thinking, reflective thinking (metacognition), problem solving and creativity (Torff 2003; King et al. 1998). Lewis and Smith (1993) argue that “Higher-order thinking occurs when a person takes new information and information stored in memory and interrelates and/or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations. A variety of purposes can be achieved through higher-order thinking . . . deciding what to believe; deciding what to do; creating a new idea, a new object, or an artistic expression; making a prediction; and solving a non-routine problem.” (p. 136). Indeed, this suggests that there is a relationship between higher-order information processing and intelligence (Pretz & Sternberg 2005).

King et al. (1998) argue that higher-order thinking is crucial in helping individuals to address many of life’s challenges such as ambiguities, uncertainties, paradoxes and dilemmas. Effective higher-order thinking results in outcome such as effective and sustainable decisions, insights, inventions, innovations and solution. Figure 18 illustrates how higher-order thinking can be developed.
### Level 3: Higher-Order Thinking

<table>
<thead>
<tr>
<th><strong>Situations</strong></th>
<th><strong>Skills</strong></th>
<th><strong>Outcomes</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Situations of multiple categories, for which the student has not learned answers, preferably real-life context</td>
<td>Multidimensional skills of applying more than one rule or transforming known concepts or rules to fit the situation</td>
<td>Outcomes that are created through thinking processes, not generated from rote responses of prior learning experiences</td>
</tr>
<tr>
<td>• ambiguities</td>
<td>Critical thinking</td>
<td>• arguments (advanced)</td>
</tr>
<tr>
<td>• challenges</td>
<td>• logical thinking</td>
<td>• compositions</td>
</tr>
<tr>
<td>• confusions</td>
<td>• evaluation</td>
<td>• conclusions</td>
</tr>
<tr>
<td>• dilemmas</td>
<td>• scientific experimentation</td>
<td>• confirmations</td>
</tr>
<tr>
<td>• discrepancies</td>
<td>• scientific inquiry</td>
<td>• decisions</td>
</tr>
<tr>
<td>• doubt</td>
<td>Creative thinking</td>
<td>• discoveries</td>
</tr>
<tr>
<td>• obstacles</td>
<td>Problem solving</td>
<td>• estimates</td>
</tr>
<tr>
<td>• paradoxes</td>
<td>• decision making</td>
<td>• explanations</td>
</tr>
<tr>
<td>• problems</td>
<td>Metacognitive thinking</td>
<td>• hypotheses</td>
</tr>
<tr>
<td>• puzzles</td>
<td>• reflective thinking</td>
<td>• insights</td>
</tr>
<tr>
<td>• questions</td>
<td>Systems thinking</td>
<td>• inventions</td>
</tr>
<tr>
<td>• uncertainties</td>
<td>• complex analysis</td>
<td>• innovations</td>
</tr>
</tbody>
</table>

- • systems analysis
- • judgments
- • performances
- • plans
- • predictions
- • priorities
- • probabilities
- • problems
- • products
- • recommendations
- • representations
- • resolutions
- • results
- • solutions

### Level 2: Bridges: Connecting networks and operations

<table>
<thead>
<tr>
<th><strong>Linkages</strong></th>
<th><strong>Schemata</strong></th>
<th><strong>Scaffolding</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension of prior learning to new context and higher-order skills may require mastery or automatisation of prior learning</td>
<td>Network, organisation, representation, or architecture for organising new learning</td>
<td>Guidance, structure, visual and verbal representations, modelling of higher-order thinking</td>
</tr>
</tbody>
</table>

### Level 3: Pre-requisites

<table>
<thead>
<tr>
<th><strong>Content and Context</strong></th>
<th><strong>Lower Order Thinking Skills</strong></th>
<th><strong>Dispositions and Abilities</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• subject area content (vocabulary, structure, concept definitions, procedural knowledge, reasoning patterns)</td>
<td>• cognitive strategies</td>
<td>• attitudes, adaptiveness, tolerance for risk, flexibility, openness</td>
</tr>
<tr>
<td>• thinking terms, structures, strategies, errors, fallacies</td>
<td>• comprehension</td>
<td>• cognitive styles (e.g. field dependence, locus of control, response rates)</td>
</tr>
<tr>
<td>• teaching strategies and learning environment (safe, motivating, supportive)</td>
<td>• concept classification</td>
<td>• habits of mind (persistence, self-monitoring, self-reflection)</td>
</tr>
<tr>
<td></td>
<td>• routine rule using</td>
<td>• multiple intelligences (linguistic-verbal, logical-mathematical, spatial, musical, bodily-kinesthetic, interpersonal, intrapersonal)</td>
</tr>
<tr>
<td></td>
<td>• simple rule using</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• simple analysis</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 18: Development of higher-order thinking skills (King et al. 1998)**
At Level 1, King et al. (1998) emphasise the importance of the presence of three important factors, the individuals’ ability to master lower level thinking skills, the dispositions (discussed more later) and the environment (e.g. learning and teaching). Lower-level thinking skills are the threshold standards. Without attaining these first, it is unlikely that the individual will be able to master higher levels. The individuals’ attitudes and dispositions must also be ‘right’, such as being motivated to learn and being open minded. In addition, a supporting and effective learning environment (and content, curriculum) must also be present. At Level 2, linkages are made by transferring learning from lower levels to new contexts. This compels individuals to change their mental schemes, however this should be undertaken with supportive guidance from an instructor. At Level 3, individuals should be provided with more challenging tasks to develop their higher-order thinking.

2.2.2. Socio-emotional Processes: Personality, Traits and Dispositions

The main purpose of this sub-section is to discuss the role of dispositions in thinking. In doing so, a brief discussion concerning individual differences in terms of personality is presented in leading to the concept of traits and disposition. It is not the intention to discuss personality in any detail as this is a significant and broad field of study. Only relevant concepts will be introduced in the context of this study and topic.

2.2.2.1. Individual Differences and Personality

Individual differences are comprised of both intellectual and socioemotional processes (Haslam 2007). Intellectual processes were discussed in the previous section and in this section, socioemotional process are to be discussed.

Socioemotional processes (or non-intellectual processes) can be divided into transient and enduring factors. Transient factors come in the form of moods. Enduring factors can be further divided into specific and broad factors. Specific enduring factors are particular in terms of situation, events, objects and even persons, and come in the form of habits and attitudes. Broad enduring factors are essentially conceptualised as ‘personality’ (Haslam 2007), as shown in Figure 19.
There are various approaches in understanding, conceptualising and studying personality (McAdams 2009; Maltby, Day & Macaskill 2010). The most popular are based on the psychoanalytic (initiated by Freud), the biological (e.g. Eysenck), the humanistic (popularised by Rogers and Maslow), the behavioural/social learning (e.g. Bandura), the cognitive (by Kelly) and the traits approaches (e.g. Costa and McCrae) (Burger 2011; Maltby et al. 2010). There is no one best approach as each approach provides its own unique contribution to our understanding of personality.

The multiplicity in conceptualising personality is also reflected in how scholars define personality. For example, Burger (2011) defined personality as “…consistent behaviour patterns and intrapersonal processes originating from the individual.” (p. 4), whilst McAdams (2009) defines personality as “The patterning of dispositional traits, characteristics adaptation and integrative life stories set in culture and shaped by human nature.” (p. xx). James and Mazerolle (2001) alternatively, conceptualise personality as all-encompassing including cognition as they define personality as “The
dynamic organization of mental (i.e. cognitive) structures and coordinated mental (cognitive) processes that determine individuals’ emotion and behavioural adjustments to their environment.” (p. 34). Cognitive structures consist of “knowledge, beliefs, cognitive schemata, implicit reasoning propensities, values, emotional; repertoires, self-concepts, goals and expectancies” (p. 34), whilst cognitive processes are “mental operations such as perceiving, thinking and feeling” (p. 34). James and Mazerolle (2001) posit that traits are the “disposition or tendency to behave in a relatively consistent manner over time across diverse situations” (p. 25), and are shaped by needs (motives). From a cognitive approach to personality, Kelly (1963) argued that people create their own personal constructs as they grow and gain new experiences. Personal constructs guide how people perceive and interpret events and thus ultimately their behaviour (Kelly 1955).

The study and consideration of personality is crucial in helping us to further understand individuals’ higher-order thinking as personality changes according to how we perceive the events and the world around us. The trait approach is adopted for this study due to the reason that the traits approach is most suited to the nomothetic approach (e.g. compare and contrast individuals amongst one another) in studying individual differences (Allport 1937; Funder 2001), which is consistent with the research paradigm of this study. In addition, the trait approach also enables researchers to predict behaviour such as, in the case of this study, which is interested in predicting behaviour related to innovativeness.

2.2.2.2. Traits and Dispositions
McAdams (2009) argues that there are three levels in explaining a person’s behaviour. Level 1 is the disposition traits (i.e. general tendencies), Level 2 are characteristic adaptation (i.e. beliefs and desires) that is partly driven by needs/motives and partly driven by situational factors, and Level 3 are ‘life stories’ (i.e. purpose of life) (each level is further described in Table 21 below). McAdams (2009) states that dispositional traits are the foundation in individual differences and are most useful when studying individuals. He states that “dispositional traits sketch an outline of the person, characteristic adaptations fill in the details, and integrative life stories tell you what a life means overall” (p. xix).
Table 21: Three-levels of personalities (McAdams & Pals 2006)

<table>
<thead>
<tr>
<th>Level</th>
<th>Definitions</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1: Dispositional traits</td>
<td>Broad individual differences in behaviour, thought and feeling that account for general consistencies across situations and over time (e.g. extraversion, the Big Five). Individual differences traits in traits are relatively stable over time.</td>
<td>Dispositional traits sketch a behavioural outlines.</td>
</tr>
<tr>
<td>Level 2: Characteristic adaptations</td>
<td>More specific motivational, social-cognitive and development variables that are contextualised in time, situations and social roles (e.g. goals, values, coping strategies, relational strategies, domain-specific schemas, stage-specific concerns). Some characteristic adaptation may change markedly over the life course.</td>
<td>Characteristics adaptations fill in the details of human individuality.</td>
</tr>
<tr>
<td>Level 3: Integrative life stories</td>
<td>Internalised and evolving life stories that reconstruct the past and imagine the future to provide an person’s life with identity (unity, purpose, meaning). Individual differences in life stories can be images, tones, themes, plots and endings. Life stories change substantially over time reflecting personality development.</td>
<td>Integrative life stories narratives tell what a person’s life means in time and culture.</td>
</tr>
</tbody>
</table>

Traits are internal dispositions that are stable over time and across situations, and are usually conceived in bipolar terms (e.g. friendly and unfriendly) (McAdams 2009). They are independent and additive (e.g. a person can be extroverted and open) (McAdams & Pals 2006). Most people fall within the middle range of traits and personality traits can be differentiated from other constructs that are considered less socioemotional and cognitive (e.g. values, schemas, intelligence traits) in nature. Thus personality traits determine socioemotional functioning such as social interaction.

The study of traits and dispositions has a long history. Only key scholars whose work is directly related to the development of the most popular and studied model of traits (i.e., the Five Factor Model or The Big Five) is reviewed, starting with Gordon Allport. Allport (1937) viewed personality from the lens of *proprium*, which assumes the uniqueness of a whole person. He argued that there is no difference between traits and motives, and encouraged both the nomothetic and the idiographic approaches to studying personality. Allport viewed traits as neuropsychic structures that cannot be seen, and tended to use the terms disposition and traits interchangeably. He claimed that traits are major structural units of personality and that there were three ‘levels’ of personal dispositions; the cardinal disposition (general, pervasive and defining of a person), the central disposition (5 to 10 central dispositions that are displayed on a
daily basis) and secondary traits (contingent on situational cues, and less defining). Allport (1937) research into traits commenced with his study of 550,000 English words that describe a person. He narrowed this down to 18,000 words describing psychological states, and then to 4,5000 words that describe relatively stable enduring personality traits.

Cattell (1957) continued Allport’s work. Cattell’s view was that personality is about behaviour and that its utility is about predicting behaviour. Similar to Allport, Cattell discerned that there are unique traits as he used various sources of information in triangulating individuals' personality. He called these data sources as L data, which is life data such as college transcripts, Q data, data from questionnaires he distributed, and T data, which are test data such as observations of individuals in controlled environments.

Cattell (1957) identified a hierarchical model of traits. The highest are dynamic traits that translate into action in attaining goals, ability traits that determine how effective a person is in attaining the goals and temperament traits, which are the stylistic aspect of traits. Continuing the work of Allport, Cattell (1957), using factor analysis, was able to trim down the number of descriptors to sixteen personality factors (James 2002). Table 22 below contains Cattel’s 16 Personality Factors.
<table>
<thead>
<tr>
<th>Descriptors of Low Range</th>
<th>Primary Factor</th>
<th>Descriptors of High Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reserve, impersonal, distant, cool, reserved, impersonal, detached, formal, aloof (Sizothymia)</td>
<td>Warmth</td>
<td>Warm, outgoing, attentive to others, kindly, easy going, participating, likes people (Affectothymia)</td>
</tr>
<tr>
<td>Concrete thinking, lower general mental capacity, less intelligent, unable to handle abstract problems (Lower Scholastic Mental Capacity)</td>
<td>Reasoning</td>
<td>Abstract-thinking, more intelligent, bright, higher general mental capacity, fast learner (Higher Scholastic Mental Capacity)</td>
</tr>
<tr>
<td>Reactive emotionally, changeable, affected by feelings, emotionally less stable, easily upset (Lower Ego Strength)</td>
<td>Emotional Stability</td>
<td>Emotionally stable, adaptive, mature, faces reality calm (Higher Ego Strength)</td>
</tr>
<tr>
<td>Deferrential, cooperative, avoids conflict, submissive, humble, obedient, easily led, docile, accommodating (Submissiveness)</td>
<td>Dominance</td>
<td>Dominant, forceful, assertive, aggressive, competitive, stubborn, bossy (Dominance)</td>
</tr>
<tr>
<td>Serious, restrained, prudent, taciturn, introspective, silent (Silvency)</td>
<td>Liveliness</td>
<td>Lively, animated, spontaneous, enthusiastic, happy go lucky, cheerful, expressive, impulsive (Surgency)</td>
</tr>
<tr>
<td>Expedient, nonconforming, disregards rules, self indulgent (Low Super Ego Strength)</td>
<td>Rule-Consciousness</td>
<td>Rule-conscious, dutiful, conscientious, conforming, moralistic, staid, rule bound (High Super Ego Strength)</td>
</tr>
<tr>
<td>Shy, threat-sensitive, timid, hesitant, intimidated (Threctia)</td>
<td>Social Boldness</td>
<td>Socially bold, venturesome, thick skinned, uninhibited (Parmia)</td>
</tr>
<tr>
<td>Utilitarian, objective, unsentimental, tough minded, self-reliant, no-nonsense (Harria)</td>
<td>Sensitivity</td>
<td>Sensitive, aesthetic, sentimental, tender minded, intuitive, refined (Premsia)</td>
</tr>
<tr>
<td>Trusting, unsuspecting, accepting, unconditional, easy (Alaxia)</td>
<td>Vigilance</td>
<td>Vigilant, suspicious, skeptical, distrustful, oppositional (Protension)</td>
</tr>
<tr>
<td>Grounded, practical, prosaic, solution orientated, steady, conventional (Praxernia)</td>
<td>Abstractedness</td>
<td>Abstract, imaginative, absent minded, impractical, absorbed in ideas (Autia)</td>
</tr>
<tr>
<td>Forthright, genuine, artless, open, guileless, naive, unpretentious, involved (Artlessness)</td>
<td>Privateness</td>
<td>Private, discreet, nondisclosing, shrewd, polished, worldly, astute, diplomatic (Shrewdness)</td>
</tr>
<tr>
<td>Self-Assured, unworried, complacent, secure, free of guilt, confident, self satisfied (Untroubled)</td>
<td>Apprehension</td>
<td>Apprehensive, self doubting, worried, guilt prone, insecure, worrying, self blaming (Guilt Proneness)</td>
</tr>
<tr>
<td>Traditional, attached to familiar, conservative, respecting traditional ideas (Conservatism)</td>
<td>Openness to Change</td>
<td>Open to change, experimental, liberal, analytical, critical, free thinking, flexibility (Radicalism)</td>
</tr>
<tr>
<td>Group-oriented, affiliative, a joiner and follower dependent (Group Adherence)</td>
<td>Self-Reliance</td>
<td>Self-reliant, solitary, resourceful, individualistic, self sufficient (Self-Sufficiency)</td>
</tr>
<tr>
<td>Tolerated disorder, unexacting, flexible, undisciplined, lax, self-conflict, impulsive, careless of social rues, uncontrolled (Low Integration)</td>
<td>Perfectionism</td>
<td>Perfectionistic, organized, compulsive, self-disciplined, socially precise, exacting will power, control, self-sentimental (High Self-Concept Control)</td>
</tr>
<tr>
<td>Relaxed, placid, tranquil, torpid, patient, composed low drive (Low Ergic Tension)</td>
<td>Tension</td>
<td>Tense, high energy, impatient, driven, frustrated, over wrought, time driven. (High Ergic Tension)</td>
</tr>
<tr>
<td>Utilitarian, objective, unsentimental, tough minded, self-reliant, no-nonsense, rough (Harria)</td>
<td>Sensitivity</td>
<td>Sensitive, aesthetic, sentimental, tender minded, intuitive, refined (Premsia)</td>
</tr>
</tbody>
</table>
Cattell’s work was further refined by Costa and McCrae (1985). Costa and McCrae (1985) developed a more parsimonious model of personality traits by identifying five major traits, extraversion (vs introversion), agreeableness, conscientiousness, neuroticism, and openness. Extraversion described the trait of person who is outgoing and generally considered ‘lively’. The opposite of extraversion is introversion. An introverted person is not necessarily a timid person (though they may seem so) but is someone who enjoys his/her own company: Introverts can be alone and not feel lonely. Agreeableness is a trait concerning the proclivity of someone who puts effort into being friendly. Conscientiousness is the trait of being meticulous. Persons who are identified as conscientious are generally seen as ‘responsible’. Neuroticism is the trait that demonstrates emotional instability and is usually observed as a negative trait. Openness is the trait that is related to being curious and innovative and not conservative. Other trait adjectives correlated with the five factors are outlined in Table 23.
Table 23: The Neuroticism-Extraversion-Openness Personality-Revised Inventory (NEO PI-R) Facets of the Big Five (Costa & McCrae 1992)

<table>
<thead>
<tr>
<th>Big Five Dimensions</th>
<th>Facet (and correlated trait adjective)</th>
</tr>
</thead>
</table>
| **E** Extraversion vs. introversion | Gregariousness (sociable)  
Assertiveness (forceful)  
Activity (energetic)  
Excitement-seeking (adventurous)  
Positive emotions (enthusiastic)  
Warmth (outgoing) |
| **A** Agreeableness vs. antagonism | Trust (forgiving)  
Straightforwardness (not demanding)  
Altruism (warm)  
Compliance (not stubborn)  
Modesty (not show-off)  
Tender-mindedness (sympathetic) |
| **C** Conscientiousness vs. lack of direction | Competence (efficient)  
Order (organized)  
Dutifulness (not careless)  
Achievement striving (thorough)  
Self-discipline (not lazy)  
Deliberation (not impulsive) |
| **N** Neuroticism vs. emotional stability | Anxiety (tense)  
Angry hostility (irritable)  
Depression (not contented)  
Self-consciousness (shy)  
Impulsiveness (moody)  
Vulnerability (not self-confident) |
| **O** Openness vs. closedness to experience | Ideas (curious)  
Fantasy (imaginative)  
Aesthetics (artistic)  
Actions (wide interests)  
Feelings (excitable)  
Values (unconventional) |

The following table, Table 24, illustrates the reason for the popularity of the Five Factor Model (FFM). It maps the Big Five traits against other traits conceptualised by other scholars. The Big Five traits have been shown to have concurrent validity with these other traits.
Table 24: The five robust dimensions of personality from 1949 to the 1990 (Digman 1990)

<table>
<thead>
<tr>
<th>Author</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiske (1949)</td>
<td>Social adaptability</td>
<td>Conformity</td>
<td>Will to achieve&quot;</td>
<td>Emotional control</td>
<td>Inquiring intellect</td>
</tr>
<tr>
<td>Eysenck (1970)</td>
<td>Extraversion</td>
<td>Psychoticism</td>
<td>Psychoticism</td>
<td>Neuroticism</td>
<td>-</td>
</tr>
<tr>
<td>Tupes and Christal (1961)</td>
<td>Surgency</td>
<td>Agreeableness</td>
<td>Dependability</td>
<td>Emotionality</td>
<td>Culture</td>
</tr>
<tr>
<td>Norman (1963)</td>
<td>Surgency</td>
<td>Agreeableness</td>
<td>Conscientiousness</td>
<td>Emotional</td>
<td>Culture</td>
</tr>
<tr>
<td>Borgatta (1964)</td>
<td>Assertiveness</td>
<td>Likeability</td>
<td>Task interest</td>
<td>Emotionality</td>
<td>Intelligence</td>
</tr>
<tr>
<td>Cattell (1957)</td>
<td>Exvia</td>
<td>Cortertia</td>
<td>Superego strength</td>
<td>Anxiety</td>
<td>Intelligence</td>
</tr>
<tr>
<td>Guilford (1975)</td>
<td>Social activity</td>
<td>Paranoid disposition</td>
<td>Thinking introversion</td>
<td>Emotional stability</td>
<td>-</td>
</tr>
<tr>
<td>Digman (1988)</td>
<td>Extraversion</td>
<td>Friendly compliance</td>
<td>Will to achieve</td>
<td>Neuroticism</td>
<td>Intellect</td>
</tr>
<tr>
<td>Hogan (1986)</td>
<td>Sociability &amp; ambition</td>
<td>Likeability</td>
<td>Prudence</td>
<td>Adjustment</td>
<td>Intellectance</td>
</tr>
<tr>
<td>Costa and McCrae (1985)</td>
<td>Extraversion</td>
<td>Agreeableness</td>
<td>Conscientiousness</td>
<td>Neuroticism</td>
<td>Openness</td>
</tr>
<tr>
<td>Peabody and Goldberg (1989)</td>
<td>Power</td>
<td>Love</td>
<td>Work</td>
<td>Affect</td>
<td>Intellect</td>
</tr>
<tr>
<td>Buss and Plomin (1984)</td>
<td>Activity</td>
<td>Sociability</td>
<td>Impulsivity</td>
<td>Emotionality</td>
<td>-</td>
</tr>
<tr>
<td>Tellegen (1985)</td>
<td>Positive emotionality</td>
<td>-</td>
<td>Constraint</td>
<td>Negative emotionality</td>
<td>-</td>
</tr>
<tr>
<td>Lorr (1986)</td>
<td>Interpersonal involvement</td>
<td>Level of socialization</td>
<td>Self-control</td>
<td>Emotional stability</td>
<td>Independent</td>
</tr>
</tbody>
</table>
The notion of traits has been subjected to criticism. One criticism is that the traits approach to personality involves circular logic (e.g. she is what she is). Another criticism is that situational factors do play a role in shaping behaviour, which cannot be denied (Mischel 1968). No single set of traits can characterise a person as there are too many different situations in life, and thus traits do not predict behaviour well as there are too many other factors at play (Burger 2010). It is also claimed that there is little evidence of cross-situational consistency (Burger 2011). In addition, it is claimed that traits are just too convenient and can be misleading as these ‘labels’ (i.e. traits) can lead to stereotyping and oversimplification of behaviours. The final criticism of traits is that it exist nowhere but in peoples’ minds. Traits are implicit theories of personality of the observer. As Goldberg (1993) states, human behaviour is encoded in language and the lexicon of society. The linguistic ‘interpretation’ of the traits approach is one of the four conceptualisations of traits as shown in Table 25. The position adopted by this study is the behavioural trait as suggested by McAdams and Pals (2006).

Table 25: Four positions of the nature of traits (McAdams 2009)

<table>
<thead>
<tr>
<th>Traits are:</th>
<th>Description</th>
<th>Theorists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioural dispositions</td>
<td>Traits are tendencies to act, think or feel in ways that interact with external influences such as cultural norms and situational variables, to influence a person’s functioning. Trait attributions can be used both to describe behaviour summaries and to suggest causal or generative mechanisms for behaviour</td>
<td>Cattell (1957) Wiggins (1973) Hogan (1986) McCrae and Costa (1990)</td>
</tr>
<tr>
<td>Act frequencies</td>
<td>Traits are descriptive summary categories for behavioural acts. Acts that have the same functional properties may be grouped together into families, with some acts being more prototypical or representative of the general family features than others</td>
<td>Buss and Craik (1983)</td>
</tr>
<tr>
<td>Linguistic categories</td>
<td>Traits are convenient fictions devised by people to categorise and make sense of the diversity of human behaviour and experience. Traits do not exist outside the human mind of the observer, and therefore they can have no causal influence. Through social interaction and discourse, people construct meanings for trait terms</td>
<td>Mischel (1968) Shweder (1975) Hampson (1988) Harré and Gillett (1994)</td>
</tr>
</tbody>
</table>
Despite the criticisms of the traits approach to personality, traits are valid and very useful. The approach provides researchers with a parsimonious perspective of personality and helps laypersons to gain a general understanding of an individual quickly. Longitudinal studies show that traits do exist in aggregation (McGregor, McAdams & Little 2006). Evidence of this are our life partners, would we marry someone whose behaviour would wildly change from day to day if durable and stable traits did not exist? In addition, in counter argument to studies that showed inconclusive proof of the existence of traits, it is argued that previous research relied on narrow (or single item) measures. New studies have found that some of these traits do have predictive utility as conscientiousness is found to be the best predictor of job performance, and adult academic achievement (Burger 2010; Schmidt 2014), whilst agreeableness is the best predictor of someone getting along with others in an organisation (Ackerman 2005).

2.2.3. An Integrated View

Both intellectual and socioemotional processes play a significant role in how individuals think. Chiu et al. (1994) argue that it is almost impossible to isolate trait motives from cognitive process as trait motives direct and energise the cognitive processes in addressing tasks (motivational and affect processes are part of personality). The acquisition and organisation of knowledge is the product of the combination of both mental operations and motivational/affective processes. Both the study of personality and intelligence shape adaptive problem-solving behaviours of individuals (Chiu et al. 1994). Salovey and Mayer (1994) argue that there is a growing need to adopt an integrative view of human functioning as the world that we live in is varied and rich. An integrated view is also more ecologically valid. Rolfhus and Ackerman (1999) state that personality traits and interests predict the where we may invest learning.

Dai and Sternberg (2004) argue that human thinking is intimately associated with emotion, affective states, and is a product of a multiplicity of motives as they state that “Reducing intellectual functioning and development to merely cognitive matters is simply no longer tenable both on theoretical grounds and in light of empirical evidence” (p. 29). Dispositions and thinking abilities influence one another more significantly than previous assumed. James and Mazerolle (2001) support this view as they argue that personality shapes the way we frame (e.g. perceive) and interpret the events and the world around us. For example, personality shapes our locus of control as some of us may have the proclivity to attribute causes as an internal source, rather
than as an external source. Personality also gives rise to conditional reasoning, and also introduces biases. Nęcka and Orzechowski (2005) conjectured that personality influences the adoption of cognitive strategies. There are no right or wrong ‘cognitive strategies’ as they are used to complement and/or compensate for other aspects of individual differences. Motivational and dispositional factors should not be discarded as these factors help to predict persistence with problem solving, and persistence often determines ‘success’ (Nęcka & Orzechowski 2005).

Previous studies have, however, found that dispositions and thinking types are not correlated (Facione, Facione & Giancarlo 2000a). Ackerman and Heggestad (1997) address such findings as they argue that this is due to different ‘measurement’ and ‘assessment’ of the constructs. They posit that measures of higher-order processes are based on maximal performance, whilst assessment of traits and dispositions are based on typical (everyday) performance. Ackerman and Heggestad (1997) underscores this contradictory position when they argue “With this explicit treatment of two respective testing paradigms, clearly the description of an ability testing paradigm begs the question, "Why shouldn't investigators be interested in predicting, from ability testing, what a person is most likely to do?" That is, an understanding of what an individual is likely to do is based partly on personality characteristics but also on how much intellectual effort the individual is likely to put forth, whether in school or at a job—namely, the individual’s typical intellectual engagement (TIE). When considered in the context of an individual’s typical behavior and in concert with investigators’ informal observations about the circumstances when ability test performance and achievement did not match, clearly personality and intelligence are not necessarily orthogonal domains” (p. 222). In other words, researchers were not comparing apples with apples. Wallace (1996) adds that cognitive measures are based on ‘response capability’, whilst personality trait assessments are premised upon ‘response disposition’. Ackerman (1997) argues that such measures and assessment “separates how the individual is likely to behave (ceteris paribus) and how the individual is capable of behaving” (p. 180). Aptitude (ability) also involves personality traits and not just cognition (Cronbach & Snow 1997).

Lately, some studies have found links between traits to knowledge, intellect and/or performance. For example, openness, which is related to intellectual curiosity, leads to further investment in learning and gaining new experiences, which leads to higher crystallised intelligence, whilst neuroticism is negatively correlated with intelligence as it produces unsettling emotions that impairs one’s ability to focus (Furnham 2006).
Conscientiousness may be both positively and negatively related to intelligence. It may be positively correlated to intelligence as it may help in the meticulous and accurate processing of information in problem solving. It may also be negatively correlated as individual who are low in intellect may become more conscientious in compensating for their lack of ability (Furnham 2006).

Another view that integrates both intellectual and socioemotional process are the conceptualisations of various forms of intelligences. For example, the concepts of multiple intelligences (Gardner 1983), emotional intelligence (Goleman 1996), social intelligence (Cantor & Harlow 1994) and practical intelligence (Sternberg et al. 2000). The concept of multiple intelligences and emotional intelligence are argued to be more ‘personality’ orientated, whilst practical intelligence is more ‘cognitive’ orientated. However, social intelligence epitomises a balanced link between personality and intelligence (Cantor & Harlow 1994). Social intelligence is the ability to solve everyday problems and to work towards goals within social environments as intelligence also contain repertoires for processes rules for social environments (Cantor & Harlow 1994).

The following subsections contain further propositions, theories and models that reinforce the link between cognition and dispositions. The first is a proposition concerning Good Thinking by Perkins and associates, which is followed by the notion of Typical Intellectual Engagement (TIE) by Goff and Ackerman (1992). We next discuss the work of Chamorro-Premuzic and Furnham (2004) whose work on the Subjectively Assessed Intelligence (SAI) model closely mirrors that of TIE. The next model is the theory of trait complexes which posits a link between ability and disposition, and this is followed by a related theory in the form of the Intelligence-as-Process, Personality, Interests, and Intelligence-as-Knowledge (PPIK) model. Finally a discussion on the concept of extra-cognition illustrates how cognition and dispositions are reflected in individuals who are deemed to have high ability.

2.2.3.1. Good Thinking
Perkins and Ritchhart (2004) argue that dispositions are about how well people use their minds rather than how well their minds work. The link between dispositions and thinking is not new as many scholars have argued that it is important for the ‘right’ dispositions to be in place for effective thinking to occur (Dewey 1933; Facione 2000; Frank et al. 2007; Irani et al. 2007). The right dispositions cultivate good habits of the mind (Dewey 1930), and ultimately ’good thinking’ (Perkins et al. 1993). ‘Good
thinking’ is a broad and informal concept concerning thinking that helps individuals to reach their personal and professional goals (Perkins et al. 1993). Examples of ‘good’ thinking are critical thinking, flexible, insightful, rationality and all other forms of higher-order thinking. Haslam and Baron (1994) add that “Good thinking involves being ‘actively open minded’” (p. 42). Thinking disposition concerns rationality, whilst thinking ability concerns the processing efficiency (Hunt 2005). Dispositions are innate qualities such as traits, capacities and temperament, whilst other disposition-like constructs include virtues, beliefs, character and attitude (Perkins & Ritchhart 2004).

Perkins et al. (1993) argue that there are three key factors that contribute to dispositions for good thinking. These are inclinations, sensitivity and ability. Inclination and sensitivity define ‘good thinking, as inclination concerns good habits (of the mind) and persistence, whilst sensitivity registers opportunities and ensnares thoughts that may have gone by unnoticed. Ability is the capacity to actually behave in a way that is consistent with the disposition. Each of these factors are distinct but complement and reinforce one another.

Perkins et al. (1993) provide an analogy to further help understand the meaning of disposition. They provide the example of ‘brittleness’ (of, for example, a glass). Britteness in this context means that the glass has a degree of tendency to shatter when it is hit, under certain situations and conditions. They exemplify how this triadic dispositional theory can be applied to a person who is deemed to be open-minded. An open-minded person will have the inclination to learn new things and to adopt multiple perspectives even if they may not agree with some of these perspectives or even if these perspectives make them uncomfortable. However, inclination is necessary but insufficient to qualify as a disposition because the open-minded individual must also be sensitive. Sensitivity will enable the open-minded person to notice certain occasions that are intentionally biased and prejudiced. Finally, an open-minded person must also have the ability to follow through with behaviours that are consistent with their disposition such as resisting the impulse to jump to conclusions, and taking care in being attentive to rival/contradictory views.

Perkins et al. (1993) argue that there are seven types of dispositions for good thinking. They state that the dispositions are to; “be broad and adventurous, sustain intellectual curiosity, clarify and seek understanding, be planful and strategic, be intellectually
careful, seek and evaluate reasons and be metacognitive” (p. 13). Each of these are
explained within the context of inclination, sensitivity and ability in Table 26 below.
<table>
<thead>
<tr>
<th>Dispositions of good thinking</th>
<th>Key inclinations</th>
<th>Key sensitivities</th>
<th>Key abilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The disposition to be broad and adventurous</td>
<td>The tendency to be open-minded and to look beyond what is given; the impulse to probe assumptions and examine alternative points of view; the desire to tinker with boundaries and play with new ideas; the urge to speculate, generate many options, and explore multiple interpretations.</td>
<td>An alertness to binariness, dogmatism, sweeping generalities, narrow thinking, parochialism, and occasions when alternative perspectives are neglected.</td>
<td>The ability to identify assumptions, to look at things from other points of view, to generate and review multiple options; brainstorming; empathic thinking; flexible thinking.</td>
</tr>
<tr>
<td>2. The disposition toward sustained intellectual curiosity</td>
<td>A zest for inquiry; the urge to find and pose problems; the tendency to wonder, question, probe.</td>
<td>An alertness to unasked questions, anomalies, hidden facets; detection of gaps in one's knowledge or understanding; noticing what is unknown or unclear.</td>
<td>The ability to observe closely, to identify and challenge assumptions, to formulate and investigate provocative questions, to focus and persist in a line of inquiry.</td>
</tr>
<tr>
<td>3. The disposition to clarify and seek understanding</td>
<td>A desire to apprehend things clearly; the impulse to anchor ideas to experience and seek connections to prior knowledge; an urge to sharpen conceptions and examples; a desire to grasp the essence of things;</td>
<td>Alertness to unclarity and discomfort with vagueness; alertness to superficiality; detection of occasions needing a sharper focus; a leaning towards hard questions.</td>
<td>The ability to ask pointed questions and to build complex conceptualizations; the ability to apply and exemplify ideas, to make analogies and comparisons, to identify and classify details.</td>
</tr>
<tr>
<td>4. The disposition to be planful and strategic</td>
<td>The urge to set goals and to make and execute plans; the tendency to approach things in a calculated and/or stepwise fashion; a desire to think ahead.</td>
<td>Alertness to aimlessness, lack of direction, lack of orientation; alertness to off-hand thinking and sprawling thinking.</td>
<td>The ability to formulate goals and to evaluate alternative modes of approach; the ability to make and execute plans and to forecast possible outcomes.</td>
</tr>
<tr>
<td>5. The disposition to be intellectually careful</td>
<td>The urge for precision; a hunger for mental orderliness and organization; a desire to be thorough.</td>
<td>Alertness to the possibility of error, to disorder and disorganization; awareness of the abiding potential for inaccuracy and inconsistency.</td>
<td>The ability to process information precisely, to recognize and apply intellectual standards, to construct order out of disarray.</td>
</tr>
<tr>
<td>6. The disposition to seek and evaluate reasons</td>
<td>A leaning towards healthy skepticism; the tendency to question the given, to probe assumptions and biases; the drive to pursue and demand justification; the urge to discover underlying grounds and sources.</td>
<td>An alertness to evidential foundations; a responsiveness to superficiality and over-generalization, a wariness of gaps in knowledge.</td>
<td>The ability to distinguish cause and effect, the ability to identify logical structure; the ability to reason inductively, the ability to weigh and assess reasons.</td>
</tr>
<tr>
<td>7. The disposition to be metacognitive</td>
<td>The urge to be cognitively self-aware and to monitor the flow of one's thinking; the impulse to stand back and take stock; the desire to be self-challenging.</td>
<td>Alertness to loss of control of one's thinking; detection of complex thinking situations requiring self-monitoring; recognition of the need to look back on a thinking episode.</td>
<td>The ability exercise executive control of mental processes, to conceive of the mind as active and interpretive, to be self-evaluative, to reflect on prior thinking.</td>
</tr>
</tbody>
</table>
Perkins et al. (1993) argue that each of the seven dispositions are necessary as none of these can be ‘dropped’ for good thinking to materialise. They argue that this proposition of good thinking and its dimensions are collectively comprehensive, normatively appropriate (as it is deemed as intuitive, as well as helps in clarification of the construct and is prescriptive in advice-giving), and finally it is functionally balanced as the dimensions complement one another.

2.2.3.2. Typical Intellectual Engagement (TIE) and the Adult Intelligence Development Theory

The TIE theory is premised upon the Adult Intelligence Development Theory by Ackerman and associates (1992; 1996; 1997; 1999) (as well as the trait complex and PPIK models, which are discussed later). Ackerman (1996) posits that previous theories on adult intelligence have been found to be limited. Previous adult theories such as that from Cattell (1963) did not adequately explain the developmental aspect of intelligence as Chamorro-Premuzic, Furnham and Ackerman (2006b) argue that “…at levels of formal education (undergraduate degrees onward) personality traits seem increasingly useful in predicting academic performance because cognitive ability levels become more homogeneous and restricted in range. This is particularly noticeable in competitive and highly selective programs, where students have already been preselected on the basis of their intellectual ability and noncognitive traits—including those referring to motivational aspects of individual differences—are more functional explaining future success. Thus the predictive power of ability tests tends to drop as students progress and advance to higher levels of formal education, whereas the opposite occurs with personality measures” (p. 262).

The TIE construct was born out of the limitation of previous studies on intelligence that personality dispositions significantly contribute to the adult intellect. Whilst ability tests are maximal performance (can do), non-cognitive information (e.g. dispositions) helps to inform typical performance (will do) (Cronbach 1949). Past evidence that shows correlation between traits from the Big Five with variables such as job performance indicates that personality traits can be valid predictors of academic performance.

The most unique of the Big Five traits in terms of association with intellect is Openness to Experience (Openness). Openness is a distinct construct compared to the other four factors in the Big Five (as it is a unique personality trait that is associated with problem solving), and was associated with the TIE construct (Ferguson &
The link between personality dispositions and intelligence is underscored by Chamorro-Premuzic and Furnham (2004) as they argue that “personality traits may also relate to actual intellectual ability. Examples of this relationship are Openness or TIE, which are two personality traits that play a relevant role in the processes underlying the development of adult intellectual competence and knowledge acquisition. Furthermore, it is also likely that intellectual ability may influence personality traits; such is the case of conscientiousness, a personality trait which may partly develop as a consequence of high or low intelligence capacity” (p. 259). Individuals need both high thinking ability and the right ‘dispositions’ to perform, as Chamorro-Premuzic et al. (2006b) state, for example, that personality and intelligence are both predictors of academic performance.

TIE was operationalised as a psychometric measure. TIE is an assessment of how people typically/normally engage with intellectual tasks/activities. The TIE scale is self-report and is used to assess rather than measure intelligence (Goff & Ackerman 1992). The TIE scale assesses both personality dispositions, through its structure, and ability, through its content. The measure for TIE adopts a different view from the typical measures of intelligence as it concerns intellectual investment. As an example, two individuals with the same level of IQ may differ in terms of their investment in their own intellectual/cognitive development and typical (everyday) performance on intellectual tasks such as problem solving, which can be a typical performance rather than maximal performance (Ferguson & Patterson 1998). Chamorro-Premuzic et al. (2006b) posit that “…the theory of TIE…posits that an individual’s level of intellectual investment will have positive developmental effects on the acquisition of adult skills and knowledge. This theory implies that typical performance may be as important in determining future intellectual competence as is maximal performance or, in simple terms, that personality may explain differences in adult intellectual competence where ability may not. Furthermore, TIE may refer to aspects of typical performance not encompassed by other, established personality traits and is therefore of potential value for expanding our understanding of individual differences, in particular with regard to the dispositional or trait determinants of educational achievement” (p. 262)

Ackerman (2014) argues that TIE has incremental validity over and beyond and the Big Five in predicting academic performance, and it significantly predicts general knowledge as individuals who score highly on TIE tend to be curious and driven (Chamorro-Premuzic et al. 2006b). Intelligence and cognition play a more significant
role, compared to traits and dispositions, when assessment requires *maximal performance* within a narrow period of time (e.g. a multiple-choice test). However, when performance requires sustained effort over a period of time (e.g. attendance, essay writing), then traits and dispositions play a more significant role compared to thinking abilities (Chamorro-Premuzic et al. 2006b).

### 2.2.3.3. Subjectively Assessed Intelligence (SAI)

A similar concept to TIE is the SAI construct, which is an interface between personality and intellect. Chamorro-Premuzic and Furnham (2004) argue that there are three levels of intelligence: cognitive ability (fluid, Gf, and crystallised intelligence, Gc), intelligence quotient (IQ) test performance and SAI. SAI is proposed to be the mediator between personality and intelligence (i.e. ability and IQ test performance), and it is another approach in understanding the link between personality dispositions and intelligence.

In their development of SAI, Chamorro-Premuzic and Furnham (2004) argued that an IQ test cannot be considered a pure measure of intelligence as performing well on an IQ test is also underpinned by other performance-related factors such as perseverance and concentration, although such factors are not considered as part of intelligence but as traits (Cattell 1943). Such an approach differs from the investment approach as Chamorro-Premuzic and Furnham (2004) state that "*Whereas the top-down approach is concerned with intelligence as measured by IQ test performance (here personality traits can modify the results of IQ tests rather than *actual* intelligence), investment theories are concerned with *actual* ability (here personality traits can partly determine the development of intellectual ability rather than merely influence IQ test performance). Hence, there are at least two connotations for intelligence, one refers to ability as a trait (*actual* intelligence), the other to ability as output (cognitive or IQ test performance). Whereas investment theories deal with how the intelligence trait or *actual* intelligence develops, top-down approaches are merely concerned with performance on IQ tests. Thus theoretical approaches to the personality/intelligence interface will differ according to their representation of ability as a trait or ability as output or performance (though the two are related)" (p. 252). Chamorro-Premuzic and Furnham (2004) proposed the following model, which is presented in Figure 20. This model shows the link between fluid and crystallised intelligence, personality traits of conscientiousness, openness, neuroticism and extraversion, with the SAI and IQ test performance. The correlation coefficients are approximates and based on a sample of 200 participants.
In reference to Figure 20, paths 1a and 1b are straightforward in the sense that individuals with high intelligence, both fluid and crystallised, should do well in IQ tests as the test contains elements that are suited for each type of intelligence. SAI is expected to predict IQ scores, albeit lower than Gf and Gc would directly. This due to the ‘expectancy effect’ phenomenon that is related to concepts such as self-efficacy (Bandura 1986). SAI assesses individuals’ intelligence ability as well as other performance-related abilities such as academic assignment, which contributes to the performance in IQ tests. In terms of paths 3a and 3b, neuroticism and extraversion may have a negative effect on IQ test performance (rather than actual intelligence). Individuals who are neurotic may lack the self-belief in doing well in the test, whilst extroverts may be too easily distracted during the test. Nonetheless, extroverts may do well in term of having a high speed of response (Chamorro-Premuzic & Furnham 2004).

In terms of paths 4a, 4b, 4c and 4d, conscientiousness positively affects SAI as conscientious individuals are meticulous and detailed in their learning. Openness also
positively impacts SAI as it enables individuals to accumulate general knowledge. Extraversion will cause individuals to be optimistic about their intelligence, whilst neurotic individuals will underestimate their cognitive abilities. Path 5b observes Gf being positively linked to conscientiousness as the trait enables the accurate processing of information. However, there may also be a negative correlation, as individuals may be more conscientiousness in compensating for their lack of Gf. In terms of 5a, openness allows for many experiences and thus the accumulation of knowledge (Chamorro-Premuzic & Furnham 2004).

The SAI measure is similar to the TIE construct by Ackerman (1996) as it measures typical rather than maximal performance. SAI can be considered more of a personality construct than that of intelligence. The SAI model illustrates the significant degree that personality and intellect interact in shaping outcomes such as IQ test performance, and provides support for the argument that an integrated view of the two is necessary.

2.2.3.4. Trait Complexes

The work concerning trait complexes was developed using five personality factors (i.e. Costa and McCrae’s (1992) Five-Factor Model. The Five-Factor Model was then matched with Eysenck’s (1970) three factors and Tellegen’s (1985) lower order traits, two broad cognitive ability factors of fluid (Gf) and crystallised intelligence (Gc) that is based on Spearman’s (1923) theory on general intelligence. In addition, the four vocational interest that was used is based on the work of Holland (1973) in terms of type and dimensions interest that explains individuals’ vocational choices and self-concept scales was based on the self-concept categories by Marsh (1990).

Ackerman and Heggestad (1997) identified a number of trait complexes that provide evidence of correlates amongst personality traits (affect), ability (cognition) and interest (conation). The trait complexes are termed social, clerical/conventional, science/math and intellectual/cultural. Ackerman (1997) argues that the term ‘trait complexes’ is adapted from Cronbach (1967) and Snow (1989) as a set of traits that combine together and interrelate in triggering some type of outcome. These trait complexes are continuous variables (not nominal). Figure 21 illustrates the efforts of Ackerman and Heggestad (1997) in linking thinking abilities and dispositions.
Figure 21: Trait complexes, including abilities, interests, and personality traits showing positive commonalities (Ackerman 2003)

Ackerman and Heggestad (1997) meta-analytic review and empirical research found the two trait complexes (i.e. clerical/conventional and intellectual/cultural) correlated with cognitive abilities, personality dispositions and vocational interests. The trait complex of science/math only correlated with cognitive ability and vocational interests, whilst the trait complex of social only correlated with personality dispositions and vocational interests.

The social trait complex contains the personality of extraversion and the interest relating to enterprise and social-related vocations. No intellectual ability factors were found to be correlated with any conventional intellectual abilities. Nonetheless, one can conjecture that personality-orientated constructs such as social intelligence (Cantor & Harlow 1994), practical intelligence (Sternberg et al. 2000) and interpersonal intelligence (Gardner 1983) are latently present. The social trait complex shows individuals who prefer dealing with highly sociable environments.
The clerical/conventional trait complex includes all three factors; intellectual ability (perceptual speed), dispositional traits (e.g. conscientiousness) and interest (i.e. conventional). This trait complex shows a prototype of individuals who prefer and excel in structured environments and conditions.

The science/math trait complex shows only intellectual ability (i.e. math reasoning) and vocational interest (realistic), with no dispositional traits evident, even though one may have assumed that introversion may have a role to play here. This trait complex provides a prototype of individuals who prefer logical/syllogistic challenges. This trait complex, however, overlaps with the final trait complex, the intellectual/cultural complex. The link between these two trait complexes are the vocational interest factor of investigative. This trait complex contains all three factors; crystallised intelligence (intellectual ability), openness (dispositional trait) and artistic/investigative (vocational interest).

Overall, two personality traits appear to be the most significant in terms of association with intelligence: openness to experience (Rolfhus & Ackerman 1999) and typical intellectual engagement (Goff & Ackerman 1992). The trait complexes show that individuals have natural proclivities that can be nurtured (Ackerman 1997). In addition, pedagogical methods can be adapted to better suit individuals. However, any redressing of pedagogy has to be undertaken holistically as addressing one aspect (e.g. vocational interest) may be in vain if the other variables are not addressed too (Ackerman & Beier 2003). Trait complexes may also be able to help to predict academic performance in terms of accumulation of knowledge and performance on academic tests and assessments (Ackerman 1997). Occupational success may also be foretold by the trait complexes as well as job satisfaction and turnover intentions (Ackerman 1997). The trait complexes are correlations not causations but as Ackerman (1997) states ‘correlation have causes’ (p. 196).

2.2.3.5. *The intelligence-as-Process, Personality, Interests, and intelligence-as-Knowledge (PPIK) model*

Ackerman (1996) claims that previous theories on adult intelligence have been found to be limited and do not adequately explain the developmental aspect of intelligence. Firstly, for example, the most famous measure of intelligence was developed for children and adolescents by Binet and Simon (1905). Secondly, many adults do not perform well in intelligence tests but function very well on a day-to-day basis (thus the concept of practical intelligence was introduced by Sternberg et al. to address this).
Thirdly, intelligence is usually synonymous with achievement, thus it is relative in terms of what interests an individual (e.g. command of syllogistic logic or how the stock market works). Fourthly, performance by experts and specialist are knowledge-based (i.e. conceptual knowledge) and skill-based (procedural knowledge), thus the capacity for knowledge and knowledge possessed are crucial in defining intelligence; intelligence is (partly) a function of knowledge. Finally, there is evidence that personality and interests plays a significant role in knowledge accumulation and in the development of intelligence (Ackerman & Heggestad 1997).

An example is put forth by Ackerman (2014) to illustrate the need for a more robust explanation of adult intelligence focusing on crystallised intelligence, “One of the best examples for this point was Michael DeBakey, the renowned surgeon who, among his many accomplishments, was a pioneering figure in coronary bypass surgery. Although he stopped wielding the scalpel in his 80s, his knowledge from performing over 60,000 cardiovascular procedures over his lifetime made it possible for him to recognize, well into his advanced years, patterns and problems during surgery better than any newly minted MD (who presumably would have much higher levels of fluid intellectual abilities). The overarching principle is that recall or recall with transfer is often more efficient and effective than novel reasoning. To the degree that other adults can apply prior learning or leverage their knowledge and skills into related domains, they can be expected to keep up pretty well with their younger counterparts, at least in many areas of intellectual activities” (p. 250)

The intellectual investment framework by Cattell (1963) suggests that fluid intelligence develops rapidly in children and declines with old age, however crystallised intelligence tends to continually develop well into middle age. There is a direct trade-off between breadth and depth of knowledge, and only the most exceptional individuals can maintain high levels of breadth and depth of knowledge (Ackerman 1996). Ackerman (2014) argues that traits may give rise to specific interests and thus influence the accumulation of domain-specific knowledge, which then increases crystallised intelligence. Ackerman (1996) developed the PPIK model to address this lacunae.

The PPIK model is underpinned by the intellectual investment framework (Ackerman 2003; Chamorro-Premuzic, Furnham & Ackerman 2006a). The PPIK integrates ability (intelligence and cognition) and non-ability traits to explain knowledge accumulation (Chamorro-Premuzic et al. 2006b). PPIK is not a linear cause-and-effect model, but a
circular self-reinforcing relationship as Ackerman (1996) argues “…abilities and interests develop in tandem, such that ability level determines the probability of success in a particular task domain, and personality/interests determine the motivation for attempting the task. Thus, subsequent to successful attempts at task performance, interest in the task domain may increase, along with the knowledge level for that task. Conversely unsuccessful attempts at task performance may result in a decrement in interest for that domain (and, perhaps result in a lack of increment in knowledge for that task)” (p. 243). Figure 22 illustrates the positive relationships between fluid and crystallised intelligence, the four trait complexes and knowledge structures of physical sciences/technology, civics, humanities, current events and business.

*Gf (fluid intelligence) represents “intelligence-as-process;” Gc = crystallized intelligence; trait complexes (including: personality, interests, self-concept, ability) from Ackerman and Heggestad (1997). Positive and negative influences derived from the theory and supported by prior empirical data (Rolfhus & Ackerman 1999; Beier & Ackerman 2001). Note: “Negative influences” mean that lower levels of one construct (e.g. Gc) lead to higher levels of the other construct (e.g. Clerical/Conventional trait complex).

**Figure 22: Constructs and influences in the PPIK Theory (Ackerman 1996)**
The PPIK addresses not only the importance of the individual differences of personality disposition, thinking ability and interest, but also the acquisition of knowledge throughout an individual’s life (Ackerman & Beier 2003) as knowledge is idiosyncratic to individuals and its pursuit is contextual. Ackerman and Heggestad (1997) also state that the PPIK explains the relationship between intelligence trait complexes and an individual’s potential knowledge structures. The PPIK explains the accumulation of general knowledge (Chamorro-Premuzic et al. 2006b). Ackerman and Beier (2003) argued that personality disposition, cognitive ability and interest need to be assessed in concert with one another when determining individuals’ career choices, as well as other choice behaviour (e.g. academic) (Ackerman 1997), as well as performance, academic or occupation-wise.

2.2.3.6. Extra-cognition

Extra-cognitive facets are those go beyond cognition. Extra-cognition is a multi- and trans-dimensional construct that goes beyond the traditional conceptualisation of intelligence and includes factors such as feelings, traits and cultural influences, which all help to contribute to an individual’s high ability (Shavinina & Ferrari 2004). ‘High ability’ refers to exceptional human abilities and can be associated with terms such as giftedness, wisdom, talent, genius, child prodigies and innovation (Shavinina & Ferrari 2004). Those with high ability score highly on intellect and positive traits and epitomise the integration of these factors. For example, Howe (2004) states that geniuses consider themselves as curious, doggedly determined and diligent as Greenspan, Solomon and Gardner (2004) reason that expertise is attained through ‘sustained practice’. Such perseverance is related to personality traits, whilst intellectual traits such as insight belong to the realm of cognitive psychology.

Extra-cognition is not only about matters that are strictly cognitive as it may involve personality traits and emotions (Runco 2004b). The relationship between these factors are complex. For example, Runco (2004b) argues that creativity is an extracognitive phenomenon but its relationship with high ability varies depending on the specific ability. For example, creativity depends on extracognitive processes such as metacognition and cognitive flexibility, and metacognitive processes are, in turn, part of other cognitive processes such as memory.

The study of extra-cognitive facets in high ability has two traditions/ sources; personality traits (e.g. creativity) and social factors. Geniuses such as Charles Darwin had effective social skills (Howe 2004). Motivation is a crucial factor of high ability
individual as it is the drive to achieve excellence, whilst personality traits also
determine characteristics such as perseverance, hard work, and self-efficacy, and
emotions such as emotional stability and enthusiasm. Shavinina and Seeratan (2004)
define extra-cognition as “a particular cognitive mode of human thinking that appears
in advance of any logical, conscious accounts of an individual’s intelligence. Guiding
function of the extra-cognitive implies that specific feelings, beliefs, preferences, and
intuition lead scientists in the process of their creative endeavors toward right
theories, approaches, and models.” (p. 96).

Extracognition involves feelings and is also known as the ‘the feeling of knowing’
(Shavinina & Ferrari 2004). Extracognition refers to intellectual feelings such as
appreciating aesthetics, style and peace, and feelings of direction, intellectual beliefs
such as high performance standards, intellectual values and preferences and intuition
(Shavinina & Seeratan 2004). Many extracognitive facets are affect-based and
dispositional constructs.

Poincare (1913) asserted that ”pure logic would never lead us to anything but
tautologies. It is by logic that we prove. It is by intuition that we discover” (p. 208).
Intuition is crucial as Rosenblueth and Wiener (1945) state, “An intuitive flair for
what will turn out to be the most important general question gives a basis for selecting
some of the significant among the indefinite number of trivial experiments which could
be carried out at that stage. Quite vague and tacit generalizations thus influence the
selection of data at the start” (p. 317). Planck (1950) in his argument that scientist
need to be creative as much as they need to be rational states that a scientist “must
have a vivid intuitive imagination, for new ideas are not generated by deduction, but
by an artistically creative imagination” (p. 109). Bowers et al. (1990) define intuition
as “a preliminary perception of coherence (pattern, meaning, structure) that is at first
not consciously represented, but which nevertheless guides thought and inquiry
toward a hunch or hypothesis about the nature of the coherence in question” (p. 74),
whilst Sadler-Smith (2008) defines intuition as “a vague feeling that certain things
are relevant and others are not, a ‘feeling in our marrow’ which is the outcome of
previous experience that hasn’t yet emerged into conscious thought, the very
vagueness of which shields it from critical scrutiny” (p. 43).

Shavinina and Seeratan (2004) reason there is a link between extracognition and
metacognition, through intuition as they state “thus the feeling of direction
corresponds to where (i.e., guiding function of the extra-cognitive). Specific scientific
taste and the feeling of beauty relate to how (i.e., function of evaluation and judgment of the extracognitive). Altogether—including intuition—they correspond to when. Therefore, the phenomenon of the extracognitive contributes to the development of a person's metacognitive abilities” (p. 95). They state that this relationship is reciprocal and reinforcing “In its turn, metacognition leads to the further development of the extracognitive, strengthening and crystallising its components in an individual’s intellectual functioning. For example, the individual with developed metacognitive abilities will be more open to his or her own feeling of direction, feeling of beauty, and intuitive processes” (p. 96).

Sternberg (2004) argues that wisdom is a form of extra-cognition. Wisdom is different from social intelligence (Cantor & Harlow 1994) and emotional intelligence (Goleman 1996), as these intelligences, similar to that of practical intelligence (Sternberg et al. 2000), can be used exclusively used for one’s own benefit even to the detriment of others. Wisdom can be defined as the “power of judging rightly and following the soundest course of action, based on knowledge, experience, understanding, and so forth” (p. 170). Wisdom is tacit knowledge and is about balancing interests as Sternberg (2004) argues “Values mediate how one balances interests and responses, and collectively contribute even to how one defines a common good. Wisdom is in applying processes of thought in combination with values to achieve solutions to problems that take into account a common good within a societal/cultural context, which may be as narrow as a family or as broad as the world” (p. 179).

The role of tacit knowledge is also recognised by Dai and Sternberg (2004) who assert that tacit processes are clearly present in experts compared to novices, for example. Lohman (2005) argue that “experts know what to look for and what to ignore. Tacit processes are also linked to feelings, which run counter to the belief that emotions interfere with reasoning” (p. 230). Practical intelligence is necessary but insufficient for wisdom (Sternberg 2004). Individuals must also have keen insight on the contextual factors as Sternberg (2004) states “Wisdom applies only to highly contextualized situations. It does not apply to all of the kinds of abstract situations to which one might apply one's intelligence (e.g. in the context of ability-test or achievement-test problems) or one's creativity (e.g. in formulating original, high-quality, but abstract ideas)” (p. 177). Wisdom involves identifying goals for the common good, balancing responses in different contexts, balancing the interests of others, deriving wisdom from tacit knowledge, and allowing values to mediate the relationship between cognition and action.
The concept of extracognition provides another argument for the integration of intellect and personality (as well as other human facets). Individuals with high ability usually have not only high intellect such as effective metacognitive skills, but they also have strong intuitions that they can trust (i.e. the ‘feeling of knowing’), have a wealth of tacit knowledge and are generally considered wise.
2.3. **Critical Thinking**

Critical-thinking disposition is a type of higher-order thinking disposition and is an independent variable in the research model. The discussion of this construct in the literature review first examines critical thinking as a cognitive skill, its definitions and constituents, and benefits (e.g. negating biases, fallacies and over dependence on heuristics). This section then discusses the dispositions that contribute to critical thinking and examines existing measures of the construct, which helps to decide how to measure this disposition in this study (further discussed in the Research Methodology chapter). This section contains a discussion about critical thinking. The first part discusses critical thinking as a skill, specifically the need for critical thinking skills. The discussion highlights the pervasiveness of biases and fallacies in our everyday thinking and the use of heuristics. The next section contains an overview of critical thinking, its definitions and elements. The next section contains a discussion on critical thinking dispositions and argues why dispositions are as important as the ability itself (this section is in conjunction with the previous discussion on personality traits and dispositions). The final section contains a presentation on how critical thinking skills can be developed.

2.3.1. **Critical Thinking Skills**

This section contains three sub-sections. The first section ‘biases, fallacies and heuristics’ provides some background on the need for critical thinking. The next section concerns the definitions and elements of critical thinking. The last sub-section concerns the scales that are available to measure critical thinking.

2.3.1.1. **Biases, Fallacies and Heuristics**

Human thinking is naturally flawed as Kee and Bickle (2004) state that “our thinking processes are often either: (i) hasty, with insufficient investment in deep processing or examination of alternatives; (ii) narrow, with a failure to challenge assumptions or consider other points of view; (iii) fuzzy, or imprecise and prone to conflation; or (iv) sprawling, or disorganized with a failure to conclude” (p. 609). Paul, Elder and Bartell (2004) suggest that “human thinking left to itself often gravitates toward prejudice, over-generalization, common fallacies, self-deception, rigidity, and narrowness” (p. 2).

The validity of this assertion may be observed in the phenomena of *apophenia* and *pareidolia*. As Carroll (2004) explains, “*apophenia is called a Type I error, perceiving patterns where there are none. Some people do not just see birth marks on*
a lamb; They spontaneously perceive connections and meaningfulness in unrelated phenomena. Pareidolia is a type of illusion or misperception involving a vague or obscure stimulus being perceived as something clear and distinct (Schick and Vaughn 2001). For example, a water stain on a window or the discoloration in tree bark is clearly perceived to be the Virgin Mary” (p. 7)

Indeed, the human mind can be rather frail and susceptible to flawed thinking such as confabulation. Carroll (2004) states that this cognitive phenomenon “is a fantasy that has unconsciously replaced events in memory. A confabulation may be based partly on fact or be a complete construction of the imagination. The term is often used to describe the “memories” of mentally ill persons, memories of alien abduction, and false memories induced by careless therapists or interviewers” (p. 10). In addition, individuals naturally have biases as we all have preferences. Biases are not abnormal but do not have a place in society, work or school/university if progress is to be made (Kahneman, Slovic & Tversky 1982). At times these biases lead to fallacies, which may be ‘used’ by individuals intentionally or not. Fallacies are a form of faulty reasoning (Hart 2003) and are usually present in arguments. Similar to biases, there are many forms of fallacies. Table 27 illustrates the different types of fallacies.
Table 27: Fallacies in argument (Hart 2003)

<table>
<thead>
<tr>
<th>Fallacy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implied definition</td>
<td>Referring to something without clearly defining it.</td>
</tr>
<tr>
<td>Illegitimate definition</td>
<td>Closing down alternatives by giving a restrictive definition.</td>
</tr>
<tr>
<td>Changing meanings</td>
<td>Defining something as A, then using A in a different way, B.</td>
</tr>
<tr>
<td>Emotional language</td>
<td>Using value loaded or ethically loaded terms as explained by Carroll (2004) “the power of loaded language is the use of highly emotive language aimed at evoking a response through emotions such as fear and hope, rather than through thought e.g. pro and anti -abortion advocates” (p. 30)</td>
</tr>
<tr>
<td>Use of all rather than some</td>
<td>Using bland generalisation to incorporate all variables and thereby minimise contradictory examples.</td>
</tr>
<tr>
<td>Ignoring alternatives</td>
<td>Giving one interpretation or example as if all others could be treated or categorised in the same way.</td>
</tr>
<tr>
<td>Selected instances</td>
<td>Picking out unusual or unrepresentative examples.</td>
</tr>
<tr>
<td>Forced analogy</td>
<td>Using an analogy without recognising the applicability of other contradictory analogies.</td>
</tr>
<tr>
<td>Similarity</td>
<td>Claiming there is no real difference between two things even when there is.</td>
</tr>
<tr>
<td>Mere analogy</td>
<td>Use of analogy with no recourse to examples from the real world.</td>
</tr>
<tr>
<td>False credentials</td>
<td>Exaggerating your credentials or experience to convince others of your authority.</td>
</tr>
<tr>
<td>Technical language</td>
<td>Deliberate use of jargon intended to impress the reader and/or hide the lack of a foundation to an argument.</td>
</tr>
<tr>
<td>Special pleading</td>
<td>Claiming a special case to raise your argument above other similar positions. This is often associated with the use of emotive language.</td>
</tr>
<tr>
<td>Playing on the reader</td>
<td>Telling readers what they want to hear rather than challenging their thinking and assumptions.</td>
</tr>
<tr>
<td>Claiming prejudice</td>
<td>Attributing prejudice to an opponent in order to discredit them.</td>
</tr>
<tr>
<td>Appealing to others for authority</td>
<td>Claiming some other in authority has made the same argument as yourself in order to strengthen your own position.</td>
</tr>
<tr>
<td>False context</td>
<td>Giving examples out of context or using nothing but hypothetical scenarios.</td>
</tr>
<tr>
<td>Extremities</td>
<td>Ignoring centre ground positions by focusing only on the extreme ends of a spectrum of alternatives.</td>
</tr>
<tr>
<td>Tautology</td>
<td>Use of language structures to get acceptance of your argument from others. This is often in the form of ‘too much of X is bad’ therefore X itself is good.</td>
</tr>
</tbody>
</table>

The human mind is also a natural miser. The mind does not like hard work and takes short cuts. Thus, we tend to use heuristics, which is a ‘good enough’ approach to problem solving and decision making (Banks & McGurk 2014). People use heuristics when they have to make a decision but do not have adequate information and/or time. Heuristics have their place in life as they are helpful and convenient. However, their
use has a time and place. The danger lies in their frequent use even when we have sufficient information and time. The indiscriminate and overuse of heuristics leads to tabloid thinking (Carroll 2004).

Facione (2006) states that heuristics are ever present. He states that there are two systems that are present in our minds. System 1, which is intuitive and reactive, and System 2, which tends to be reflective and deliberate. He states that System 1 is most susceptible to heuristics due to its nature (i.e. in prioritising speed). The heuristics used in System 1 are availability, affect, association, simulation and similarity. Availability involves adopting what comes to mind and is used to make decisions, whilst affect is the use of emotions in decision making (e.g. gut feeling). Association occurs when a word or idea resonates with us (e.g. ‘cancer’ and ‘death’), which makes us jump to conclusion. Simulation involves imagining how a scenario will unfold and can mislead us, whilst similarity concerns drawing conclusions based on simple association (e.g. diet food and losing weight) (Facione, 2006).

The heuristics used in System 2 are satisficing, risk/loss aversion, anchoring with adjustment, illusion of control and dominance structure. Satisficing involves us being easily satisfied with the alternative that best matches our goals. Similarly there is temporising, which refers to being satisfied with the first alternative that best matches our goals. Risk/loss aversion occurs when we decide on matters on the basis of avoiding loss rather than balancing it with what we may gain. This type of heuristic is present in conservative decision making. Anchoring with adjustment is, for example, using a first impression of something to be the basis on evaluating others. Illusion of control involves over-estimation of our own abilities (e.g. hindsight bias) and with dominance structure, we elevate the status of a particular option in our minds when we have committed to it (e.g. reinforcing our decision) (Facione, 2006). Table 28 shows other types of heuristics.
Table 28: Examples of social and non-social heuristic, their building blocks, application and conditions for performance (Raab & Gigerenzer 2005)

<table>
<thead>
<tr>
<th>Heuristic</th>
<th>Building Blocks</th>
<th>Applications</th>
<th>Environment that enable good performance</th>
<th>Environment that enable poor performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition</td>
<td>Search rule: Look for recognition information</td>
<td>• Answering general knowledge questions;</td>
<td>Positive correlation between recognition and criterion</td>
<td>Zero correlation between recognition and criterion</td>
</tr>
<tr>
<td>heuristic</td>
<td>Stopping rule: If you recognise one option and not</td>
<td>• Predicting outcomes of sports games (Goldstein &amp; Gigerenzer 2002);</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>the other, stop search</td>
<td>• Investment decisions;</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Decision rule: Infer that the option that you</td>
<td>• Stock picking (Borges et al. 1999).</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>recognise has a higher value on the criterion</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Gaze</td>
<td>Fixate the ball then start running, thereafter:</td>
<td></td>
<td>Intersection of moving objects for which the angle of gaze changes (relative to a fixed observer)</td>
<td>Intersection of moving objects for which the angle of gaze is constant (relative to a fixed observer)</td>
</tr>
<tr>
<td>heuristic</td>
<td>Search rule: Look for information concerning the</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>angle of gaze</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stopping rule: Use the angle of the gaze only</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Decision rule: When the angle changes adjust speed</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>so that the angle remains constant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tit-for-tat</td>
<td>Trust first, thereafter:</td>
<td>• Exchange of goods;</td>
<td>Mostly tit-for-that players present.</td>
<td>Only defectors present.</td>
</tr>
<tr>
<td>heuristic</td>
<td>Search rule: Recall information concerning behaviour</td>
<td>• International politics;</td>
<td>The possibility to exclude non-cooperative players by custom or law (Dawkins 1989; Boyd &amp; Lorberbaum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(cooperation or defection) of your partner</td>
<td>• Social behaviour and trust in dyadic relations (Kollock 1994; Messick &amp;</td>
<td>1987)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stopping rule: Ignore everything except the last</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>behaviour of your partner</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Decision rule: Imitate behaviour of your partner</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Take-the-first</td>
<td>Search rule: Generate options in the order of</td>
<td>• Chess playing (Klein et al. 1995);</td>
<td>An environment in which the person is highly trained by feedback, that is, options that are automatically</td>
<td>An environment in which the person is a novice, that is, options that are not generated in the order of</td>
</tr>
<tr>
<td>heuristic</td>
<td>validity</td>
<td>• Allocation decisions in ball games</td>
<td>generated from memory in the order of validity.</td>
<td>validity.</td>
</tr>
<tr>
<td></td>
<td>Stopping rule: Stop after the first option is</td>
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<tr>
<td></td>
<td>generated that can be implemented, ignore all the</td>
<td></td>
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<tr>
<td></td>
<td>rest</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Decision rule: Take this option</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Take-the-best</td>
<td>Search rule: First try the recognition heuristic,</td>
<td>• Hindsight bias (Hoffrage, Hertwig &amp; Gigerenzer 2000);</td>
<td>Non-contemporary environments, in which high ranking cues cannot be compensated by combinations of</td>
<td>Compensatory environments, in which higher-ranking cues can be compensated by combination of lower-ranking</td>
</tr>
<tr>
<td>heuristic</td>
<td>if both objects are recognised, look up cues in</td>
<td>• Attractiveness judgement of famous men or women;</td>
<td>lower-ranking cues (Martignon &amp; Hoffrage 1999)</td>
<td>cues,</td>
</tr>
<tr>
<td></td>
<td>order of their validity</td>
<td>• Predicting high school dropout rates (Czerlinski, Gigerenzer &amp; Goldstein</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stopping rule: Stop search when the first cue is</td>
<td>1999).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>found that has a positive value for one alternative</td>
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Heuristics, bias and fallacies are all well established and documented phenomena (Kee & Bickle 2004). However, their pervasiveness needs to be addressed in order to develop effective critical thinking. However, this is not straightforward as Van Gelder (2005) states “humans are not naturally critical . . . critical thinking is a highly contrived activity” (p. 42), and requires effort (Halx & Reybold 2006). This task is made even more difficult as Harley (2001) argues that the erroneous forms of thinking are exacerbated by today’s values of expediency and convenience, which often come at the expense of the development of effective thinking skills.

There are various approaches that have been developed to develop effective thinking. One approach is the Argumentation Model by Toulmin (1969), which helps to break down the essential components of a robust argument and can be used to check against fallacies. Toulmin (1969) observed that in the real-world syllogism was too rigid because arguments are organic in terms of structure. Arguments consist of logical operators, premises and conclusions, as well as claims based on probability. All arguments are implicitly underpinned by warrants (e.g. individual beliefs, and social norms). However, effective argumentation is underpinned by sound thinking. Arguments inherently require critical thinking (Toulmin 1969).

Haack (1998, cited in Kee & Bickle, 2004, p. 610) provides an analogy of how we can develop cogent arguments by developing effective thinking skills "How reasonable an entry in a crossword is depends on how well it is supported by the clue and any other intersecting entries ... and how much of the crossword has been completed...How well evidence supports a proposition depends on how much the addition of the proposition improves its explanatory integration". Effective arguments are those that embody the principles of adequacy, coherence, parsimony, relevance, completeness and robustness (Keil 2006).

Critical thinking is crucial for effective argumentation as the essence of critical thinking is to be able to link a conclusion (claim) with evidence (Halpern 1998; Facione 2006; Facione & Facione 1996). Critical thinking is an approach that may help to address the issues related to faulty thinking. As Halx and Reybold (2006) posit “in general terms, we can say that to think critically is to think clearly, accurately, knowledgeably, and fairly while evaluating the reasons for a belief or for taking some action” (p. 2). Critical thinking helps with decision making, judgement, reasoning, problem solving and reflective practice (Edwards 2007).
Edwards (2007) analysis of the term *critical thinking* is shown in Table 29, which indicates that critical thinking may be a panacea to biases, fallacies and can address the limitations of heuristics. Table 29 also contains the thinking processes of analysis and synthesis in demonstrating the higher-order status of critical thinking (Bloom & Krathwohl 1956).

**Table 29: Definition of the concepts in critical thinking (Edwards 2007)**

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<th>Concept</th>
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| Critical | • Often associated with fault-finding, criticism, exercising negative judgment  
• Uncovering hidden assumptions, individual values and beliefs, opinions.  
• Positive role to enhance the position of an argument  
• Situations, practices and innovations can be interpreted, judged and preferred choices determined to bring about change |
| Thinking | • A mental process whereby all the sorting and organising of information takes place  
• The formation of patterns is logically assembled, in the mind or on paper  
• It is not a method that can be learned, but a process, an orientation of the mind  
• It is the ability to consider all possible descriptions of a problem or situation and includes other people's perspectives  
• The thinking process considers individual assumptions and past experiences and then to expand perspectives by continual questioning |
| Analysis | • Breaking down of material into parts  
• Discovering the relationships between the parts  
• Searching for and identifying evidence, and interpreting that evidence following a detailed examination |
| Synthesis | • Once all sources have been identified, summarised and critiqued the abstract summaries begins to create a synthesised product.  
• Identify common ideas within selected areas  
• Sort all the ideas into reasonable divisions – conceptual thinking of ideas/solutions until they become organised  
• What might be the result of implementing the different ideas/solutions?  
• What changes could be made?  
• How would people adapt/cope? |

The importance of critical thinking is underscored by Beyer (1987). Individuals with high levels of critical thinking skills are able to differentiate between facts that are verifiable and claims that are based on personal values, and distinguish between
relevant and irrelevant information/facts, appropriate and inappropriate claims, and reasons. Beyer (1987) also states that individuals with effective critical thinking skills are able to establish the factual accuracy of a statement, estimate the credibility of a source of information, recognise ambiguous claims or arguments. They are also able to detect biases, unstated assumptions, logical fallacies and inconsistencies in logic/reasoning. Individuals who are critical thinkers are able to establish the cogency of a claim or of the entire argument.

Williams and Stockdale (2003) argue that critical thinking is crucial as it is both a predictor and outcome of college courses. This is a reciprocal relationship as high critical thinking results in high grades. In turn, high grades motivate and energises students to enhance their critical thinking skills. This phenomenon also works the other way when critical thinking skills are low. Students with low critical thinking skills will obtain low grades, and be demotivated to learn and enhance their critical thinking skills. This may be due to the impact on students’ affective states such as self-efficacy.

2.3.1.2. Definitions and Elements of Critical Thinking

Critical thinking has a long history dating back to 350 BC to the writings of Socrates, Plato and Aristotle (Natale & Ricci 2006). Much of the recent seminal work on critical thinking has been by Facione and associates. Facione (1990) undertook a significant and comprehensive study in defining critical thinking and its elements. This study involved the Delphi Method in attaining consensus amongst experts in critical thinking. The findings of this study has informed the development of a measure of critical thinking, the California Critical Thinking Test (CCTT), which is now widely used (Bernard et al. 2008).

Facione (2000) states that critical thinking is about “judging in a reflective way what to do and what to believe” (p. 2). Thus critical thinking is purposive and involves judgement based on reflection. He argues that critical thinking is a complex construct that involves analysis, interpretation, inference, explanation, evaluation, and monitoring of one’s thoughts, and, if appropriate, their correction.

The American Philosophical Association (1990) in defining critical thinking state that “we understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual
considerations upon which that judgment is based... CT is essential as a tool of inquiry. As such, CT is a liberating force in education and a powerful resource in one's personal and civic life... While not synonymous with good thinking, CT is a pervasive and self-rectifying human phenomenon” (p. 3)

There are various conceptualisations and definitions of critical thinking. Dewey (1933) suggests that critical thinking is about suspending judgement and healthy scepticism. Bisdorf-Rhoades et al. (2005) argue that critical thinking is an introspective approach to problem-solving. Tsui (2003) states that critical thinking is “assessing and scrutinizing ‘knowledge’ prior to its consumption” (p. 328), whilst Walters (1990) state that it is a “calculus of justification” (p. 451). Paul (1995) posits that critical thinking is an intellectual standard, whilst Halpern (1996) states that it is “thinking that is purposeful, reasoned and goal directed — the kind of thinking involved in solving problems, formulating inferences, calculating likelihood, and making decisions” (p. 5). Zoller et al. (2000) define critical thinking as “purposeful inquiry-oriented, consistently rational, logical, reflective, and consequentially evaluative, thinking” (p. 572). Norris and Ennis (1989) argue that critical thinking is “reasonable reflective thinking that is focused upon deciding what to believe or do” (p. 18).

Ultimately, critical thinking is a form of logical reasoning and helps with evaluation (Watson & Glaser 1980; Facione 1990; Simpson & Courtney 2002; Stahl & Stahl 1991; Simon & Kaplan 1989).

The discussion concerning the various perspectives of critical thinking indicates that there is some agreement in terms of what critical is and regarding the elements that constitute it. Based on the work of Ennis (1985), Furedy and Furedy (1985) Pascarella and Terenzini (2005), and Watson and Glaser (1980), there are six primary aspects to critical thinking; interpreting whether conclusions are warranted, analysing and deducing conclusions from data provided, evaluating evidence or authority, making correct inferences from data, identifying and explaining central issues and assumptions and reflecting on one’s own biases by of self-monitoring and self-regulation. Many of these elements overlap with the findings from the Delphi study undertake by Facione (1990). Table 30 contains a description and explanation of each element (termed as ‘skills’ by Facione).
### Table 30: Skills and sub-skills of critical thinking (Facione 1990)

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<th>Skill</th>
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<td><strong>1. Interpretation</strong>&lt;br&gt;To comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures or criteria.</td>
<td><strong>1.1 Categorization</strong>&lt;br&gt;- To apprehend or appropriately formulate categories, distinctions, or frameworks for understanding, describing, or characterizing information.&lt;br&gt;- To describe experiences, situations, beliefs, events, etc. so that they take on comprehensible meanings in terms of appropriate categorizations, distinctions, or frameworks.&lt;br&gt;For example: to recognize a problem and define its character without prejudice to inquiry; to determine a useful way of sorting and sub-classifying information; to make an understandable report of what one experienced in a given situation; to classify data, findings, or opinions using a given classification schema.</td>
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<td><strong>1.2 Decoding Significance</strong>&lt;br&gt;- To detect, attend to, and describe the informational content, affective purport, directive functions, intentions, motives, purposes, social significance, values, views, rules, procedures, criteria, or inferential relationships expressed in convention-based communication systems, such as in language, social behaviours, drawings, numbers, graphs, tables, charts, signs, and symbols.&lt;br&gt;For example: to detect and describe a person’s purposes in asking a given question; to appreciate the significance of a particular facial expression or gesture used in a given social situation; to discern the use of irony or rhetorical questions in debate; to interpret the data displayed or presented using a particular form of instrumentation.</td>
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<td><strong>1.3 Clarifying Meaning</strong>&lt;br&gt;- To paraphrase or make explicit through stipulation, description, analogy, or figurative expression, the contextual, conventional, or intended meanings of words, ideas, concepts, statements, behaviours, drawings, numbers, signs, charts, graphs, symbols, rules, events, or ceremonies.&lt;br&gt;- To use stipulation, description, analogy, or figurative expression to remove confusing, unintended vagueness or ambiguity, or to design a reasonable procedure for so doing.&lt;br&gt;For example: to restate what a person said using different words or expressions while preserving that person’s intended meanings; to find an example which helps explain it something to someone; to develop a distinction which makes clear a conceptual difference or removes a troublesome ambiguity.</td>
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| 2. Analysis                  | **2.1 Examining Ideas**  
To determine the role various expressions play or are intended to play in the context of argument, reasoning, or persuasion.  
To define terms.  
To compare or contrast ideas, concepts, or statements.  
To identify issues or problems and determine their component parts, and also to identify the conceptual relationships of those parts to each other and to the whole.  
For example: to identify a phrase intended to trigger a sympathetic emotional response which might induce an audience to agree with an opinion; to examine closely related proposals regarding a given problem and to determine their points of similarity and divergence; given a complicated assignment, to determine how it might be broken up into smaller, more manageable tasks; to define an abstract concept. |
| To identify the intended and actual inferential relationships among statements, questions, concepts, descriptions, or other forms of representation intended to express beliefs, judgments, experiences, reasons, information, or opinions.                                                                                     |                                                                                                                                                                                                  |
| 2.2 Identifying Arguments    | **2.2 Identifying Arguments**  
Given a set of statements, descriptions, questions, or graphic representations, to determine whether or not the set expresses, or is intended to express, a reason or reasons in support of or contesting some claim, opinion, or point of view.  
For example: given a paragraph, determine whether a standard reading of that paragraph in the context of how and where it is published, would suggest that it presents a claim as well as a reason or reasons in support of that claim; given a passage from a newspaper editorial, determine if the author of that passage intended it as an expression of reasons for or against a given claim or opinion; given a commercial announcement, identify any claims being advanced along with the reasons presented in their support. |
| 2.3 Analyzing Arguments      | **2.3 Analyzing Arguments**  
Given the expression of a reason or reasons intended to support or contest some claim, opinion, or point of view, to identify and differentiate: (a) the intended main conclusion, (b) the premises and reasons advanced in support of the main conclusion, (c) further premises and reasons advanced a backup or support for those premises and reasons intended as supporting the main conclusion, (d) additional unexpressed elements of that reasoning, such as intermediary conclusions, unstated assumptions, or presuppositions, (e) the overall structure of the argument or intended chain of reasoning, and (f) any items contained in the body of expressions being examined which are not intended to be taken as part of the reasoning being expressed or its intended background.  
For example: given a brief argument, paragraph-sized argument, or a position paper on a controversial social issue, to identify the author’s chief claim, the reasons and premises the author advances on behalf of that claim, the background information used to support those reasons or premises, and crucial assumptions implicit in the author’s reasoning; given several reasons or chains of reasons in support of a particular claim, to develop a graphic representation which usefully characterizes the inferential flow of that reasoning. |
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<td>3. Evaluation</td>
<td>To assess the credibility of statements or other representations which are accounts or descriptions of a person’s perception, experience, situation, judgment, belief, or opinion; and to assess the logical strength of the actual or intended inferential relationships among statements, descriptions, questions, or other forms of representation.</td>
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| 3.1 Assessing Claims | • To recognize the factors relevant to assessing the degree of credibility to ascribe to a source of information or opinion.  
• To assess the contextual relevance of questions, information, principles, rules, or procedural directions.  
• To assess the acceptability, the level of confidence to place in the probability or truth of any given representation of an experience, situation, judgment, belief, or opinion.  
For example: to recognize the factors which make a person a credible witness regarding a given event or credible authority on a given topic; to determine if a given principle of conduct is applicable to deciding what to do in a given situation; to determine if a given claim is likely to be true or false based on what one knows or can reasonably find out. |
| 3.2 Assessing Arguments | • To judge whether the assumed acceptability of the premises of a given argument justify one’s accepting as true (deductively certain) or very probably true (inductively justified) the expressed conclusion of that argument.  
• To anticipate or to raise questions or objections, and to assess whether these point to significant weakness in the argument being evaluated.  
• To determine whether an argument relies on false or doubtful assumptions or presuppositions and then to determine how crucially these affect its strength.  
• To judge between reasonable and fallacious inferences.  
• To judge the probative strength of an argument’s premises and assumptions with a view toward determining the acceptability of the argument.  
• To determine and judge the probative strength of an argument’s intended or unintended consequences with a view toward judging the acceptability of the argument;  
• To determine the extent to which possible additional information might strengthen or weaken an argument.  
For example: given an argument to judge if its conclusion follows either with certainty or with a high level of confidence from its premises; to check for identifiable formal and informal fallacies; given an objection to an argument to evaluate the logical force of that objection; to evaluate the quality and applicability of analogical arguments; to judge the logical strength of arguments based on hypothetical situations or causal reasoning; to judge if a given argument is relevant or applicable or has implications for the situation at hand; to determine how possible new data might lead logically to the further confirmation or disconfirmation of a given opinion. |
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<td><strong>4. Inference</strong>&lt;br&gt; To identify and secure elements needed to draw reasonable conclusions; to form conjectures and hypotheses; to consider relevant information and to induce the consequences flowing from data, statements, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions, or other forms of representation.</td>
<td><strong>4.1 Querying Evidence</strong>&lt;br&gt; In particular, to recognize premises which require support and to formulate a strategy for seeking and gathering information, which might supply that support.&lt;br&gt; In general, to judge that information relevant to deciding the acceptability, plausibility, or relative merits of a given alternative, question, issue, theory, hypothesis, or statement is required, and to determine plausible investigatory strategies for acquiring that information. For example: when attempting to develop a persuasive argument in support of one’s opinion, to judge what background information would be useful to have and to develop a plan which will yield a clear answer as to whether or not such information is available; after judging that certain missing information would be germane in determining if a given opinion is more or less reasonable than a competing opinion, to plan a search which will reveal if that information is available.</td>
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<td><strong>4.2 Conjecturing Alternatives</strong>&lt;br&gt; To formulate multiple alternatives for resolving a problem, to postulate a series of suppositions regarding a question, to project alternative hypotheses regarding an event, to develop a variety of different plans to achieve some goal.&lt;br&gt; To draw out presuppositions and project the range of possible consequences of decisions, positions, policies, theories, or beliefs.&lt;br&gt; For example: given a problem with technical, ethical or budgetary ramifications, to develop a set of options for addressing and resolving that problem; given a set of priorities with which one may or may not agree, to project the difficulties and the benefits which are likely to result if those priorities are adopted in decision making.</td>
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<td><strong>4.3 Drawing Conclusions</strong>&lt;br&gt; To apply appropriate modes of inference in determining what position, opinion, or point of view one should take on a given matter or issue.&lt;br&gt; Given a set of statements, descriptions, questions or other forms of representation, to educe, with the proper level of logical strength, their inferential relationships and the consequences or the presuppositions which they support, warrant, imply, or entail.&lt;br&gt; To employ successfully various sub-species of reasoning, as for example to reason analogically, arithmetically, dialectically, scientifically, etc.&lt;br&gt; To determine which of several possible conclusions is most strongly warranted or supported by the evidence at hand, or which should be rejected or regarded as less plausible by the information given.&lt;br&gt; For example: to carry out experiments and to apply appropriate statistical inference techniques in order to confirm or disconfirm an empirical hypothesis; given a controversial issue to examine informed opinions, consider various opposing views and the reasons advanced for them, gather relevant information, and formulate one’s own considered opinion regarding that issue; to deduce a theorem from axioms using prescribed rules of inference.</td>
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<td><strong>5. Explanation</strong>&lt;br&gt;To state the results of one’s reasoning; to justify that reasoning in terms of the evidential, conceptual, methodological, criteriological, and contextual considerations upon which one’s results were based; and to present one’s reasoning in the form of cogent arguments.</td>
<td><strong>5.1. Stating Results</strong>&lt;br&gt;• To produce accurate statements, descriptions, or representations of the results of one’s reasoning activities so as to analyse, evaluate, infer from, or monitor those results. For example: to state one’s reasons for holding a given view; to write down for one’s own future use one’s current thinking about an important or complex matter; to state one’s research findings; to convey one’s analysis and judgment regarding a work of art; to state one’s considered opinion on a matter of practical urgency.</td>
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<td><strong>5.2 Justifying Procedures</strong>&lt;br&gt;• To present the evidential, conceptual, methodological, criteriological, and contextual considerations which one used in forming one’s interpretations, analyses, evaluation, or inferences, so that one might accurately record, evaluate, describe, or justify those processes to one’s self or to others, or so as to remedy perceived deficiencies in the general way one executes those processes. For example: to keep a log of the steps followed in working through a long or difficult problem or scientific procedure; to explain one’s choice of a particular statistical test for purposes of data analysis; to state the standards one used in evaluating a piece of literature; to explain how one understands a key concept when conceptual clarity is crucial for further progress on a given problem; to show that the prerequisites for the use of a given technical methodology have been satisfied; to report the strategy used in attempting to make a decision in a reasonable way; to design a graphic display which represents the quantitative or spatial information used as evidence.</td>
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<td><strong>5.3 Presenting Arguments</strong>&lt;br&gt;• To give reasons for accepting some claim. • To meet objections to the method, conceptualizations, evidence, criteria, or contextual appropriateness of inferential, analytical, or evaluative judgments. For example: to write a paper in which one argues for a given position or policy to anticipate and to respond to reasonable criticisms one might expect to be raised against one’s political views; to identify and express evidence and counter-evidence intended as a dialectical contribution to one’s own or another person’s thinking on a matter of deep personal concern.</td>
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<td>overlooked important</td>
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<tr>
<td>information; to</td>
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<td>identify and review</td>
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<td>the acceptability of</td>
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<td>the facts, opinions</td>
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<td>or assumptions one</td>
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<td>relied on in coming</td>
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<td>to a given point of</td>
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<td>view; to identify</td>
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<td>and review one’s</td>
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<td>reasons and reasoning</td>
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<td>processes in coming</td>
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<td>to a given conclusion.</td>
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<tr>
<td>6.2 Self Correction</td>
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<td>• Where self-examinations reveals errors or deficiencies, to design reasonable procedures to remedy or correct, if possible, those mistakes and their causes.</td>
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<td>For example: given a methodological mistake or factual deficiency in one’s work, to revise that work so as to correct the problem and then to determine if the revisions warrant changes in any position, findings, or opinions based thereon.</td>
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Much of the discussion and debate concerning critical thinking has assumed that it is
domain general. However, there are suggestions that subject matter has an impact on
individuals’ application of critical thinking. Renaud and Murray (2008) adopt a
domain-specific perspective as they posit that critical thinking may be more prominent
in subject-specific tests than general tests because critical thinking helps with the
acquisition of knowledge by verifying and ‘organising’ knowledge in making it more
meaningful.

Although most measures of critical thinking are domain general, the arguments for a
contextual view of critical thinking is growing as one cannot truly be critical without
having knowledge that is specific to a particular domain. One view is that domain
specific critical thinking is more valid than domain general critical thinking as
individuals may not have the need to engage in general topics (e.g. politics) critically
and thus demonstrate low critical thinking ability. This is different compared to a
subject that is relevant to their work or studies that requires them to engage with the
subject in a critical manner (Renaud & Murray 2008). Nonetheless, critical thinking
skills should not be entirely context-specific as these skills are expected to be
transferable (Halpern 1998): For instance, students transferring critical thinking skills
from academia to the workplace.

2.3.1.3. Measures of Critical Thinking Skills

Whilst the debates concerning the definition and elements of critical thinking
continue, scholars have agreed on the basic aspects of critical thinking and a number
of scales have been developed to measure critical thinking skills. Pascarella and
Terenzini (1991) state that “...critical thinking has been defined and measured in a
number of ways but typically involves the individual’s ability to do some or all of the
following: identify central issues and assumptions in an argument, recognize
important relationships, make correct inferences from data, deduce conclusions from
information or data provided, interpret whether conclusions are warranted on the
basis of the data given, and evaluate evidence or authority” (p. 118).

Glaser (1941) posits that critical thinking involves several distinct abilities.
Specifically, the ability to: "(a) to recognise problems, (b) to find workable
means for meeting those problems, (c) to gather and marshal pertinent
information, (d) to recognise unstated assumptions and values, (e) to
comprehend and use language with accuracy, clarity and discrimination, (j) to
interpret data, (g) to appraise evidence and evaluate statements, (h) to
recognise the existence of logical relationships between propositions, (i) to draw warranted conclusions and generalisations, (j) to put to test the generalisations and conclusions at which one arrives, (k) to reconstruct one's patterns of beliefs on the basis of wider experience; and (l) to render accurate judgements about specific things and qualities in everyday life" (p. 6).

Being able to identify and understand the different measures of critical thinking is crucial as the subscales of these test usually represent the ‘theory’ or ‘definition’ of critical thinking upon which the measure is based (Bernard 2008). Bernard et al. (2008) claim that there four major measures of critical thinking; the Watson-Glaser Critical Thinking Appraisal (WGCTA), Cornell CT Test (CCTT), California CT Skill Test (CCTST) and Test of Critical Thinking-Form G. The components sub-amongst these scales overlap a great deal.

Bernard et al. (2008) cautioned that although the elements of critical thinking are tightly inter-related they do not ‘additively’ constitute the critical thinking construct. They assert that "we may need to abandon attempts to explore unique qualities or skills associated with critical thinking and concentrate instead on critical thinking as a collection of highly interrelated skills and abilities not easily divorced from one another, not operating separately, but existing conjointly and complementarily. On the other hand, perhaps we may need to develop new methods of evaluating critical thinking” (p. 20). Thus it is equally important not to overly focus on the individual elements of critical thinking.

Williams, Oliver and Stockdale (2004) adopt an educational perspective and assert that tests of critical thinking abilities may be categorised as generic or subject specific. Critical thinking may be more relevant in some courses compared to others such as one requiring making inferences compared to recalling factual information. Their research showed that subject-specific critical thinking assessments better predict exam performance than do generic assessments of critical thinking. The correlation between subject specific critical thinking and exam performance increased from the beginning to the end of the course whereas the correlation between generic critical thinking and exam performance remained virtually unchanged (Williams et al. 2004). This finding demonstrates that critical thinking skills are more effectively taught in the context of subject specific courses. Furthermore, this finding shows that the developmental aspect of critical thinking within a particular subject does not necessarily improve general critical thinking skills, which puts in doubt the notion that critical thinking
skills are transferable. However, Williams et al. (2004) argue that critical thinking skills are transferable as studies have shown the cumulative effect of higher education in enhancing general critical thinking skills.

Williams et al. (2004) intimate the important role that disposition plays in critical thinking. They assert that it is no surprise that those students who score low in critical thinking tests actually perform worse by the end of their education as they find the tasks related to the development of their critical thinking skills to be daunting, disconcerting and difficult, and end up becoming frustrated with the entire notion. Critical thinking is hard work, and many students are put off by the amount of effort required to be effective in critical thinking. Williams et al. (2004) claim that it is seldom the case that students who enter a course with low levels of critical thinking skills will finish the course with high levels of critical thinking skills even though the course may emphasise the development of critical thinking skills. This may be due to the disposition that these students have about critical thinking in that it is too difficult and they ‘give up’.

2.3.2. Critical Thinking Dispositions
In addition to critical thinking skills, scholars have argued the importance of critical thinking dispositions (Dewey 1930; Paul 1995). Halx and Reybold (2006) argue that critical thinking is about good reasons being relevant, considering complete information, sufficient warrant but it is also about having the right attitude. Irani et al. (2007) support this view as they argue that dispositions are attitudinal, and are significant precursors to critical thinking: That is, they are the gateway to critical thinking.

Dispositions can change but do so slowly, and thus are ‘reliable’ indicators of critical thinking. Bisdorf-Rhoades et al. (2005) argue that whilst critical thinking disposition is the ‘habits-of-the-mind’, Ricketts and Rudd (2004) state that critical thinking disposition is ‘half the story’ of critical thinking because critical thinking disposition is necessary but insufficient. Other scholars such as Paul (1995) include dispositions in their conceptualisation of CT, which is reasonable considering one must be willing as much as able to be a critical thinker. Table 31 contains various perspectives of critical thinking identified by Paul (1995).
Table 31: What is Critical Thinking? (Paul 1995)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Operational Definition</th>
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<tr>
<td>A unique kind of purposeful thinking</td>
<td>In any subject area or topic whether academic or practical, requiring intellectual training for the mind, akin to physical training for the body.</td>
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<tr>
<td>In which the thinker systematically and habitually</td>
<td>Actively develops traits such as intellectual integrity, intellectual humility, fair-mindedness, intellectual empathy, and intellectual courage. Identifies the criteria of solid reasoning, such as precision, relevance, depth, accuracy, sufficiency, and establishes clear standards by which the effectiveness of the thinking will be assessed.</td>
</tr>
<tr>
<td>Imposes criteria and intellectual standards upon the thinking</td>
<td>Awareness of elements of thought such as assumptions and point of view that are present in all well-reasoned thinking. A conscious, active, and disciplined effort to address each element is displayed.</td>
</tr>
<tr>
<td>Taking charge of the construction of thinking</td>
<td>Continually assessing the course of construction during the process. Adjusting, adapting, and improving using criteria and standards.</td>
</tr>
<tr>
<td>Guiding the construction of the thinking according to the standards</td>
<td>Deliberately assessing the thinking to determine its strengths and limitations according to the defining purpose, criteria, and standards.</td>
</tr>
<tr>
<td>Assessing the effectiveness of the thinking according to the purpose, criteria, and standards</td>
<td>Studying the implications for further thinking and improvement.</td>
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</tbody>
</table>

Facione et al. (2000a) posit that dispositions are a nexus of attitudes, intentions and beliefs. Dispositions they infer a habitual way of behaving/acting. In social psychology disposition is an attitude or attitudinal tendency (Nunnally & Bernstein 1994; Cronbach 1990). Dispositions are tendencies and thus knowing someone's disposition allows the person's behaviour to be predicted. Facione (2000) views dispositions as “a person's consistent internal motivation to act toward, or to respond to, persons, events, or circumstances in habitual, and yet potentially malleable, ways” (p. 6), meaning that dispositions are intrinsic and determine the typical manner in which an individual engages with problems and makes decisions. This is consistent with the view of Huitt (1998) who states that critical thinking is a process that encompasses individuals’ dispositions, affective states and motives. Although skills and dispositions are two separate matters, they both reinforce one another.

The reflective component of critical thinking intimates the importance of critical thinking. John Dewey’s notion of reflective thinking is similar to the present day conception of critical thinking. Dewey (1933) stated that the two most important characteristics of critical thinking are ‘persistence’ and ‘carefulness’.
Glaser (1941) emphasised the importance of the role of attitudes such as persistence in defining critical thinking. Norris and Ennis (1989) state that critical thinking involves being reasonable and reflective in one's thinking. Halx and Reybold (2006) argue that critical thinking must involve and consider ‘personal perception and context’ (p. 295) and that “critical thinking requires a willingness to entertain ideas without necessarily accepting them” (p. 312) thus the right disposition is fundamental to the development of critical thinking. The right dispositions are required to recognise when critical thinking is required and when to exert effort and persist with the effort (Halpern 1998).

Giancarlo and Facione (2001) assert that attitudes, values and inclinations all impact human personality/dispositions. Individuals demonstrate different levels of critical thinking skills depending on whether or not they are motivated to do so. Thus critical thinking is not purely cognitive as learners must not only be able but must also be willing: That is, be motivated to be critical in one’s thinking (Zoller et al. 2000).

Friedel et al. (2008a) argue that critical thinking disposition is “the consistent willingness, motivation, inclination and an intention to be engaged in critical thinking while reflecting on significant issues, making decisions and solving problems” (p. 73). McBride, Xiang and Wittenburg (2002) assert that dispositions include inquisitiveness, willingness to suspend judgement, tolerance for ambiguity, open-mindedness and sensitivity to others.

McBride et al. (2002) assertion is similar to Triadic Dispositional Theory by Perkins et al. (1993) who suggest that intellectual behaviour can be explained by three elements of dispositions, which are reinforcing but distinct: inclinations, sensitivity and ability. Inclination is the felt tendency and propensity to think and behave in a certain manner, sensitivity is the natural alertness to certain occasions and cues, whilst ability is actual capability to do something well. The triad of elements are the necessary and sufficient conditions for a target disposition to materialize: All must be present. For example, one may have the sensitivity for certain occasions and the ability but without the inclination nothing will materialise.

Moving beyond conceptualising cognitive processes from a purely rational perspective helps to promote the virtues of interpersonal reasoning. This type of reasoning involves dialogue rather than arguments, an ethic of joint discovery rather
self-seeking goals and ultimately gives priority to moral development in addition to truth seeking (Noddings 1991). Effective thinking is as much as due to dispositions as it is to knowledge and cognitive skills (Beyer 1987).

Although dispositions were ultimately excluded from the definition of critical thinking in the Delphi Report of the American Philosophical Association (1990) and by Facione (1990), many experts (although clearly not the majority) were in favour of including dispositions. The American Philosophical Association (1990) nonetheless recognises that dispositions play an important role in the holistic development of critical thinking when they state that “the ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit” (p. 3). Table 32 contains details of the critical thinking dispositions identified by the American Philosophical Association (1990) and Facione (1990).
Table 32: Critical Thinking Dispositions (Facione et al. 1995)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Description:</th>
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<tbody>
<tr>
<td>1. Truth-seeking.</td>
<td>Targets the disposition of being eager to seek the best knowledge in a given context, courageous about asking questions, and honest and objective about pursuing inquiry even if the findings do not support one's self-interests or one's preconceived opinions. Truth-seeking is the disposition of being eager to seek the best knowledge in a given context, courageous about asking questions, and honest and objective about pursuing inquiry even if the findings do not support one's self-interests or one's preconceived opinions. Once a liberally educated person acknowledges a given set of facts to be the case or a given set of reasons to be relevant and forceful, that person is inclined to adjust his or her beliefs in accord with those facts and reasons. The truth-seeker is one who remains receptive to giving serious consideration to additional facts, reasons, or perspectives even if this should necessitate changing one's mind on some issue.</td>
</tr>
<tr>
<td>2. Open-mindedness.</td>
<td>Measures one's tolerance of divergent views and sensitivity to the possibility of one's own bias. It is about being tolerant of divergent views and sensitive to the possibility of one's own bias. Open-mindedness is crucial for citizens of a pluralistic, multi-cultural society which values tolerance and understanding of the beliefs and lifestyles of others. Conversely, dispositional intolerance of divergent views might preclude effective client services, clinical practice interventions, or educational efforts in such varied populations as those with substance abuse problems, those in the criminal justice system, and those enmeshed in urban violence.</td>
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<tr>
<td>3. Analyticity.</td>
<td>Assesses prizing the application of reasoning and the use of evidence to resolve problems, anticipating potential conceptual or practical difficulties, and consistently being alert to the need to intervene. Prize the application of reasoning and the use of evidence to resolve problems, anticipating potential conceptual or practical difficulties, and consistently being alert to the need to intervene. Analyticity is a core disposition for the inquiring mind. Persons with this characteristic are inclined to want to anticipate the consequences of events and ideas, and to use reason, rather than some other strategy to address serious problems as well as entertaining puzzles. Analyticity is a virtue for the psychologist (scientist, educator, humanist, jurist, economist) as a scholar and researcher; but it is no less important to the nurse (teacher, attorney, journalist, physician, psychologist, pharmacist, journalist, manager) as a working professional. Being analytical disposes the person in professional practice to connect observations with her/his theoretical knowledge base, and to anticipate events likely to threaten the safety or limit potential or create an advantage for a given client.</td>
</tr>
<tr>
<td>4. Systematicity</td>
<td>Measures being organized, orderly, focused, and diligent in inquiry. Systematicity is about being organized, orderly, focused, and diligent in inquiry. No particular kind of organization, e.g. linear or non-linear, is implied. Organized approaches to problem-solving and decision-making are hallmarks of a thoughtful person regardless of the problem domain being addressed. The inclination to approach problems in an orderly and focused way is an indispensable part of competent clinical (accountancy, managerial, psychological, scientific) practice, and deficits in systematicity might particularly predispose a nurse (pharmacist, attorney, physician) to the possibility</td>
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<tr>
<td>Dimension</td>
<td>Description:</td>
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<tr>
<td>5. Inquisitiveness.</td>
<td>A measure of one's intellectual curiosity and desire for learning even when the application of the knowledge is not readily apparent.</td>
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<td></td>
<td>It is intellectual curiosity and one's desire for learning even when the application of the knowledge is not readily apparent. Intellectual curiosity and a desire to know are among the defining characteristics of the liberally educated person. Considering that the knowledge base for competent engineering (psychology, nursing, teacher education, journalism) practice continues to expand, a deficit in inquisitiveness would signal a fundamental limitation of one's potential to develop expert knowledge and professional practice ability.</td>
</tr>
<tr>
<td>6. CT self-confidence.</td>
<td>Measures the trust one places in one's own reasoning processes. Critical thinking self-confidence allows one to trust the soundness of one's own reasoned judgments and to lead others in the rational resolution of problems.</td>
</tr>
<tr>
<td></td>
<td>Self-Confidence is the trust one places in one's own reasoning processes. Critical thinking self-confidence allows one to trust the soundness of one's own reasoned judgments and to lead others in the rational resolution of problems. An appropriate level of critical thinking self-confidence, increasing in relation to one's maturity and in relation to one's mastery of critical thinking skills, would be the desired developmental trajectory for all students. Rises and falls in critical thinking self-confidence might suggest the progress of a person through developmental levels, with a rise of critical thinking self-confidence indicating comfort at a given level of cognitive development and a fall in critical thinking self-confidence resulting from the same cognitive dissonance which gives impetus to an upward movement. Whether an individual's level of critical thinking self-confidence is warranted is another matter, however. Some under-estimate their ability to think critically, while others over-rate their critical thinking ability.</td>
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<tr>
<td>7. Maturity.</td>
<td>Targets the disposition to be judicious in one's own decision-making. The critical thinking-mature individual is one who approaches problems, inquiry, and decision-making with a sense that some problems are necessarily ill-structured, some situations admit more than one plausible option, and many times judgments must be made based on standards, contexts and evidence that preclude certainty.</td>
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<td></td>
<td>Maturity is the disposition to be judicious in one's decision-making. The critical thinking-mature person can be characterized as one who approaches problems, inquiry, and decision making with a sense that some problems are necessarily ill-structured, some situations admit of more than one plausible option, and many times judgments must be made based on standards, contexts and evidence which preclude certainty. This dispositional attribute has particular implications for responding to ill-structured problems and making complex decisions involving multiple stakeholders, such as policy-oriented and ethical decision-making, particularly in time-pressured environments.</td>
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Building upon the work of Facione et al. (1995), Irani et al. (2007) conceptualised a more parsimonious construct of critical thinking disposition consisting of engagement, maturity and innovativeness. They state that “a person with a high disposition in engagement would be able to anticipate situations where good reasoning will be necessary to employ. They would also look for opportunities to use their reasoning.
skill and be confident in their ability to reason, solve problems, and make decisions. This person is also a confident communicator and is able to explain the reasoning process used to arrive at a decision or problem solution” (p. 4-5).

An individual with a high level of cognitive maturity “is aware of his own predispositions and biases in the decision making process. This person is aware that he holds opinions and positions that have been influenced by who he is, his environment, and experiences. This person is aware that others may or may not agree with the opinions and positions he holds. He is open to opinions of others and takes care to seek out divergent points of view and consider them objectively when making decisions or arriving at a problem solution. People with high levels of Cognitive Maturity know that most problems are more complex than they appear on the surface and understand that rarely is there ‘one-right-answer’ to problems they encounter” (p. 5), whilst “people who have a high innovativeness disposition could be described as ‘hungry learners’. They are consistently looking for new knowledge Individuals who possess a high level of innovativeness what to know more about their profession, their situation, their life, and their world. A person with high Innovativeness is intellectually curious with new challenges and actively seeks to know more through research, reading, and questioning. This person is also characterized by his desire to know the truth, even if the truth conflicts with presently held beliefs and opinions” (p. 6)

Williams and Stockdale (2003) argue that positive dispositions are crucial in a general sense. They assert that positive dispositions may result in effective work habits that help to compensate for low levels of critical thinking skills, rather than contributing to critical thinking per se. In their study of critical thinkers and high performers in higher education, they found that some high performing but low critical thinking individuals expended a lot more effort. This group compensated for their low critical thinking skills by taking complete and accurate notes in class. Students in this group also put in effort in courses that had no credit but saw this as an opportunity to learn more. However, many other students in this group will inherently have poor study/work habits and low confidence. Ultimately, positive dispositions to achieve (not just to be critical thinkers) help to promote effective work habits that may contribute in two ways; i) by developing critical thinking and in turn scholastic success, or ii) compensating for the a lack of critical thinking skills in attaining scholastic success. Either way, the study by Williams and Stockdale (2003) demonstrates the importance of having the right attitude and dispositions.
Renaud and Murray (2008) state that whilst the inclusion of emotive aspects in critical thinking has been debated, nonetheless, attitudes and biases can have a strong influence on the ability to think critically. Halx and Reybold (2006) argue that many definitions of critical thinking implicitly contain emotional, attitudinal and dispositional traits. For example, volition is implied if critical thinking is conceptualised as ‘purposeful, reasoned, and goal-directed thinking’. In addition, the descriptions by Browne and Freeman (2000) who state that critical thinking is “a controlled sense of skepticism” (p. 305) and Pithers and Soden (2000) who posit that critical thinking is about discipline and self-regulation, suggest that dispositions are central to critical thinking. Such a notion is well supported by a study undertaken by Williams and Worth (2002) who found that low critical thinking skills is intractable due to students disposition to resist developing critical thinking skills as doing so requires significant effort. They assert that students with low critical thinking skills are more concerned about right or wrong answers rather than understanding the reasons behind the answers. These students also seldom embrace inferential discussion and many find such discussions uncomfortable. Thus, dispositions are essential in the development of critical thinking skills.
2.4. **Problem Solving**

Problem solving is an important aspect of organisational life. Ineffective solutions potentially beget new problems as reflected in the adage ‘today’s solutions becomes tomorrow’s problem’ (Starling 1992). Effective problem solving not only contributes to organisations but also to individuals’ personal lives as this ability helps to negate stress, depression, hopelessness and anxiety, which are usually accompanied by an individuals’ inability to cope with challenges in life (Heppner & Baker 1997). Problem-solving disposition is a type of higher-order thinking disposition and is an independent variable in the research model. This section discusses the main elements of this construct from a skill perspective e.g. problem finding, solution development and solutions implementation. This section also examines the various ‘types’ of problem solving concept such as social and complex problem solving to help situate and locate the underpinnings of the problem-solving construct adopted for this study. This section also examines existing measures of the construct, which helps to decide how to measure this disposition in this study (further discussed in the Research Methodology chapter).

2.4.1. **Overview**

Improving problem-solving skills will also help to facilitate better attitudes towards change. Problem solving is holistic and involves cognitive, affective and behavioural aspects (Heppner & Baker 1997). From an education perspective, problem solving is a form of higher-order thinking as problem-based learning pedagogies are only appropriate for learners that have adequate knowledge (Kalyuga et al. 2001). Learners that are considered novice in terms of knowledge are best taught using worked examples, whilst those that are considered knowledgeable should be taught using problem-based pedagogies (Kalyuga et al. 2001). Problem solving has two primary parts, ‘the problem’ and ‘solving the problem’.

2.4.1.1. **Identifying the Problem**

A “problem” refers to the gap between the current situation and a desired future state (Pounds 1969). Similarly Hayes (1980) states that “wherever there is a gap between where you are now and where you want to be, and you don’t know how to find a way to cross that, you have a problem.” (p. i) whilst Baer, Dirks and Nickerson (2013) define a problem “as a deviation from a desired set of specific or a range of acceptable conditions resulting in a symptom or a web of symptoms recognized as needing to be addressed” (p. 199).
Starling (1992) also states that whilst a problem is a discrepancy between current performance and expected performance (or organisational goals), he further asserts that problems may be due to changes in expectations, without necessarily involving a change in reality. D’Zurilla et al. (2004) define a problem as (or problematic situation) as “any life situation or task (present or anticipated) that demands a response for adaptive functioning but no effective response is immediately apparent or available to the person or people confronted with the situation because of the presence of one or more obstacles” (p. 12).

Frensch and Funke (1995) assert that a problem should not be defined just by the task or the task features but by the interaction between the task and the problem solver, specifically in terms of the novelty of the task to the problem solver and the problem solver’s capability. The same task faced by another problem solver, may not be a problem at all. Thus, a problem is relative. Indeed, Quesada, Kintsch and Gomez (2005) argue that whilst ‘problem’ and ‘tasks’ are usually deemed as synonymous, they are not. Problems also relate to the ‘starting point’ of the problem solvers as well as to other exogenous factors. D’Zurilla et al. (2004) support this notion as they assert that problems may originate from various sources such as the situation (i.e. increasing difficulty in the task), or the circumstances in the form of impediments (e.g. ambiguity, conflicting demands, competing goals, inadequate resources, novelty and the lack of time) or the individual (i.e. too high or a change in expectation, and/ or deficiency in skills).

In terms of the individual, Greeno (1973) linked problem solving to knowledge and memory. He stated that algorithmic knowledge contains sets of rules that are held in individuals’ long-term memory to help with problem solving, usually problems that have been encountered before by the problem solver. The other set of knowledge, propositional knowledge, relates to knowledge about concepts that have to be transformed to solve new and novel problems encountered by the problem solver (Greeno 1973). The above illustrates the degree of variability in defining problem. Whilst the definitions above are not by any means comprehensive, it provides an opportunity to identify important characteristics of a problem, namely i) a problem is a gap between a current state and future goals, ii) a problem is when a solution is difficult to obtain, and iii) something being regarded as problematic depends on attributes of both the individual(s) and the context. For instance, a mechanical issue with one’s car is more likely to be seen as a problem if one is not skilled and if one does not have the tools to fix the issue.
Scholars have also attempted to classify the types of problems. There are generally two types of problems, defined (structured, routine, standard, analytic) and ill-defined (ill-structured non-routine, insight) (DeYoung, Flanders & Peterson 2008; Dow & Mayer 2004; Pretz, Naples & Sternberg 2003; Tallman & Gray 1990; Lee & Cho 2007; Hew & Knapczyk 2007). Defined (routine, standard, analytic) problems do not need the problem to be restructured or reformulated (DeYoung et al. 2008), whilst ill-defined (ill-structured non-routine, insight) problems are problem situations that are usually more complex, open-ended, change from circumstances to circumstances (Hew & Knapczyk 2007), and contain minimum or very general data/information (Lee & Cho 2007).

Ill-structured problems may have multiple solutions (with multiple evaluation criteria for alternatives) or have no solutions at all (Hew & Knapczyk 2007). Quesada et al. (2005) provide a similar conceptualisation of such a continuum though they term it as ‘knowledge-lean’ and ‘knowledge-intensive’ problem. Knowledge-lean problems do not require specialist knowledge, whereas knowledge-intensive problems require specialist knowledge. The continuum of ill-defined and defined problems consequently impacts the problem solving abilities that are required such as abilities that are domain-general and/or domain-specific (Dow & Mayer 2004). Domain-General Theory views all problems as requiring the same problem-solving strategy, whilst Domain Specific Theory views problems as existing in different categories or sub-groups. For example, domain-specific problems may be categorised into the sub-groups of verbal, spatial and mathematical insight problems (Dow & Mayer 2004).
2.4.1.2. Solving the Problem

If a problem is a gap, then problem solving is the process of closing the gap (Lee & Cho 2007) and the outcome of problem solving is the solution. D’Zurilla et al. (2004) address the definition of a ‘solution’ as a “situation-specific coping response or response pattern (cognitive or behavioral) that is the product or outcome of the problem solving process when it is applied to a specific problematic situation. An effective solution is one that achieves the problem-solving goal (i.e., changing the situation for the better or reducing the emotional distress that it produces), while at the same time maximizing other positive consequences and minimizing negative consequences” (p. 13). Thus, a solution should be an explicit goal that the problem solver has articulated. A solution is relative, and not absolute, as it concerns providing an optimum solution in relation to the goal and constraints.

There is no singularly accepted definition of a ‘problem’ and or of ‘problem solving’ (Chang et al. 2007). The most common and popular approach to problem solving is the process approach involving articulating the current state and the goal state in identifying the ‘problem space’ (Newell & Simon 1972). Once the ‘problem space’ has been identified, the problem solving process is a series of steps that helps the solver transition from their current state to their goal state (Newell & Simon 1972). This form of problem solving is synonymous with ‘logical problems’ (Adeyemo 1994). Frensch and Funke (2002) conceptualise problem solving as part of the ‘natural’ human thinking process. They assert that problem solving comprises both inductive and deductive thinking as illustrated in Figure 23 below.
Whilst, there is no convincing evidence that links general intelligence to effective problem solving, research has found that there are specific cognitive functions that are associated with effective problem solving (Wenke et al. 2005). Wüstenberg, Greiff and Funke (2012) assert that effective thinking and reasoning helps to inform the problem-solving process and the decision-making process. Contrary to Frensch and Funke’s (2002) notion that problem solving starts with a precise starting point (as per Figure 2.17), problem solving is conceptualised as a much broader concept by other scholars. Starling (1992) includes the stages of problem finding, framing and formulation in the definition of problem solving. He states that problem solving involves i) problem recognition, ii) formulation, iii) alternative generation, iv) information search v) judgement or choice and vi) action/feedback. Hew and Knapczyk (2007) adopt a similar view to that of Starling (1992) as they posit that the steps that should be followed in addressing ill-structured problems are i) problem representation, ii) problem solution, iii) making justification and iv) monitoring.

Heppner and Peterson (1982) assert that there are five stages in problem-solving: general orientation, problem definition, generation of alternatives, decision making and evaluation. D’Zurilla et al. (2004) posit a similar perspective to that of Heppner and Peterson (1982) as they state that the term ‘problem solving’ also encompasses problem definition and formulation. However, they go further and assert that ‘problem solving’ also involves solution implementation and verification. These broad
definitions of problem solving are not unusual as many other scholars focus on the steps involving problem solving such as i) establishing the current situation and future goals, ii) identifying the problem, iii) identifying the constraints, iv) identifying the alternatives, v) evaluating the alternatives, vi) selecting the best solution, vii) implementing the solution (Knippen & Green 1997).

2.4.2. Problem Finding

Effective problem solving is dependent on effective problem finding. The more accurate the problem finding process is, the more efficient the problem-solving process becomes (Lee & Cho 2007). In addition, effective problem finding helps to inculcate a practice in making continuous improvement through the pursuit of problems or opportunities to be addressed. Problem finding is an important construct in its own right and concerns the awareness and recognition of problematic situations (Brugman 1991). However, problem finding is not as straightforward as it seems as some problems are almost impossible to detect due to bounded rationality and that ‘we do not know what we do not know’. Starling (1992) makes an important point concerning problems that are almost undetectable and thus underscoring the importance of problem finding (recognition and detection), as he uses the tragedy of the Challenger space shuttle as an example (p. 219-220):

The technical issues are clear enough. In order to contain the stupendous explosive forces of the solid rocket booster (SRB) the rubbery O-rings had to be pushed into a sealing position by the first wave of pressure, milliseconds after ignition. Once firmly sealed, they could prevent a flow of exhaust gas from developing. But if they did not seal immediately, the flow would slip past them, gather speed, burn the rings away, and eventually blast through the metal case. Since the rings had to move in order to function, they had to be flexible. At the time of the Challenger launch, the rings had sat through a night in which the temperature had dropped to 26 degrees Fahrenheit. The following events also seem reasonably clear. Since the O-rings were classified as ‘criticality one’ (i.e., if they go, so does everything else), the SRB project manager at Marshall Space Flight Center, Lawrence B. Mulloy, applied a “launch constraint” because of increasingly frequent O-ring problems. But he did not tell higher-ups about the restraint and routinely waived it for the next six flights. By the night before the Challenger launch, NASA’s concerns had grown sufficiently dull that Mulloy and other officials gave short shrift to the objections of engineers from Morton Thiokol, the contractor. After few minutes’ reconsideration, Thiokol management agreed that they could not prove the launch unsafe. Note how the project manager, through a speech act, had changed the context of the conversation. Every time a shuttle mission returned with evidence that erosion of solid rocket seals had occurred on lift off, it was interpreted not as a warning of a pending problem but as an indication that partially eroded seals were an acceptable risk. How does one prove a design safe or not safe? Prior to the fatal Challenger launch, the issue was always discussed in the context of whether the shuttle was safe to fly. Their affirmative answers meant that they could not think of a way the shuttle could fail that had not already been taken care of or was believed to be extremely remote. But, when the Challenger launch was...
discussed, Mulloy had changed the context—engineers were being asked to prove that Challenger was unsafe. Since there was no data on the O-ring performance at low temperatures, engineers had no proof to support their concerns. The Rogers Commission devoted much of its time to analyzing why, being aware of the O-ring danger, NASA allowed the launch. Throughout the hearings, witnesses said that if they known about the seriousness of the problem with the O-rings, they would have stopped the flights; or (in their opinion) had the decision makers known about it, the flights would have stopped. The witnesses acknowledged that the problems with the O-rings had been briefed at all levels but always in a way that did not communicate the seriousness of the problem. Yet the witnesses appeared reluctant to attribute this to poor technical judgement on the part of the managers or technical staff with expertise in propulsion; they preferred instead to blame it on “poor communications.” In hindsight, the difficulties of problem recognition [finding] can easily be underestimated.”

**Problem finding** is being aware of a problem and involves the process of discovering and recognising the gap between the present and desired future state (i.e. the problem) (Lee & Cho 2007), as well as the impediments in reaching the goal state (Pounds 1969). Lee and Cho (2007) define problem finding as the “ability to think, initiate, and formulate questions or problems in an ill- or moderately structured problem situation” (p. 114). They assert that there are five stage in the problem finding process involving i) recognising the problem (Hayes 1981), ii) identifying the problem (Bransford & Stein 1984), iii) comprehension of the problem or opportunity (Polya 1957), iv) observing the need to address the problem, and formulating or articulating the problem (Rossman 1931) and iv) preparation in solving the problem (Wallas 1926).

Effective problem-finding skills are linked to both crystallised and fluid intelligence (Martindale 2001). Lee and Cho (2007) claim that problem solvers that have high levels of problem-finding skills are able to discover more original and sophisticated problems when the problems are ill-structured. In addition to intelligence and knowledge, motivation and personality traits and dispositions are also considered as antecedents of problem finding (Lee & Cho 2007; Brugman 1995; Jay & Perkins 1997). Motivation can make a person more ready to recognise the cues to a problem and sustain them through the problem-finding (and problem-solving) process (Lee & Cho 2007). Csikszentmihalyi (1996) further asserts that problem-finding effectiveness is premised upon the individual’s idiosyncratic situation in terms of his/her affective and motivational levels, as well as his/her knowledge of a particular domain and/or field.
2.4.3. Solving the Problem

As discussed, problem-solving involves surmounting problems, which can be routine or non-routine. For routine problems, the problem-solving process involves clear starting point, goals and the barriers. For non-routine problems, the problem-solving process generally involves the steps of problem framing, framing, formulation, option generation and evaluation and selection of an alternative from various options (Tallman & Gray 1990).

Probabilities can be viewed from two perspectives, the objective and actual odds of potential outcomes, and the subjective belief/values of the actor of potential outcomes (Tallman & Gray 1990; Kahneman & Tversky 1972). Subjective values and beliefs such as those related to morality (Etzioni 1988).

Problem-solving is closely related to the concepts of choice and decision making, which have been used interchangeably with one another (Tallman & Gray 1990). Problem-solving, choice and decision making are all related to probability and the chances of cost and benefit (Tallman & Gray 1990; Kahneman & Tversky 1972).

Choices are options that one is presented with, however, choices are only genuine when the actor also has an opportunity to refrain from making any of the choices. Tallman and Gray (1990) also state that genuine choices do not guarantee an outcome (Tallman & Gray 1990). Choices usually concern matters that are routine (e.g. type of breakfast to have) whereas decisions usually relate to matters that are not (e.g. whether to get married).

As decisions are made on non-routine matters, there is usually a lack of information or past experience that the decision maker can rely on (Tallman & Gray 1990). Decision making usually involves goal ambiguity and this results in decision makers breaking down decisions into a series of parts and evaluating each part for its own merits: parts-worth, in terms of consequences, act-event, a phenomenon explained by the Multi-Attribute Utility Theory (MAUT) in terms of making trade-offs in view of multiple objectives (Berkeley & Humphreys 1982). The evaluation of each part in terms of its importance and consequences results in trade-offs being made against each part in a reiterative manner until the decision maker deems an optimum balance has been found (Tallman & Gray 1990).
Problem-solving may be observed as a construct that encompasses, or at least significantly overlaps with, both choices and decision making specifically in terms of the latter two stages of problem-solving; evaluation and selection. The evaluation of the options involves the consideration of potential solutions that are applied to routine (choices) and non-routine events (decisions), whilst the selection of an alternative from various options may reflect the MAUT processes.

Choices and decision making are generally underpinned by the rational perspective and that of self-interest (Etzioni 1988). There are a number of theories that help explain why people make the choices and decisions that they do. The most common, to the point of it being considered a normative perspective, is Utility Theory (Tallman & Gray 1990) that helps to explain choices and decisions of actors in maximising advantages (Elster 1986). A similar theory, Subjective Expected Utility Theory (SEU), also maintains that actors will make choices and decisions that result in the best utility, however it has also been used in evaluating the relative power of actors in a choice/decision situation (Ford & Zelditch 1988); actors were unlikely to act opportunistically if they believed that this would cause a more powerful actor to impose sanctions.

Game Theory also explains people’s choices and decisions from a utility maximisation perspective in situations that include the conflict of interest specifically when to compete, cooperate and/or compromise with an opponent (Von Neumann & Morgenstern 1953). The prisoner’s dilemma is a puzzle that reflects the choice and decision that an actor has to make in regards to cooperating or competing with an opponent. Generally, although not always, actors benefit in the short run if they compete with their opponents and self-serve, however, in the long run it is better to cooperate (Kahneman & Tversky 1984). However, the issue with Utility Theory, SEU and Game Theory is that they assume that decisions are made in a rational manner, which is not always the case.

Choice and decisions are essentially based on heuristics, and this inevitably results in biases and distortion of information such as representativeness and stereotyping, availability (consider information that comes easily comes to mind) and anchoring (using arbitrary information or experience as references points) (Kahneman & Tversky 1984). For example, Prospect Theory helps in understanding cognitive and personal biases involving risk (Kahneman & Tversky 1979; Kahneman et al. 1982). The puzzle below demonstrates how Prospect Theory works. If individuals are given a choice of:
A. 85% chance to win £100 or
B. Sure gain of £85

Most individuals would choose ‘B’ as people generally tend to be risk averse. If individuals are given another set of options of:

A. 100% chance of losing of £85
B. 85% chance of losing £100

Most individuals would choose also ‘B’ as people generally deem it unthinkable of accepting sure loss, and they take unreasonable risks to avoid a sure loss.

Bounded rationality helps to explain the limitation of the human mind in handling excessive information that curtails the effectiveness of human choice and decision making (Simon 1979). Whilst economists endeavour to understand how people make choices, sociologist deems that the situation makes the choice for people (Hechter 1983): three aspects of the social context; historical, social and life experience shape actors’ choices and decisions. The historical aspects involve the cultural and structural conditions that exist in a particular time that determines the norms. The social aspects involves the actor’s social and family life, while life experiences shapes the actor’s skills and abilities that they have acquired (Tallman & Gray 1990). These three aspects of the social context inevitably shape and narrows actor’s choices and decisions.

Whilst the difference between choices, and decision-making are generally quite clear, the difference between decision-making and problem-solving is less clear. For example, Berkeley and Humphreys (1982) state that the decision vignette in the quasi-experiment by Kahneman and Tversky (1984) is more of a problem than a decision as it is involves how best to deal with losses due to the disease. Tallman and Gray (1990) assert that problem solving refers to a series of decisions and involves not only cognitive components but also affective components. They state that problem solving involves a conscious commitment to solving a problem. They assert that individuals’ disposition such as tolerance for ambiguity and conflict, persistence and risk-taking influence problem-solving outcomes.

2.4.4. Solutions Implementation

Problem solving does not include solution implementation (Chang et al. 2007; D'Zurilla et al. 2004). The distinction is drawn as problem solving and solution implementation require distinct skills. Solution implementation may require specific
and additional skills such as project management, organisation skills and the ability to control outcomes, whereas problem solving skills relate to general, but effective, reasoning capabilities. In addition, the environment that the solution implementation takes place in may also yield new challenges that was not part of the initial problem (addressed by the problem solving ‘phase’). Hence, it is possible that an individual may possess effective problem-solving skills but poor solution-implementation skills.

2.4.5. **Concepts of Problem Solving**

The varied definition of problem solving has resulted in various models (and measures) of problem solving (Chang et al. 2007). This next section contains different conceptualisations of problem solving. The types discussed are not comprehensive. They are selected to show the wide array of conceptualisations of problem solving. The types of problem solving are Ackoff’s (1993) view on resolving, solving and dissolving problems, creative problem solving, theory on inventive problem solving, complex problem solving and social problem solving.

2.4.5.1. **Resolve, Solve and Dissolve**

Ackoff (1993) noted that there are three ways to address problems; *resolve*, *solve* and *dissolve*. Resolving a problem is a ‘good enough’ approach that *satisfices* (satisfy and suffices) and relies on common sense. Whilst this approach may be quick, its limitations is evident as problems that are *resolved* most likely will reappear as the root cause has not been addressed. The second approach of *solving* problems relies on systematic and scientific methods in solving problems. It methodically breaks down complex problems into smaller, more manageable components. However, the mere act of decomposing a complex problem means that the solver is not addressing the problem in its complete form. Breaking the problem into smaller parts means that the solver does not ‘see’ and appreciate the complexity of the whole problem and thus the solution may not address the entire problem.

The most effective way to address problems is to *dissolve* them. Ackoff (1993) states that “dissolving problems is to change the nature, and/or the environment, of the entity in which it is embedded so as to remove the problem. Problem dissolvers idealise rather than satisfice or optimise because their objectives is to change the system involved or its environment in such a way as to bring it closer to an ultimately desired state, one in which the problem cannot or does not arise” (p. 48). The dissolving approach indicates that systems must be *redesigned* so that any potential problem is dissolved and does not arise (i.e. nipped at the bud). The design approach
may involve reshaping organisational aspects such as the structure, culture and systems of an organisation as collectively together and not in a piecemeal manner.

2.4.5.2. Complex Problem Solving

Frensch and Funke (1995) state that complex problems are multidimensional and occur in the context of the real world (Frensch & Funke 2002). Some problems are complex as they are characterised by multiple effect and dependencies, as well as the various trajectories/directions that the problem may take (Greiff & Funke 2008). In terms of research, complex problems are differentiated from ‘normal’ or ‘simple’ problems as the latter tend to include simple tasks such as the Tower of Hanoi, which is a mathematical puzzle, to assess problem solving skills, whilst the former tend to use microworld simulations, which reflect many real-world characteristics (Frensch & Funke 2002).

Complexities of problems are heightened by four characteristics; opaqueness, polytely, complicated and dynamic (Funke & Frensch 2007a; Fritzlar 2006). Opaqueness is the lack of clarity of the situation that may obscure the actual problem. Polytely is the emergence of multiple goals. Some of these goals are ambiguous or vague while some are at odds with one another, other goals may emerge, and some diminish as they become irrelevant through events or mere passage of time. Complicatedness involves many variables and factors that are connected, and affect one another. The last feature of complexity is dynamism. Dynamism is underpinned by time and change. Change may be temporal, latent and unpredictable, and can be related to goals or its underlying factors.

Complex problem solving (CPS) is a construct that is intentional and explicit. CPS is cognition-based and is underpinned by the information-processing theoretical framework (Funke & Frensch 2007a). This is not unexpected as solving complex problems requires extensive thinking. Frensch and Funke (2005) conceptualised CPS as an antidote to complex problems. Frensch and Funke (1995) state complex problem solving is required “to overcome barriers between a given state and a desired goal state by means of behavioral and/or cognitive, multi-step activities. The given state, goal state, and barriers between given state and goal state are complex, change dynamically during problem solving, and are intransparent. The exact properties of the given state, goal state and barriers are unknown to the solver at the outset. Complex
problem solving implies efficient interaction between a solver and the situational requirements of the task, and involves a solver’s cognitive, emotional, personal and social abilities and knowledge” (p. 18).

Buchner (1995) defines complex problem solving as “…the successful interaction with task environments that are dynamic (i.e., change as a function of user’s intervention and/or as a function of time) and in which some, if not all, of the environment’s regularities can only be revealed by successful exploration and integration of the information gained in that process” (p. 14). Predictably, this definition postulates that competence in complex problem solving should be related to solving complex problems. As mentioned, complex problem solving requires the solver to efficiently interact with the tasks and the environment. Funke and Frensch (2007b) illustrate these interactions in Figure 24:

Figure 24: CPS interaction amongst the problem solver, task and environment
(Funke & Frensch 2007b)

The problem solver is conceptualised from three perspectives; memory contents, information processing capabilities and non-cognitive variables such as motivation. The eventual completion of each task and the feedback obtained from each action is evaluated against the Givens and Tools. The problem solver then prepares for the next task based on the lessons learned from the previous task. This is an interactive process that is iterative that is undertaken until the goals are achieved. The solver is affected by and effects his/her environment. Environmental factors include time pressure and
distractions that the solver may encounter while trying to solve the problem (Funke & Frensch 2007a).

Quesada et al. (2005) have, however, questioned the concept of complex problem solving specifically in terms of its definition. They argue that scholars have generally defined what CPS is not rather than what it is as it appears that complex problem solving is anything that is not ‘simple’ problem solving. Quesada et al. (2005) also critiqued the measure of complex problem solving in terms of the use simulation games (i.e. microworlds) in terms of how the functionality of microworlds specifically ‘measure’ the characteristics of CPS; opaqueness, polytely, complicated and dynamic (Funke & Frensch 2007a; Fritzlar 2006). They argue there is a lack of evidence that computational and relational complexity programmed in microworlds reflect real world complexity. Another criticism of microworlds relates to controlling the problem solver’s ability to learn. Some problems necessitate or only offer a ‘one shot’ chance at solving the problem. However, microworlds operate on reiterative cycles. This enables problem solvers to learn as they solve the problem. The question, thus, is how much of the problem solving can be attributed to problem solving ability and/or the problem solver’s ability to learn, both of which are distinct abilities and constructs.

2.4.5.3. Social Problem Solving
D'Zurilla et al. (2004) conceptualised the construct of social problem solving. Social problem solving also refers to real world problems as it relates to how one adapts and functions in the social environment (D'Zurilla & Maydeu-Olivares 1995). It relates not only to impersonal (e.g. insufficient finances) and interpersonal problems (e.g. disputes with family and friends) but also intrapersonal problems (e.g. health and emotional problems). Social problem solving is conceptualised as a conscious, rational and purposeful activity.

It is clear from the discussion above that there a wide variety of different conceptualisations of problem solving. However, the different perspectives on problem solving and concepts reflects the array of problems that individuals and organisation face. Hence the different problem-solving strategies are all potentially necessary.

2.4.6. Operationalising Problem Solving Disposition
There are two primary categories in measuring problem solving: process or outcomes. Process measures involve assessing the cognitive and behavioural activities (e.g. skills
and dispositions) that facilitate problem solving, whereas outcomes assess the quality of the solution (D'Zurilla et al. 2004). Process measures are usually in the form of inventories whilst outcomes measures are usually in the form of a ‘test’. The former may relate to perception of one’s ability (Heppner & Peterson 1982; Heppner & Baker 1997).

In terms of the ‘outcomes measures’ usually involving tests, D'Zurilla et al. (2004) assert that that the validity of any test of problem-solving ability depends on the definition adopted. For example, if the definition of social-problem-solving ability is in terms of the ‘solution’ to close the gap between the current state and future desired states, then the test should measure the quality of the solution (D'Zurilla et al. 2004). However, if it is defined as an intrapersonal process, D'Zurilla and Nezu (1999) assert that self-observation or problem-solving self-monitoring may be a more valid method. D'Zurilla and Maydeu-Olivares (1995) state that this method involves the problem solver “identifying, observing, and recording significant problematic situations, mediating cognitive and behavioral problem-solving activities, and solution-implementation activities as they occur in the real life setting” (p. 419).

2.4.6.1. Positive Problem Solving Orientation
D'Zurilla et al. (2002) state that problem orientation refers to individuals’ metacognitive processes that reflect their “beliefs, personal appraisal and feelings” (p. 14) about a problem that serves as the motivational function in perceiving a problem optimistically or otherwise. They conceptualise problem orientation as a set of dispositions that involves an individual i) appraising a problem, not as a setback, but as a challenge and there is something to gain from solving the problem, ii) being optimistic that the problem can be solved, iii) having high levels of self-efficacy in the belief that they can solve the problem iv) accepting that problem solving involves hard work in terms of effort and time, and v) committing oneself to solving the problem rather than avoiding it. This problem solving disposition is potentially related to locus of control (Heppner & Peterson 1982).
2.4.6.2. **Rational and Systematic Problem Solving**

D'Zurilla et al. (2002) assert that rational problem solving is a constructive form of problem solving that is sound, logical and deliberate. Systematic problem solving involves the conscientiousness of the problem solver in methodically solving a problem in a systematic manner (Heppner & Peterson 1982). The disposition of rational and systematic problem solving underpins 'hard' problem-solving skills of problem definition and formulations, generation of alternative solutions, decision making, solution implementation and verification, as mentioned previously. Rational and systematic problem solving are conceptualised as a *style* of problem solving (D'Zurilla et al. 2004).

The disposition of rational and systematic problem solving in individuals underpins their propensity to clarify and understand the problem by gathering facts concerning the problem, identifying impediments and based on the preceding, set realistic goals in defining and formulating a problem (D'Zurilla et al. 2004). In generating alternative solutions, the problem solver produces as many solutions as possible, conventional and original. In decision making, the individual evaluates the options by ranking them against one another based on set criteria that they have established in choosing the best solution. In solution implementation and verification, the rational and systematic problem-solving disposition facilitates the problem solver in monitoring and evaluating the outcomes of the solution that has been implemented (D'Zurilla et al. 2004). The systematic and methodical aspect in problem solving involves attempting to predict the result of the solution once it has been implemented. In addition, being systematic means that the problem solver has effective heuristics in possessing methods and criteria that they use in a consistent manner in comparing and evaluating decisions (Heppner & Peterson 1982).

Figure 25 illustrates how positive problem orientation and rational and systematic problem solving style are constructive to problem solving. It also shows the dysfunctional or ineffective problem solving involves negative problem orientation and problem solving style that is impulsive and careless.
2.4.7. Effective Problem Solving at the Organisational Level

Problem solving takes up a substantial part of a manager’s time and managers must be effective at solving problems. Effective problem-solving is crucial because ineffective problem solving usually results in undesirable trade-offs being made, compromising on the solution, which may not be sustainable (O’Loughlin & McFadzean 1999). Problem solving at the organisational level involves problem solving at the individual level, including as mentioned, cognitive processing and dispositions, as well as organisational decision-making processes, team culture and organisational culture (O’Loughlin & McFadzean 1999).

Starling (1992) asserts that within an organisational context, problem solving is essentially a social process. What this means to the individual is that they also need to focus on working with others, in addition to focusing on the problem itself. Organisational problem solving means undertaking the steps of identifying i) what needs to be done, ii) how it should be done, iii) who should do what, iv) when it needs to be done, v) where it should be done, and vi) what the budget is (Knippen & Green 1997).

Whilst problem-finding and problem-solving have been discussed at the individual-level, many of its principles have equivalents at the organisational level. Nickerson,
Yen and Mahoney (2011) assert that the four activities of i) problem finding, framing and formulation, ii) problem-solving, iii) solution implementation, and iv) operating implemented solutions are underpinned by the resource-based view of the firm (Barney 1991; Rumelt 1984; Wernerfelt 1984), dynamic capabilities (Teece 2007; Eisenhardt & Martin 2000; Teece et al. 1997; Zollo & Winter 2002) and governance (Williamson 1985; Williamson 1991) (see Figure 26).

Figure 26: The problem finding and problem-solving approach joins the three perspectives (Nickerson et al. 2011)

The model illustrated in Figure 2.20, also highlights the need for organisations to attain equifinality in balancing problem-finding and problem-solving. Attaining equifinality is important as it ensures that the organisation’s undertakings are within its core competencies and that it is able to ‘finish what it starts’ (Nickerson et al. 2011). The resource-based view (RBV) forms the basis of the problem-finding and problem-solving approach as it is the routines that organisations develop in addressing and meeting challenges that becomes an organisational asset (Nickerson et al. 2011). Successful routines inherently contribute to an organisation’s competencies and may set it apart from its competitors (Williamson 1991). These routines are usually heterogeneous and may be become valuable, rare, inimitable and non-substitutable (VRIN) as they are borne out of the organisation’s unique competencies and the idiosyncrasies of the situation/challenge (Nickerson et al. 2011; Barney 1991; Rumelt 1984).

Dynamic capabilities refer to a firm’s ability to cope with and adapt to change, thus it contributes to the firm’s ability to find, frame and formulate problems as well as
opportunities (Nickerson et al. 2011). Whilst Teece et al. (1997) define dynamic capabilities as “a firm’s ability to integrate, build, and reconfigure internal and external competences” (p. 516), dynamic capabilities are also known as ‘combinative capabilities’ (Kogut & Zander 1992b) and ‘architectural competencies’ (Henderson & Clark 1990). Dynamic capabilities underpin problem finding, framing and formulation as it directs organisations in determining its strategic direction, future value propositions, and markets (Nickerson et al. 2011).

Problem formulation is critical as organisations are faced with complex and ill-structured problems, and the ‘wrong’ articulation of the problem may cause organisations to lose their competitive advantages (Nickerson et al. 2011). In addition, dynamic capabilities shape problem-solving and solution implementation in terms of determining the methods that are most cost-effective and the manner of implementation (Nickerson et al. 2011).

The way an organisation is governed also influences an organisation’s problem-finding and problem-solving approach and capabilities. Governance relates to how organisations seek the most cost-effective way in conducting its business, which in turn influences the way the organisation is governed in terms of the hierarchy and/or market perspectives (Williamson 1991; Williamson 1985). Governance, influenced by the transaction cost theory, thus shapes the problem-finding and problem-solving approach in the form of organisation determining the most optimum governance structure, controls, incentives and rules (Williamson 1991; Williamson 1985; Nickerson et al. 2011). Effective governance may result in knowledge creation, appropriation and transfer, thus further developing organisational capabilities (Foss & Michailova 2009).

Nonetheless, the limitations of the activities of problem finding, framing, formulation and solving at the organisational-level is similar to that at the individual as managers are fallible to bias, delusions, bounded rationality, information distortion, group think and anchoring (Kahneman et al. 1982; Nickerson et al. 2011).
2.5. **Metacognition Self-Consciousness**

Metacognition self-consciousness disposition is a type of higher-order thinking disposition and is an independent variable in the research model. This sub-section contains a discussion of the various definitions and antecedents of metacognition to help the understanding of the construct. This understanding is supported by a discussion of the role and benefits of possessing high metacognition self-consciousness. This sub-section then examines a key existing measure of the construct, which helps to decide how to measure this disposition in this study (further discussed in the Research Methodology chapter). There are three parts to this section. The first part contains an overview of metacognition and discusses definitions provided by various scholars, including self-consciousness. This is followed by the second part that outlines some of the debates concerning the antecedents of metacognition that will arguably help to illuminate the meaning of the construct. The final and third part contains a discussion of the impact of metacognition self-consciousness (referred to as metacognition or ‘MC’ for short latterly in the dissertation e.g. Chapter 3 onwards).

2.5.1. **Overview and Definition of Metacognition**

Metacognition is ‘thinking about thinking’ (Flavell 1979; Adey & Shayer 1994), involves questioning oneself (Livingston 2003) and is likened to being able to ‘read one’s own mind’ (Langan-Fox et al. 2002). Metacognition is a higher-order mental process (Coutinho 2007) and are the executive controls (e.g. planning, monitoring and evaluating) of other cognitive components (Livingston 2003). The prefix ‘meta’ refers to something that transcends the subject it is related to such as individuals’ own awareness and control of their cognitive strategies and processes (Fisher 1998). Shimamura (2000) posits that metacognition is the “evaluation and control of one’s own cognitive processes” (p. 313). Metacognition is an interplay between the object and meta levels. The object is monitored by the meta-level. The meta-level evaluates what is being monitored and feeds information back on the object (Nelson & Narens 1990). Metacognition is conceptualised as a multidimensional set of general skills. Kornell (2009) supports this notion as he states that metacognition concerns self-reflection and conscious awareness. It is omnipresent in life and usually goes unnoticed (Kornell 2009). Nonetheless metacognition is generally conceptualised as possessing two parts; knowledge and experience/regulation of cognition (Schraw 1998; Schraw & Moshman 1995; Flavell 1979).
Flavell (1979), who is usually attributed with popularising the construct, defines metacognition as “any knowledge or cognitive activity that takes as its object, or regulates, any aspect of any cognitive activity” (p. 275). He posited that metacognition consists of metacognitive knowledge and metacognitive regulation. Metacognitive knowledge consists of knowledge of the person, task and strategies. Metacognitive knowledge of the person is the knowledge (or beliefs) about the knowledge that one has, the knowledge that one does not have (e.g. one’s own strengths and weaknesses), and learning processes.

Person knowledge is essentially about human factors that impact on learning (e.g. motivation, ability and aptitude), what they know and what they do not know (known unknowns) (Wenden 1998). Tasks relate to understanding the nature of the tasks, what is required of the task, and the demands and challenges that go with it. Task knowledge is the information about the demands of the tasks (e.g. how to do the task in general and the skills required to perform the task) (Wenden 1998). Strategies involve knowing what is sufficient, expedient, comprehensive, and the steps and processes that are involved in addressing the challenges based upon the strengths and limitations of the person. Strategic knowledge includes general and specific knowledge about strategies (e.g. how strategies work in general, how and when to use specific strategies) (Wenden 1998). Metacognition knowledge is the result of the interaction of all three parts in helping individuals to be effective in solving problems, for example. Veenman, Van Hout-Wolters and Afflerbach (2006) recognise that metacognitive knowledge may also include Conditional knowledge, which is knowing ‘what to do when’.

The experience aspect of metacognition has a regulatory function as it enables one to select, evaluate, revise and/or abandon strategies (Flavell 1979). In other words, control of one’s thinking. The monitoring and regulating aspects are essential parts of metacognition in developing strategies for planning, organising, monitoring, evaluating and problem solving (Vandergrift 2005; Gwilliam, Wells & Cartwright-Hatton 2004). Monitoring involves making judgments about one’s memory and cognition, and regulation (or control) and concerns using judgements to guide one’s actions (Kornell 2009).

Metacognitive experiences and strategies are crucial elements for effective learning as the feedback mechanism can help to plan, monitor and evaluate actions related to skill acquisition (Veenman et al. 2006). Cognition is necessary but insufficient as cognitive
strategies are about making progress whereas metacognitive strategies are about monitoring progress. Metacognitive experiences allow one to enhance and refine metacognitive knowledge (Flavell 1979).

The monitoring aspect of metacognition (metacognition self-consciousness) is usually emphasised in clinical psychology. For example, Wells and Cartwright-Hatton (2004) observe monitoring and regulation are central to the definition of metacognition when they posit that “metacognition refers to the psychological structures, knowledge, events and processes that are involved in the control, modification and interpretation of thinking itself” (p. 386).

Metacognitive knowledge and metacognitive experience reinforce each other (Schraw 1998). For example, one cannot know how well one is doing without actually having knowledge of the performance standard and the problem-solving step (Veenman et al. 2006). In addition, metacognitive knowledge provides the basis for monitoring how, during the monitoring process, information is gathered that further develops metacognitive knowledge (Wenden 1998).

Other scholars have their own definitions of metacognition. Cross and Paris (1988) state that metacognition is “the knowledge and control children have over their own thinking and learning activities” (p. 131), whilst Hennessey (1999) posit the metacognition is “awareness of one’s own thinking, awareness of the content of one’s conceptions, an active monitoring of one’s cognitive processes, an attempt to regulate one’s cognitive processes in relationship to further learning, and an application of a set of heuristics as an effective device for helping people organize their methods of attack on problems in general” (p. 3). Kuhn and Dean (2004) supports this view as they assert that metacognition is the “awareness and management of one’s own thought” (p. 270), which is similar to a definition by Martinez (2006) who argues that metacognition is “the monitoring and control of thought” (p. 696).

Fisher (1998) provides a slightly different conceptualisation of metacognition. He argues that metacognition concerns both going above and going beyond cognition. Going above is the monitoring and control of one’s cognitive processes (Adeyemo 1994). Going beyond, which is similar to the executive control (self-regulation) is stretching one’s thinking to the next level, similar to the developmental processes underpinned by the concept of “zone of proximal development” (Vygotsky 1978).
Fisher (1998) also states that whilst metacognition does involve self-regulation, it also involves *experimenting* with one’s own thoughts (Brown & Walker 1983).

The construct of metacognition has grown, as has its application (Georghiades 2000). There are various keyword and terms associated with definitions of metacognition such as cognition about cognitions (Meichenbaum et al. 1985), knowledge, awareness and control of process involved in their learning (Gunstone 1991), recognising, evaluating and reconstructing ideas (when required) that is characteristics of metacognitive learners (Garner & Alexander 1989), metalearning (White & Gunstone 1989), deuto learning (Bateson 1983), mindfulness (Salomon & Globerson 1987), and triple and double-loop learning (Argyris 2005; Tosey, Visser & Saunders 2011). Veenman et al. (2006) adds to this list in identifying terms such as metacognitive beliefs, metacognitive awareness, feeling of knowing, judgement of learning, theory-of-mind, metacognitive skills, executive skills, higher-order skills, metacomponents, comprehension monitoring, learning strategies, heuristic strategies and self-regulation. Metamemory and judgements is about internal memory representations, and is linked to both metacognitive knowledge and experience (Kornell 2009). Table 33 below details the links between different aspects of metacognition.
<table>
<thead>
<tr>
<th>Metacognitive component</th>
<th>Type</th>
<th>Terminology</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive knowledge</td>
<td>Knowledge about oneself as a learner and factors affecting cognition</td>
<td>Person and task knowledge</td>
<td>Flavell (1979)</td>
</tr>
<tr>
<td></td>
<td>Self-appraisal</td>
<td>Paris and Winograd (1990)</td>
<td></td>
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<tr>
<td></td>
<td>Epistemological understanding</td>
<td>Kuhn and Dean (2004)</td>
<td></td>
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<tr>
<td></td>
<td>Declarative knowledge</td>
<td>Cross and Paris (1988)</td>
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<tr>
<td></td>
<td></td>
<td>Schraw, Crippen and Hartley (2006)</td>
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<td></td>
<td></td>
<td>Schraw and Moshman (1995)</td>
<td></td>
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<tr>
<td>Awareness and management of cognition, including knowledge about strategies</td>
<td>Procedural knowledge</td>
<td>Cross and Paris (1988)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kuhn and Dean (2004)</td>
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<tr>
<td></td>
<td></td>
<td>Schraw et al. (2006)</td>
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</tr>
<tr>
<td></td>
<td>Strategy knowledge</td>
<td>Flavell (1979)</td>
<td></td>
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<tr>
<td></td>
<td>Conditional knowledge (knowledge of why and when and to use certain strategy)</td>
<td>Cross and Paris (1988)</td>
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<tr>
<td></td>
<td></td>
<td>Schraw, Crippen and Hartley (2006)</td>
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<tr>
<td></td>
<td></td>
<td>Schraw and Moshman (1995)</td>
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</tr>
<tr>
<td>Cognitive regulation</td>
<td>Identification and selection of appropriate strategies and allocation of resources</td>
<td>Planning (goal setting, identifying appropriate strategies and allocation of resources)</td>
<td>Cross and Paris (1988)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paris and Winograd (1990)</td>
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<td>Schraw et al. (2006)</td>
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<td>Schraw and Moshman (1995)</td>
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<td></td>
<td>Whitebread et al. (2009)</td>
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<tr>
<td></td>
<td>Attending to and being aware of comprehension and task performance</td>
<td>Monitoring/ regulating (Flavell states that regulating refers to the “compensatory strategies to redirect and bolster faltering strategies” p. 6)</td>
<td>Cross and Paris (1988)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paris and Winograd (1990)</td>
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<td>Whitebread et al. (2009)</td>
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<tr>
<td></td>
<td>Cognitive experiences (insights and perceptions in to one’s experience e.g. “I am not getting this”)</td>
<td>Cross and Paris (1988)</td>
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<td></td>
<td></td>
<td>Paris and Winograd (1990)</td>
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<td></td>
<td></td>
<td>Whitebread et al. (2009)</td>
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<tr>
<td></td>
<td>Assessing the processes and products of one’s learning, and revisiting and revising learning goals</td>
<td>Evaluating</td>
<td>Cross and Paris (1988)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Paris and Winograd (1990)</td>
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<td>Schraw et al. (2006)</td>
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<td>Whitebread et al. (2009)</td>
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</tbody>
</table>
Sternberg (1986) argues that metacognition is related to intelligence: That is, enhanced cognitive abilities. There is evidence to suggest that metacognition is moderately correlated with intelligence and learning performance (Sternberg 1996). Pretz and Sternberg (2005) state that “…intelligence seems to be a metacognitive ability, the ability to selectively attend, to focus one’s cognitive processes, and to switch processing as conditions change. Intelligence is more than just good cognition; it is the ability to use cognitive ability adaptively. This characteristic of intelligence is most apparent in studies of higher-order cognition, perhaps because those studies include problems complex enough to require this kind of flexibility of processing” (p. 315). Schraw (1998) argues otherwise in that metacognition is not the same as general intelligence but may help compensate any deficits in intelligence and/or prior knowledge. Veenman et al. (2006) support this view as they state that metacognition is not synonymous with intellectual ability. They go on to state that intelligence may give children a head start in the development of their metacognitive skills but this is only in the short run (Veenman et al. 2006). Metacognitive skills may help compensate students’ cognitive limitations. This idea is consistent with the position of Swanson (1992) who posited that individuals with higher metacognitive skills are more effective in their use of metacognitive strategies, which in turn enables them to be more effective in problem solving. He also asserted that experts usually have better metacognitive skills, as with those with higher intelligence.

The conceptualisation and evaluation of metacognition is challenging as i) it is a complex construct, ii) it is not directly observable, iii) it is confounded by memory and verbal ability, and iv) existing measures of it are too narrow and decontextualized (Lai 2011). Some scholars argue that metacognition must be at the conscious level to allow for higher-order processing (Nelson 1996), whilst others argue that it may also be at the less conscious level as many self-monitoring processes run in ‘the background’ (Veenman, Prins & Elshout 2002). This debate asks the question whether metacognition takes place at the conscious, subconscious or unconscious levels. Due to its link to cognition, there is a sound basis to assume that this link to our senses means that metacognition is a conscious phenomenon (Seth 2008), although this cannot be verified.

Metacognitive knowledge is the knowledge that individuals have about their own cognition and internal states, however, this ‘knowledge’ may not be knowledge per se but rather ‘beliefs’. Thus, individuals may apply inappropriate coping strategies if the ‘knowledge’ is erroneous (Spada et al. 2008a). Wenden (1998) states that
metacognitive knowledge is also known by other terms, with each assuming that individuals have some knowledge of the way they think. For example, it is also known as learner beliefs (Horowitz 1987), which refers to the learner’s subjective views, idiosyncratic truths, and commitment to these truths. In addition it is also known as the learner’s naïve psychology of learning (Wenden 1987) in terms of the learner’s hypothesis about factors that contribute to their learning. Finally, it is also about learner representations (Gremmo & Riley 1995), as metacognition knowledge is not an exact replica of experience but a ‘flawed’ encoding in long-term memory. In addition, belief systems (as opposed to knowledge) are more resistant to change as they are more tenaciously held than knowledge (Veenman et al. 2006).

Whilst metacognition has been generally conceptualised as domain general, Veenman et al. (2006) argue that is not necessarily domain general. They argue that higher-order cognition is the governing system that must be intricately linked to what it governs (i.e. cognition). For example, one cannot really know about one’s depth/breadth of metacognitive knowledge without actually having domain-specific knowledge (i.e. cognition). Metacognition does depend on both content and context (Pramling 1998), as metacognitive strategies have to be informed by context in order to be effective (Fisher 1998). This is consistent with the notion of metamemory. Schneider and Lockl (2002) state that metamemory concerns “knowledge about memory processes and content” (p. 5) and is closely related to declarative and procedural cognitive knowledge, thereby indicating that gaining domain-specific knowledge as part of metacognition is inevitable.

### 2.5.2. Antecedents of Metacognition

The understanding of metacognition may be enhanced by identifying its antecedents. This section will trace the roots of metacognition, in particular knowledge monitoring and regulation, to the work of James, Vygotsky and Piaget. In addition, the section will also contain a discussion on contributions of developmental psychology to metacognition, in particular, the Theory-of-Mind Theory.

Fisher (1998) asserts that *thinking about thinking* in metacognition is in essence a reflective activity that individuals undertake. This reflective process enables one to trace the roots of metacognition to the work of William James who emphasised the importance of introspective observation (James 1890). Fox and Riconscente (2008) posit that introspection and/or introspective observation is the deliberate attention to and reporting of one’s own mind. It involves ‘*thinking about thinking*’ until it becomes
Vygotsky (1962) was the first to assert that conscious reflective control was crucial to learning. Vygotsky (1962) posited that as people grow their acquisition of knowledge grows, from automatic unconsciousness to one that is active and conscious of the knowledge acquired and retained. Vygotsky (1978) was one of the first to intimate the development of metacognition. He argued that knowledge is initially unconsciously acquired but over time this is followed by a gradual increase in conscious control. He asserted that metacognition is the awareness of one’s thoughts and the ability to communicate one’s rationale. Metacognition thoughts are intentional, intelligent, logical and verbally communicable (i.e. tacit knowledge can be made communicable to some extent). Vygotsky observes metacognition and self-regulation co-developing and reinforcing one another.

By bringing the learning process to the conscious level, individuals will be more aware of their own thoughts through mental schemas (Piaget 1980). Fox and Riconscente (2008) argue in Piaget terms, consciousness means abstraction and controlled attention, and that metacognitive knowledge is the mature capacity for reflective abstraction. Metacognition and self-regulation are completely intertwined. Intentionality implies self-regulation requires consciousness (i.e. metacognition) and involves control (i.e. self-regulation). Other forms of mental schemas in metacognition are thinking frames (Perkins 1986), scenarios, scripts and narratives (Bruner 1991). Brown and Walker (1983) argue that there are essentially four strands of metacognition literature; self-knowledge of cognitive process (e.g. James (1890) and Flavell (1979), self-regulation (e.g. Piaget (1980), social mediation (e.g. Vygotsky (1978)), and information processing and executive control (e.g. Sternberg (1985)).

The executive control concept put forth by Sternberg (1985) highlights the role of meta/executive function or higher-order cognition in terms of decision-making, planning, monitoring and evaluating, and differentiates it from lower-order cognition such as comparing, classifying, combining, acquiring, retention and transfer (Kuhn & Dean 2004). Schunk (2008) argues that in cognitive psychology, the control of executive process is crucial for information processing.
Shimamura (2000) states that metacognitive regulation is a form of executive control that involves “attention, conflict resolution, error correction, inhibitory control, and emotional regulation” (p. 313). He argues that there are four aspects of executive control: selecting, maintaining, updating and re-routing. Selecting the object of focus, maintaining and regulating, updating new knowledge received from the maintaining and monitoring processes, and re-routing is shifting the information process in terms of stimuli and processes. Similar to what is espoused by Vygotsky and Piaget, the regulation and control of information can be achieved through rehearsing information to be learned, forming mental images, organising information, monitoring the level of understanding and using retrieval strategies (Atkinson & Shiffrin 1968).

It is Piaget’s work that led to the development of the Theory-of-Mind Theory (Flavell 2004), which concerns understanding the mental world such as beliefs, desires and emotions. The Theory-of-Mind is based on the premise that our knowledge of the mind comes from informal everyday ‘frameworks’ that are unique to each individual (Bartsch & Wellman 1995), which is similar to the notion of Theory-in-Use (e.g. individual’s own mental models and assumptions of how the world works) by Argyris (1995). The second premise is that as children mature, they are able to infer the mental states of others through role-taking or other simulation processes (i.e. simulation theory) (Harris 1992; Baron-Cohen 1995). Egeth and Kurzban (2009) state that Theory-of-Mind involves individuals having metarepresentation of what they have seen, what other people think, it is a psychology of their own psychology and other people’s psychology. Schneider (2008) states that the Theory-of-Mind is the “ability to estimate mental states, such as beliefs, desired or intentions, and to predict other people’s performance based on judgments of their mental states” (p. 11)

Flavell (2004) provides two examples when he states “the subject animal sees another individual put an object in container A and then leave the scene. The subject then sees someone else transfer the object from container A into container B while the individual is still absent. The subject animal should then be credited with some understanding of belief if it acts as if it expects that the returning individual will search for the object in A rather than B” (p. 276). In another example, he states, “after children discover that a cookie box actually contains pencils instead of cookies, they are asked what another child who has not looked inside will think the box contains. Younger preschoolers say pencils; older ones, with a better understanding of belief, say cookies” (p. 276). Flavell’s narrative illustrates how Theory-of-Mind is about folk
psychology, what people think they are thinking and what they think others are thinking.

2.5.3. Impact of Metacognition Self-Consciousness

The previous sections have discussed the construct of metacognition, including the main dimension of self-consciousness. This section discusses the impact of metacognition. The following discussion suggests that, as form of executive control, high levels of metacognition help with many functions and enable high levels of performance. For example, metacognition helps with learning languages (Wenden 1998), development of mathematical and analogical skills, and the transfer of knowledge (Voss, Wiley & Carretero 1995). This section discusses the impact of metacognition on affective states, self-regulation and self-regulated learning, learning and academic success, transfer of learning, critical thinking and problem solving.

2.5.3.1. Affective States

Individuals with highly developed metacognitive abilities gain effective insights into themselves that may further help refine their metacognitive knowledge. Metacognition in general helps one to be sensitive to external stimulus in activating reflective processes within individuals (Hoffman & Spatariu 2008), which involves individuals’ cognition, emotion and conation. Metacognition impacts on both motivation and affective states (Cross & Paris 1988). Metacognition helps with improving affective states such as being persistent in addressing challenging tasks. Individuals with high levels of metacognition are able to better assess their own strengths, weaknesses, emotions, needs and drives (Paris & Winograd 1990).

Metacognition, in helping to develop individuals in being more able, inevitably also impacts on their self-efficacy. Positive affective states in turn help to reinforce the positive approaches to problem solving (Hoffman & Spatariu 2008). Eisenberg (2010) argues that self-regulation of emotions inevitably involves the monitoring and regulation of motivation. He states that such, “‘effortful control’, which is the efficiency of executive attention, helps to inhibit (inappropriate) dominant response and/or activate (appropriate) subdominant response, to plan, and to detect errors” (p. 682). Individuals who have high effortful control are better able to control their emotions and are more pro-social, and have better quality relationship with others. Metacognition helps to improve affective states such as self-efficacy (Schraw et al. 2006), which in turn enables other positive outcomes such as performance, task completion and attaining learning outcomes (Thomas, Anderson & Nashon 2008).
2.5.3.2. Critical Thinking

Critical thinking is a broad construct with multiple components. Whilst definitions vary in terms of the components encompassed, the common components are analysing arguments (Ennis 1985; Facione 1990; Halpern 1998; Paul & Elder 2002), making inferences using inductive or deductive reasoning (Ennis 1985; Willingham 2007; Paul & Elder 2002; Facione 1990), judging or evaluating (Ennis 1985; Facione 2000; Case 2005; Lipman 1998; Tindal & Nolet 1995) and making decisions or solving problems (Ennis 1985; Halpern 1998; Willingham 2007) (see section on Critical Thinking).

Many authors agree that there is a strong relationship between metacognition and critical thinking, although some may disagree in terms of the way these are related to one another (Flavell 1979; Martinez 2006; Kuhn 2000; Schraw et al. 2006). For example, effective metacognition certainly helps with critical thinking as it makes the individual more aware and able to self-regulate (e.g. not ‘jumping to conclusion’) and to be more thorough in their thinking. Critical thinking in turn ‘improves’ metacognition, specifically metacognitive knowledge as it improves the quality of knowledge that is retained by the individual.

Flavell (1979) assumes that critical thinking is subsumed in metacognition when he states that “critical appraisal of message source, quality of appeal, and probable consequences needed to cope with these inputs sensibly” can lead to “wise and thoughtful life decisions” (p. 910). This view is supported by Martinez (2006) who argues that metacognition consists of critical thinking, metamemory and problem solving. To Kuhn (2000), critical thinking and metacognition are similar concepts. This position is supported by Hennessey (1999) who rationalises that both involve questioning one’s own knowledge and beliefs, withholding judgement until further ‘analysis’ can be undertaken, being genuinely open to credible evidence and changing one’s view in light of evidence.

Schraw et al. (2006), however, observed self-regulation as the superordinate construct that subsumes both metacognition and critical thinking (and motivation). They see metacognition as playing a supporting role to critical thinking in monitoring and controlling the quality of the thought process and outcomes. Critical thinking is, nonetheless, generally agreed to benefit from effective metacognition.
2.6. **SYSTEMS THINKING**

Systems-thinking disposition is a type of higher-order thinking disposition and is an independent variable in the research model. This section discusses the concept of systems thinking. The historical roots of the topic are first surveyed, specifically involving the concept of systems, and the theories and fields of general systems theory, system dynamics, cybernetics, and hard and soft system methodologies. We then discuss systems thinking as an ability and we provide three examples of what systems thinking mean as a skill. Next we discuss the dispositions required for effective systems thinking. This is followed by two examples of how systems thinking can be applied within organisations. This section also examines existing measures of the construct, which helps to decide how to measure this disposition in this study (further discussed in the Research Methodology chapter).

2.6.1. **The Concept of Systems**

Systems are interconnected dynamic components that are open to their environment (Mulej et al. 2004; Von Bertalanffy 1950; Boulding 1956). Checkland (1999) defines systems as “the idea of a set of elements connected together which form a whole, thus showing properties which are properties of the whole, rather than properties of its component parts” (p. 3). Skyttner (1996) defines a system as “a set of interacting units or elements that form an integrated whole intended to perform some function” (p. 16-17). In short, Skyttner (1996) states that a system is about order, pattern and purpose. He further states that “to qualify for the name system, two conditions apart from organization have to be present: continuity of identity and goal directedness. Something that is unable to preserve its structure amid change is never recognized as a system. Goal directedness is simply the existence of a function” (p. 17). However, there are many other definitions and interpretations of the term ‘system’, which is due to its broad and varied history.

Systems theory has a long history and can be traced to philosophical underpinnings as the *Harmony of Opposites* by I Ching, the *Philosophy of the Whole* by Baruch Spinoza and *Recyclical Universe* from Hindu Mythology, and includes contributions from Western sciences such as physics, chemistry, ecology and biology (International Institute for General Systems Studies 2001). ‘Systems’ and ‘system theories’ differ greatly, not because of confusion but due to the breadth of the concept, which reflects that it is still very much in development.
How the term ‘system’ is defined depends on the perspective adopted. An internal definition would encompass the ‘structural’ aspects of the system, whilst an external definition would entail the functional aspect of the system (Von Bertalanffy 1972). The popularity of the field of systems is increasingly growing and even as far back as 1972, Kast and Rosenzweig (1972) claimed that the word ‘system’ has become a status-symbol with many scholars including the word system into their work.

Whilst the definition of systems may vary, there is some agreement in terms of characteristics such as homeostasis, autopoiesis, synergy, dissipative structures, complexity and chaos (Vallee 2000; Von Bertalanffy 1972; International Institute for General Systems Studies 2001). Homeostasis concerns maintaining equilibrium to offset and pre-empt any disruptive changes. Autopoiesis is the characteristics of living systems that automatically self-create and self-organise whilst synergy is the cooperation between subsystems. Examples of dissipative structures are cyclones and hurricanes that seemingly appear spontaneously. This concept is related to the concept of chaos, where cause-and-effect between factors and events are not clearly obvious (though evident in hindsight). Complexity theory introduced the notion of emergence. Emergence involves the spontaneous appearance and self-organisation of new variables (Barton et al. 2004). Chaos is the randomness of events and relationships where a seemingly trivial and unrelated event can trigger a chain reaction that alters an entire system. A well-known adage of the chaos concept is, a butterfly flapping its wings in one part of the world can cause a hurricane on the other side of the earth (Scott 2000).

Hall and Fagen (2003) argue that a system is generally a relationship amongst objects and their attributes. They argue that systems have properties, functions or purposes that are distinct from their constituent objects, relationships and attributes. Objects are components of a system, whilst attributes are properties of objects. However, it is the relationships that make a system what it is in ‘hanging together’. Hall and Fagen (2003) also posit that all systems have sub-systems, which is similar to a hierarchy or partition of systems. Sub-systems have their own behaviour. Finally, all systems live and operate in an environment, which is also called a suprasystem (subsystem part of a system, which in turn is part of a suprasystem).

The macroscopic properties of systems involve the characteristics of wholeness and independence. To be whole and independent, a system must be self-sustaining. In addition, systems can also be differentiated in terms of systemisation (growth) and/or...
segregation (decay), that can occur simultaneously. Finally, systems are unique in terms of the degree of centralisation, which is the presence of a dominant role of one element or subsystem.

Hall and Fagen (2003) differentiate between natural systems and man-made systems. Natural systems tend to be open systems that are adaptive and stable systems, which have evolved to react and maintain equilibrium through well-established feedback loops. Man-made systems such as language and social organisations, are also adaptive but tend to be performance-related. There are no guarantees of compatibility between man-made systems and natural systems but they can be in harmony with one another (Hall & Fagen 2003). Geyer (1995) suggests that “Living systems are generally organisationally closed but informationally open” (p. 12)

Boulding (1956) argues that there are different levels (or classification) of systems, ranging from simple to sophisticated, as a hierarchy of complexity (e.g. in terms of function). For example he identifies nine levels. The first is a framework, which is a static structure. This is followed by a system such as a clock that moves in motion at a specific, continuous rate, irrespective of any changes in the environment. The third level includes systems such as a thermostat that has control mechanisms that allow it to ‘change’ according to changes (in this case temperature) in the environment. The fourth level of system are cells, which are open systems, and are self-maintaining and self-reproducing. The fifth level are plants, whilst the sixth level are animals that have self-awareness. The seventh level is where humans are located as we have self-consciousness in addition to self-awareness. Social organisations and societies are at the eighth level and transcendental systems are at the ninth level. A description of each of these levels are contained in Table 34.
Table 34: Classification of systems (Boulding 1956)

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Frameworks</td>
<td>The geography and anatomy of the universe: the patterns of electrons around a nucleus, the pattern of atoms in a molecular formula, the arrangement of atoms in a crystal, the anatomy of the gene, the mapping of the earth, etc.</td>
</tr>
<tr>
<td>2. Clockworks</td>
<td>The solar system or simple machines such as the lever and the pulley, even quite complicated machines like steam engines and dynamos fall mostly under this category.</td>
</tr>
<tr>
<td>3. Thermostats</td>
<td>Control Mechanisms or Cybernetic Systems: the system will move to the maintenance of any given equilibrium, within limits.</td>
</tr>
<tr>
<td>4. Cells</td>
<td>Open systems or self-maintaining structures. This is the level at which life begins to differentiate itself from not life.</td>
</tr>
<tr>
<td>5. Plants</td>
<td>The outstanding characteristics of these systems (studied by the botanists) are first, a division of labour with differentiated and mutually dependent parts (roots, leaves, seeds, etc.), and second, a sharp differentiation between the genotype and the phenotype, associated with the phenomenon of equifinal or &quot;blueprinted&quot; growth.</td>
</tr>
<tr>
<td>6. Animals</td>
<td>Level characterized by increased mobility, teleological behaviour and self-awareness, with the development of specialized 'information receptors (eyes, ears, etc.) leading to an enormous increase in the intake of information.</td>
</tr>
<tr>
<td>7. Human Beings</td>
<td>In addition to all, or nearly all, of the characteristics of animal systems man possesses self-consciousness, which is something different from mere awareness.</td>
</tr>
<tr>
<td>8. Social Organizations</td>
<td>The unit of such systems is not perhaps the person but the &quot;role&quot; that part of the person which is concerned with the organization or situation in question. Social organizations might be defined as a set of roles tied together with channels of communication.</td>
</tr>
<tr>
<td>9. Transcendental Systems</td>
<td>The ultimates and absolutes and the inescapable unknowables, that also exhibit systematic structure and relationship.</td>
</tr>
</tbody>
</table>

Boulding (1956) states that ‘systems’ are those that are purposiveness and goal seeking, have mutual interaction and are adaptive, such as that of organisations. Mole (2004) supports this view as he states that ‘genuine’ systems are inherently complex. Thus, he states, organisations are complex adaptive systems as they embody complexity with many variables and interconnections, and are required to adapt to the external environment for survival. Similarly, in the domain of management, Skyttner (1996) argues that a system can be defined as “the organized collection of men, machines and material required to accomplish a specific purpose and tied together by communication links” (p. 17). This is view is supported by Barnard (1968), who states that “a cooperative system is a complex of physical, biological, personal and social components which are in a specific systematic relationship by reason of the
cooperation of two or more persons for at least one definite end. Such a system is evidently a subordinate unit of larger systems from one point of view; and itself embraces subsidiary systems; physical, biological etc, from another point of view. One of these systems comprised within a cooperative system, the one which is implicit in the phrase “cooperation of two or more persons” is called an “organisation” (p. 65). Autopoiesis is a fundamental concept as it highlights an organisation’s balancing act in changing to adapt to the environment but at the same preserving its identity (Mole 2004). Many organisational problems cannot be easily resolved and a systems view is necessary in dealing with the growing complexity of problems (Kast & Rosenzweig 1972). This is partly because, as Boulding (2003) explains, organisations and management are interdisciplinary fields that makes it inherently complex.

Indeed, Frank et al. (2007) argue that addressing problems as a whole are more effective and sustainable than dividing a problem into smaller parts. By dividing a problem into smaller parts, the problem may be concealed especially if the root cause is the interrelationship between the components rather than the components themselves. Also, systems have emergent properties as Frank et al. (2007) argue that “Systems have emergent properties that are not found among their parts. While it is true that the system’s properties, capabilities, and behaviors emerge from the system’s parts, they also emerge from the interactions between these parts. You cannot predict the properties of a complete system by taking it apart and analyzing its individual components...this synergistic effect is one of the central and most important attributes of a system, but it is, at times, difficult to identify” (p. 38).

The historical underpinnings of theories that relate to system were, for some time, disparate. Although this remains much the case (Midgley 2003), the most significant attempt to integrate theories that relate to systems was the General Systems Theory (GST) proposed by Ludwig von Bertalanffy (1901 - 1972) (Mulej et al. 2004). The relevance of GST in this study is that it is essentially a tool for problem solving (Funke & Frensch 2007a). GST, as the term indicates, is based on the generality of its application.
2.6.2. General Systems Theory

Von Bertalanffy (1950) argues that the notion of ‘systems’ is a new paradigm. He argues that it qualifies as a paradigm based on the criteria articulated by Kuhn (1970) as it competes with the dominant elementalistic approach to science. The prevailing approach to science is due to the scientific revolution in Europe as it shaped the enduring linear, cause-and-effect thinking, that is the antithesis to systems theory. Von Bertalanffy (1972) quoted Aristotle, who said that “the whole is more than the sum of its parts” (p. 407). He elaborates on this point as he says that “the properties and modes of action of higher levels are not explicable by summation of the properties and modes of action of their components taken in isolation. If, however, we know the ensemble of the components and the relations existing between them, then the higher levels are derivable from the components” (p. 411).

Systems are by nature abstract. However, systems can be better understood by identifying a systems ontology (i.e. what is a system? what are its boundaries?). An important feature of a system is that of its cohesion: That is, how elements in the system are interdependent on one another, such as an ecosystem. Systems ontology leads to systems epistemology (Von Bertalanffy 1969). Systems, however, have generally remained a philosophy until only recently as it is now recognised as a science (e.g. system dynamics and cybernetics).

Systems are most evident in biology, however, the field of psychology also bears similar connotations in the form of Gestalt theory, which infers that human psychology cannot be understood just by its analysing the relationship between stimulus and sensations. In explaining the catalyst of general systems theory (GST), derived mainly from the field of biology, Von Bertalanffy (1972) stated that “Since the fundamental character of the living thing is its organisation, the customary explanation of the single parts and processes cannot provide a complete explanation of the vital phenomena. This investigation gives us no information about the coordination of parts and processes. Thus, the chief task of biology must be to discover the laws of biological systems (at all levels of organisation). We believe that the attempts to find a foundation for theoretical biology point at a fundamental change in the world picture. This view, considered as a method of investigation, we shall call ‘organismic biology’, and as an attempt at an explanation, “the system theory of organism”” (p. 410). GST may be applied broadly as such as how the term evolution is used to refer to fossils, neurophysiological states and anatomy.
Von Bertalanffy (1955) argues that there is a difference between system science and the GST. System science is a theory about systems such as the systems found in biology and psychology, whereas GST is about the doctrine of principles that be applied to all systems. GST, in addition, provides a refocus on interrelationship and interactions. Von Bertalanffy (1950) attempted to address this by identifying a mathematical description to illustrate the dynamism of systems through the identification of system principles, such as the wholeness vs sum of parts, the nature of growth in systems such as allometry (growth of different parts at different rates), dynamism and mechanisation in systems, centralisation, isomorphism (to shape), trajectory of growth, teleology (purpose of the system), finality of systems (state of being irreversible) and equifinality (and end state can be attained by different means). Kast and Rosenzweig (1972) elaborate on the principles of GST as shown in Table 35.

**Table 35: Key concepts of general systems theory (Kast & Rosenzweig 1972)**

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subsystems or Components</td>
<td>A system by definition is composed of interrelated parts or elements. This is true for all systems—mechanical, biological, and social. Every system has at least two elements, and these elements are interconnected.</td>
</tr>
<tr>
<td>Holism, Synergism, Organicism, and Gestalt</td>
<td>The whole is not just the sum of the parts; the system itself can be explained only as a totality. Holism is the opposite of elementarism, which views the total as the sum of its individual parts.</td>
</tr>
<tr>
<td>Open Systems View:</td>
<td>Systems can be considered in two ways: (1) closed or (2) open. Open systems exchange information, energy, or material with their environments. Biological and social systems are inherently open systems; mechanical systems may be open or closed. The concepts of open and closed systems are difficult to defend in the absolute. We prefer to think of open-closed as a dimension; that is, systems are relatively open or relatively closed.</td>
</tr>
<tr>
<td>Input-Transformation-Output Model</td>
<td>The open system can be viewed as a transformation model. In a dynamic relationship with its environment, it receives various inputs, transforms these inputs in some way, and exports outputs.</td>
</tr>
<tr>
<td>System Boundaries</td>
<td>It follows that systems have boundaries which separate them from their environments. The concept of boundaries helps us understand the distinction between open and closed systems. The relatively closed system has rigid, impenetrable boundaries; whereas the open system has permeable boundaries between itself and a broader suprasystem. Boundaries are relatively easily defined in physical and biological systems, but are very difficult to delineate in social systems, such as organizations.</td>
</tr>
<tr>
<td>Negative Entropy</td>
<td>Closed, physical systems are subject to the force of entropy which increases until eventually the entire system fails. The tendency toward maximum entropy is a movement to disorder, complete lack of resource transformation, and death. In a closed system, the change in entropy must always be positive; however, in open biological or social systems, entropy can be arrested and may even be transformed into negative entropy—a process of more complete organization and ability to transform resources—because the system imports resources from its environment.</td>
</tr>
<tr>
<td>Steady State,</td>
<td>The concept of steady state is closely related to that of negative entropy. A</td>
</tr>
</tbody>
</table>
Dynamic Equilibrium, and Homeostasis

Closed system eventually must attain an equilibrium state with maximum entropy—death or disorganization. However, an open system may attain a state where the system remains in dynamic equilibrium through the continuous Inflow of materials, energy, and information.

Feedback

The concept of feedback is important in understanding how a system maintains a steady state. Information concerning the outputs or the process of the system is fed back as an input into the system, perhaps leading to changes in the transformation process and/or future outputs. Feedback can be both positive and negative, although the field of cybernetics is based on negative feedback. Negative feedback is informational input which indicates that the system is deviating from a prescribed course and should readjust to a new steady state.

Hierarchy

A basic concept in systems thinking is that of hierarchical relationships between systems. A system is composed of subsystems of a lower order and is also part of a suprasystem. Thus, there is a hierarchy of the components of the system.

Internal Elaboration

Closed systems move toward entropy and disorganization. In contrast, open systems appear to move in the direction of greater differentiation, elaboration, and a higher level of organization.

Multiple Goal-Seeking

Biological and social systems appear to have multiple goals purposes. Social organizations seek multiple goals, if for no other reason than that they are composed of individuals and subunits with different values and objectives.

Equifinality of Open Systems

In mechanistic systems there is a direct cause and effect relationship between the initial conditions and the final state. Biological and social systems operate differently. Equifinality suggests that certain results may be achieved with different initial conditions and in different ways. This view suggests that social organizations can accomplish their objectives with diverse inputs and with varying internal activities (conversion processes).

Skyttner (1996) argued that GST attempts to explain ‘systemness’ and can be classified as a meta-theory. He states that systems are not something that is presented to the observer but rather is something that the observer recognises and constructs.

There are many other definitions of systems such as something that is ‘unitary’, ‘all that is not chaos’ and a structured entity with subcomponents (Skyttner 1996).

There are, however, some criticisms of System theory and GST. Van den Berghe (1963) argues that systems are not new. He argues that the ‘structure-function’ approach (also known as the functionalist approach) has many similarities with GST.

For example, in using society as an example, he states that “Societies must be looked at holistically as systems of interrelated parts. Hence, causation is multiple and reciprocal. Although integration is never perfect, social systems are fundamentally in a state of dynamic equilibrium, i.e. adaptive responses to outside changes tend to minimize the final amount of change within the system. The dominant tendency is thus towards stability and inertia, as maintained through built-in mechanisms of adjustment and social control. As a corollary of dysfunctions, tensions and "deviance"
do exist and can persist for a long time, but they tend to resolve themselves or to be "institutionalized in the long run. In other words, while perfect equilibrium or integration is never reached, it is the limit towards which social systems tend. Change generally occurs in a gradual, adjustive fashion, and not in a sudden, revolutionary way. Changes which appear to be drastic, in fact affect mostly the social superstructure while leaving the core elements of the social and cultural structure largely unchanged. Change comes from basically three sources: adjustment of the system to exogenous (or extra-systemic) change; growth through structural and functional differentiation; and inventions or innovations by members or groups within society. The most important and basic factor making for social integration is value consensus, i.e., underlying the whole social and cultural structure, there are broad aims or principles which most members of a given social system consider desirable and agree on. Not only is the value system (or ethos) the deepest and most important source of integration, but it is also the stablest element of socio-cultural systems” (p. 696). Thus, according to Van den Berghe (1963), GST is not a radical departure from our existing understanding of systems such as a society.

In addition, Peery (1972) argues that GST is not a science as the propositions from GST are non-refutable. He also states that empirical evidence are selected based on its support for the theory. System theory is so broad that it allows for any examples to be selectively used. GST suffers from the Pygmalion effect as selected examples are those that fit the systems characteristics. In addition, he claims that GST is biased in suggesting that the goals of all systems is stability and maintenance. He also argued that most principles in GST are based on principles in biology, which is not necessarily applicable or transferable to other systems. For example, components in biological systems tend to work together and cooperate for the ‘greater good’ of the system. However, in social systems, each subsystems has its own goals and do not necessarily work together cooperatively.

Despite the criticisms that have been levelled against GST, this theory has many merits, especially in drawing attention to the presence of systems and their impact on all sciences. Von Bertalanffy (1972) criticises specialisation as the cause of silo mentality and myopia. The intention of GST was to bridge all sciences, such as physical and socials sciences, under one holistic approach, based on the concept of isomorphism. Isomorphism is a concept borrowed from biology to describe common attributes in which different streams of science tend to converge in bridging a general view of humankind with nature (Midgley 1992).
2.6.3. System Dynamics and Cybernetics

System dynamics and cybernetics are both part of the systems family of theories. It is not the intention of this section to review both fields in any detail, however, its introduction is to highlight their presence as major developments in the field of systems and their relationships with systems thinking. Systems dynamics was developed to understand complex systems (Forrester 1961) as one must first understand the dynamics of a system to be able to make predictions about the system (Lyons et al. 2003). Systems dynamics is learning by doing (e.g. via simulations) and is counter to systems thinking, which as its name suggest, is about thinking. Systems thinking and systems dynamics share many similarities although systems dynamics goes further and uses simulation to test systems (Forrester 1994).

Forrester (1994) argues that by actually modelling and simulating systems, systems dynamics can reveal things that are counter-intuitive, as he exemplifies “The most powerful influence on a city was shown to be the policy governing building of low-income housing. The United States has followed a policy that makes urban poverty worse. As a city ages, it becomes imbalanced. As industrial structures grow older, they are used in ways that employ fewer people. However, as housing ages, it drifts to lower rents and higher population densities. Building low-income housing accelerates the rate of decay. The “obvious” policy of building low-cost housing occupies land that could have been used for job-creating business structures while at the same time the housing attracts still more people who need jobs. The apparently humanitarian policy of building more housing actually creates poverty by pulling people into areas of declining economic opportunity” (p. 8).

Forrester (1994) adds that systems dynamics show that many events and phenomena are counter-intuitive, it follows that we cause most of our own problems as most people act on what we think is intuitive (i.e. rational, logical and at times popular). He provides an example as he posits, “Usually, problems exhibited by a social system are caused by the people in that system. However, people naturally tend to blame others. When Detroit was losing market share to Japanese automobiles, executives of American companies blamed Japan for dumping at low prices, when the real cause was Detroit’s own declining quality. Parents blame schools for low competence of students, when perhaps the deficiency arises more from preschool home life and failure in parental guidance. A company is more inclined to blame falling sales on
unfair competition or fickle consumers than on its own poor products and service” (p. 16-17).

Cybernetics, which is a field that is related to system dynamics and systems thinking, is a transdisciplinary field concerning systems that use feedback to self-regulate. Cybernetics is a field related to systems dynamics and concerns communications and control, where communications are signals represented as feedback (Vallee 2003). Vallee (2000) argued that cybernetics involves functional analysis, in particular control and communication, encompassing both positive and negative feedback. Negative feedback loops are crucial for system maintenance as Geyer (1995) cites an example in the form of “the well-known prisoner’s dilemma which, when played over several cycles, changes from a non-zero-sum game to a zero-sum one: at first, both prisoners tend to betray one another to maximize their own profit...both partners start empathizing with the other’s position after a while, and then both converge to what [is called] a tit-for-tat strategy: an honest move will be rewarded by an honest counter-move, and a dishonest one will be punished by a dishonest counter-move” (p. 11).

Montuori (2000) argues that the feedback loops emphasised in systems thinking and cybernetics parallels the concepts of single- and double-loop learning suggested by Argyris (2005), and the adaptive and generative learning suggested by Senge (1992). Muses (2000) posits that systems theory and cybernetics are the ‘conscience’ of science as both can help to simplify complexity or at least make systems more ‘manageable’. Rose (1994) suggests that cybernetics is about ‘the art of steering’, whilst Lunca (1999) states that cybernetics helps with problem solving by making problems more tractable. Problems can be rendered more tractable by reducing circularity in favour of more linearity. Cybernetics, however, recognises circular logic and it has the tools to deal with problems that are circular (Geyer 1995).
2.6.4.  **Hard and Soft System Methodologies**

There is another set of perspectives to systems studies that involve the dichotomous pairing of hard and soft systems methodologies. Hard systems methodologies are deterministic, rational, unitary and is teleological (purposive and based on an ‘ends approach’). Systems dynamics and cybernetics can be categorised as hard system methodologies due to their reliance on mathematics and operations research methods. Soft systems methodologies, are quite the opposite, as they are undeterministic, generally non-rational, assume pluralism and are deontological (means approach) (Wang & Ahmed 2003). The term soft systems methodologies (SSM) has been popularised by Checkland (1981) and is used as a nomenclature in describing systems that significantly consider the human element in their conceptualisation of systems.

Hard systems usually involve mechanistic entities, addressing routine tasks and problems in a deterministic environment. However, the world is complex and ambiguous, and is undeterministic (Wang & Ahmed 2003). Thus soft systems are more conducive for such complex environments. Hard systems adhere to logical procedures whilst soft systems are behavioural and are shaped by a multitude of factors that may not be entirely rational (e.g. human perception, attitude and motives). Hard systems are unitary as all components and parts work together for a single goal, whereas soft systems usually contain subsystems that have their own goals, which may sometimes compete against the goals of the overall system goals (e.g. humans polluting the earth). Hard systems are goal-driven and thus adopt a teleological perspective, whereas soft systems are about the *means* (deontological) such as human experiences. Table 36 elaborates on the distinction between hard systems methodologies and soft systems methodologies.
### Table 36: Hard systems vs soft systems methodology (Wang & Ahmed 2003)

<table>
<thead>
<tr>
<th>Hard systems methodologies</th>
<th>Soft systems methodologies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Deterministic</strong></td>
<td><strong>Undeterministic</strong></td>
</tr>
<tr>
<td>Appropriate in well-defined, obvious problems. The approach starts by asking what system is needed to solve this problem, and leads to the problem being solved.</td>
<td>Appropriate in ill-defined real world problems. The approach starts by exploring the problem domain, and allows unexpected results to occur in later stages.</td>
</tr>
<tr>
<td><strong>Rational (logical)</strong></td>
<td><strong>Non-rational (behavioural)</strong></td>
</tr>
<tr>
<td>Thinking in terms of technical problems. Managing is the decision-taking process.</td>
<td>Thinking in terms of human situations. People perceive and judge the facts based on personal, institutional and cultural factors. Managing is the sense-making process.</td>
</tr>
<tr>
<td><strong>Unitary (aggregate)</strong></td>
<td><strong>Pluralist/critical (disaggregate)</strong></td>
</tr>
<tr>
<td>Demonstrating focus on the technical interest of mankind by developing techniques for the control of natural and social processes (Ho and Sculli, 1994).</td>
<td>Guiding human interaction, promoting mutual understanding, and freeing people from unhealthy constraints imposed by power relations</td>
</tr>
<tr>
<td><strong>Teleological (an ends approach)</strong></td>
<td><strong>Deontological (a means approach)</strong></td>
</tr>
<tr>
<td>In organisational management contexts, hard systems methodology initially contributed to goal-seeking, focusing on the &quot;ends&quot;: the problem being solved.</td>
<td>Soft systems view the process of inquiry into a problem of complexity and ambiguity as an organised learning system, leading to a changed situation and new learning. The focus is on the 'means'.</td>
</tr>
</tbody>
</table>

Whilst both hard and soft systems methodologies inform systems thinking, the nature of soft systems methodologies render them more ‘sympathetic’ to systems thinking. This is because soft systems methodologies are generally considered as ‘a way of thinking’ (Checkland 1999). Checkland (1981) states that, in essence, soft systems methodologies incorporate the effects of human behaviour, attitude and perceptions. Thus, soft systems methodologies are more dynamic and varied. Checkland (2000) claims that soft systems methodologies have had more acceptance by academics and practitioners than has GST. He argues that soft systems methodologies concern systemicity and that is a form of an appreciative system of the Weltanschauung (or world view). System thinkers in soft systems methodologies are those that adopt multiple perspectives and ‘see’ different layers. Checkland (2000) argues that soft systems methodologies is a form of organisational learning.

Senge et al. (1994) argue that people’s thought processes go through stages that reflect the important role of people in epitomising the ‘soft’ aspects in systems, as shown in Figure 27. These stages are part of what Argyris (1983) calls the ladder of inference, which has seven steps. The first involves senses in observing ‘raw’ data and experiences, such as what a video recorder might do. Like a video recorder that can
only focus on one object at a time, people have tendencies to be selective of the ‘data’ that they are attentive to, which is the second step. The third step occurs when individuals start ‘adding’ to the data in terms of their previous experiences, and their personal and cultural lenses. Essentially these involve our own biases. Step four involves generalising and making assumptions based upon the meaning-making process in step three. In step five, individuals draw conclusions, in ‘making up their minds’. In step six, these ‘conclusions’ begin to fortify themselves in being ingrained in individuals’ psyche and they become beliefs. In the last and seventh step, individuals then ultimately take action behave based on these beliefs. Johannessen (1996) states that systems thinking acknowledges that bounded rationality exists and that people operate on partial knowledge.

```
“I take Actions based on my beliefs”
“I adopt Beliefs about the world”
“I draw Conclusions”
“I make Assumptions based on the meaning added”
“I add Meanings (cultural and personal)”
“I select ‘Data’ from what I observe”
Observable ‘data’ and ‘experiences’ (senses)
```

Figure 27: Ladder of inference (Senge et al. 1994)

Soft systems methodologies is a nomenclature that includes a variety of approaches and perspectives. Gao, Li and Nakamori (2002) identified a number of methodologies may be categorised as soft systems methodologies. The key methodologies are social system design (SSD) (Churchman 1970), viable system diagnosis (Beer 1972), interactive planning (Ackoff 1979), soft systems methodologies (Checkland 1981), strategy assumption surfacing and testing (SAST) (Mason & Mitroff 1981), critical systems heuristics (CSH) (Ulrich 1983), total systems intervention (TSI) (Flood &
Jackson 1991) and technical, organizational and personal perspectives (TOP) (Linstone 1994). The key points for each methodology are described in Table 37:

Table 37: Summary of soft system methodologies (Gao et al. 2002)

<table>
<thead>
<tr>
<th>Author</th>
<th>Methodology and key point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Churchman (1970)</td>
<td><strong>Social systems design (SSD)</strong></td>
</tr>
<tr>
<td></td>
<td>• Holistic perspective drawn from dialectic debate</td>
</tr>
<tr>
<td></td>
<td>• Thesis</td>
</tr>
<tr>
<td></td>
<td>• Antithesis</td>
</tr>
<tr>
<td></td>
<td>• Synthesis</td>
</tr>
<tr>
<td>Beer (1972)</td>
<td><strong>Viable systems diagnosis (VSD)</strong></td>
</tr>
<tr>
<td></td>
<td>• Identification, diagnosis, adaptation, and information flows</td>
</tr>
<tr>
<td></td>
<td>• Implementation</td>
</tr>
<tr>
<td></td>
<td>• Coordination</td>
</tr>
<tr>
<td></td>
<td>• Control</td>
</tr>
<tr>
<td></td>
<td>• Development</td>
</tr>
<tr>
<td></td>
<td>• Policy</td>
</tr>
<tr>
<td>Ackoff (1979)</td>
<td><strong>Interactive planning (IP)</strong></td>
</tr>
<tr>
<td></td>
<td>• Objectivity, participative principle, principle of continuity, and holistic principle</td>
</tr>
<tr>
<td></td>
<td>• Formulate the mess</td>
</tr>
<tr>
<td></td>
<td>• Ends planning</td>
</tr>
<tr>
<td></td>
<td>• Means planning</td>
</tr>
<tr>
<td></td>
<td>• Resource planning</td>
</tr>
<tr>
<td></td>
<td>• Design of implementation and control</td>
</tr>
<tr>
<td>Checkland (1981)</td>
<td><strong>Soft system methodology (SSM)</strong></td>
</tr>
<tr>
<td></td>
<td>• Learning, culture, participation, two modes of thought, and CATWOE (Clients, Actors, Transformation, Weltanschauung or worldview, Owner and Environmental constraints) analysis</td>
</tr>
<tr>
<td></td>
<td>• Enter situation</td>
</tr>
<tr>
<td></td>
<td>• Express the problem situation</td>
</tr>
<tr>
<td></td>
<td>• Formulate root definitions</td>
</tr>
<tr>
<td></td>
<td>• Build conceptual models</td>
</tr>
<tr>
<td></td>
<td>• Compare models with real-world action</td>
</tr>
<tr>
<td></td>
<td>• Define possible changes</td>
</tr>
<tr>
<td></td>
<td>• Take action to improve the problem situation</td>
</tr>
<tr>
<td>Mason and Mitroff (1981)</td>
<td><strong>Strategy assumption surfacing and testing (SAST)</strong></td>
</tr>
<tr>
<td></td>
<td>• Adversarial, participative, integrative, managerial mind supporting</td>
</tr>
<tr>
<td></td>
<td>• Group formation</td>
</tr>
<tr>
<td></td>
<td>• Assumption surfacing</td>
</tr>
<tr>
<td></td>
<td>• Dialectical debate</td>
</tr>
<tr>
<td></td>
<td>• Synthesis</td>
</tr>
<tr>
<td>Ulrich (1983)</td>
<td><strong>Critical systems heuristics (CSH)</strong></td>
</tr>
<tr>
<td></td>
<td>• Dialectical solution on what ought to be done</td>
</tr>
<tr>
<td></td>
<td>• 12 critically heuristic categories</td>
</tr>
<tr>
<td></td>
<td>• Polemical employment of boundary judgments</td>
</tr>
<tr>
<td>Flood and Jackson (1991)</td>
<td><strong>Total systems intervention (TSI)</strong></td>
</tr>
<tr>
<td></td>
<td>• Complementarism, sociological awareness, and human well-being and emancipation, system of systems methodologies</td>
</tr>
<tr>
<td></td>
<td>• Creativity</td>
</tr>
<tr>
<td></td>
<td>• Choice</td>
</tr>
<tr>
<td></td>
<td>• Implementation</td>
</tr>
</tbody>
</table>

212
<table>
<thead>
<tr>
<th>Author</th>
<th>Methodology and key point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linstone (1994)</td>
<td>Technical, organizational and personal perspectives (TOP)</td>
</tr>
<tr>
<td></td>
<td>• Multiple perspectives</td>
</tr>
<tr>
<td></td>
<td>• Technical perspective (scientific and technological)</td>
</tr>
<tr>
<td></td>
<td>• Organizational perspectives (unique group or institutional view)</td>
</tr>
<tr>
<td></td>
<td>• Personal perspectives (individual, the self-view)</td>
</tr>
</tbody>
</table>

The social system design by Churchman (1970) concerns the adoption of multiple perspectives in appreciating the whole. Beer’s (1972) viable system design assumes that a system design will only be useful if a variety of inputs is obtained. Ackoff’s (1979) interactive planning concerns obtaining input from all stakeholders so all views and perspectives may be considered, whilst Checkland’s (1981) soft system methodology emphasises the reiterative nature of systems and that systems are socially constructed. Mason and Mitroff’s (1981) model is similar to Ackoff and Checkland work (i.e. obtaining different views from participants in system design) although it was conceptualised to address complex problems. Ulrich’s (1983) critical system heuristic encouraged the use of heuristics to solve problems, whilst Flood and Jackson’s (1991) critical systems thinking concerns the emancipation of people to develop critical and social awareness. Finally, Linstone’s (1994) technical, organizational and personal perspectives provides a framework to incorporate the multiple levels of systems.

Wang and Ahmed (2003) argue that hard systems methodologies and soft systems methodologies are not dichotomous but are a continuum based on the ‘evolution’ of their development in encompassing more rich but subjective and granular principles. Figure 28 shows the granularity of systems methodologies ranging from hard systems to abstract and intangible systems such as ethical systems. Each of these systems is related to the degree of tangibility of a system’s components (e.g. hard systems with machine components, open systems in terms of relationships with the environment, appreciative systems with people’s meaning in their communication, soft systems with people’s enquiry, creativity, critical systems and the well-being of people with ethical systems) (Wang & Ahmed 2003). Wang and Ahmed (2003) argue that emotions are core to many soft system methodologies as humans are largely driven by socio-emotional systems (e.g. personality). Emotions should be equally considered and given credence in the assessment of any soft systems as they are linked to people’s values, well-being and learning.
Barton et al. (2004) argue that the many streams of systems theory e.g. system dynamics (Wolstenholme 1990), critical systems thinking (Flood 1990), and open systems thinking (Emery 2000), demonstrate that the field is maturing in some respects as the focus has now shifted from planning to evolution (from structure stability to dynamic stability). In addition, there are now many more tools and methods for practitioners to draw upon in practising systems thinking (Barton et al. 2004). Many more business have also developed more dynamic methods for managing their business and utilise more comprehensive and holistic ways of measuring performance.

The advent of more focused perspectives and concepts on systems thinking such as critical system thinking acknowledges the partial view that soft systems (i.e. people) have on the world, and how people ‘act’ on incomplete information. Barton et al. (2004) argues that systems thinking, which is a key development from the systems field, is becoming more important as it helps to address the complexity that is increasing all around us. Systems thinking is empowering as it enables us to understand interrelationships that provide a more meaningful understanding of a problem/situation (Barton et al. 2004).
2.6.5. Systems Thinking Skills

The previous discussion concerned systems and related theories and models that have evolved from the field. The discussion served as a context to the concept of system thinking, in illustrating its historical roots and the debates that accompany it. Nonetheless, the main focus of this study is system thinking.

Systems thinking originated from the work of Jay Forrester (1961) in systems dynamics, which involved how to make meaningful and effective changes in organisations. Systems thinking is a higher-order thinking skill (Frank et al. 2007) and involves ‘seeing the whole’ (Senge 1992). Systems thinking is known as a method, tool, language or framework (Senge et al. 1994). Nonetheless, irrespective of what it is called or termed, systems thinking provides a medium to shape the way we think and see. For example, by adopting a systems thinking view, we will be more aware of interrelationships (e.g. amongst events, people and places) as well as being aware of patterns of change through time rather than seeing snapshots. The key principles in systems thinking are ‘seeing’ the whole system, recognising the contribution of parts to the system, appreciating the synergy within the system (from its parts), and viewing the system from different and multiple perspectives (Frank 2002).

Barton et al. (2004) posit that there is a convergence of perspectives of systems thinking. The transdisciplinary nature of systems does not disregard or trivialise the importance of specific domain knowledge. Cabrera et al. (2008) suggest that systems thinking is about thinking systemically, rather than thinking about systems, which potentially necessitates expert knowledge in various fields. The term ‘systemic thinking’ is used synonymously with systems thinking (Barton et al. 2004).

Senge (1992) proposes that systems are about the whole rather than unilateral silos. Knowledge and information are critical in systems thinking as it requires drawing upon different domains to infer both the direct and indirect impacts of events on other areas. Systems thinking does not essentially require expertise of all subject matters but, as a start, compels an awareness of interdependencies. Mulej et al. (2004) argue that human will never attain holism due to our inherent cognitive limitations but efforts to adopt systems thinking will help alleviate the issues caused by reductionist thinking. However, there are principles that differentiate systemic and un-systemic (traditional) thinking. They summarise these characteristics and contrast each term against traditional modes of thought as shown in Table 38.
Table 38: The seven basic terms of systems vs. un-systemic thinking (Mulej et al. 2004)

<table>
<thead>
<tr>
<th>Systems Thinking</th>
<th>Un-systemic, traditional thinking</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Interdependence, relations, openness,</td>
<td>Independence, dependence closeness, a single viewpoint/system</td>
</tr>
<tr>
<td>interconnectedness</td>
<td></td>
</tr>
<tr>
<td>2 Complexity (and complicatedness)</td>
<td>Simplicity or complicatedness alone</td>
</tr>
<tr>
<td>3 Attractors</td>
<td>No influential force/s, but isolation</td>
</tr>
<tr>
<td>4 Emergence</td>
<td>No process of making new attributes</td>
</tr>
<tr>
<td>5 Synergy, system, synthesis</td>
<td>No new attributes resulting from relations</td>
</tr>
<tr>
<td>6 Whole, holism, big picture</td>
<td>Parts and partial attributes only</td>
</tr>
<tr>
<td>7 Networking, interaction and interplay</td>
<td>No mutual influences</td>
</tr>
</tbody>
</table>

Mulej et al. (2004) views on systems thinking have many commonalities with the views of other researchers. Many characteristics of systems thinking, such as relationships and dynamism, have been discussed by many theorists of systems thinking. Hall and Fagen (2003) argue that systems thinking depends on the scale (e.g. problem) as it involves problem identification and problem appreciation. Checkland (2000) states that in overcoming such an issue, the use of rich pictures can help to develop systems thinking skills. Nonetheless, Ballé and Jones (1995) stress that the implementation of systems thinking requires a lot of practice. The next two sections provide a discussion of two different, but not too dissimilar, views on systems thinking. Senge’s (1992) conceptualisation of systems thinking is primarily based on the recognition of structures and patterns whilst Cabrera, Colosi and Lobdell’s (2008) view of systems thinking is akin to fluid conceptualising.

2.6.6. **Systems Thinking in the Workplace**

In attempting to instil a workable ‘language’ in ‘implementing’ systems thinking, Senge (1992) argued that there are four levels in a system of which the systems thinker must be cognisant. **Events** that are the most observable, **pattern of behaviour** that occurs over time, **system** that ties in various patterns of behaviour together and **mental models**, all which underpin behaviour. Table 39 contains an example of how events, patterns, systems and mental models play a role in systems thinking from Senge’s (1992) book, ‘The Fifth Discipline’. 
In late 1992 Acme’s senior management team met to consider some individual events which had recently troubled the company. After the presentation ended, the executives sat silently for five minutes. Then everyone began to speak at once. “We’re way off our sales targets” said the senior vice president of marketing. “We’d better remind the salespeople that they’re still accountable for those targets if they want to get bonuses”. “We need new promotions and lower prices” said the senior vice president of sales. “Otherwise, we’ll have a hard time replacing our lost customers with new ones. I’d like to see us start delivering outside our service area, too”. “I understand the need to sell at low cost,” said the senior vice president of manufacturing, “but we’re getting really behind. With all our new special orders, we can’t do long production runs any more. That’s slowing us down. We’re also getting some technical problems with the equipment. Well do our best, but I warn you, we may have to think about adding resources.”

“No way,” said the general manager. “Our finances are too tight right now. You’ll have to make do with what you’ve got.” “Can’t we be proactive about this?” asked the CEO. “We can accept some investment if it will pay off and solve these problems”. It’s at this point, like many organizations that problem-solving stops and people jump to solutions. Acme’s senior managers did exactly that:

- They instituted a new system to speed up deliveries.
- To cut billing errors and improve customer service, they ordered improved training programs and rewrites of the operations manuals.
- To boost sales, they instituted new pricing promotions, allowed more nonstandard deliveries, established better sales incentives, and held motivational meetings, “to put fire under the sales force.”
- Unfortunately, profitability and sales dropped even more precipitously during the following three quarters.

Six months later, the senior management team met again. As before, they began to brainstorm about possible solutions, and single out targets for blame. Then the CEO said, “I’ve been curious about the trends” said the general manager “We seem to have a lot of seemingly unrelated factors here”. Senior management assigned a task force to research the patterns of behavior of the system over time. Instead of listing isolated events, the task force would select key variables and track them back three or four years. They tracked three patterns; Service Problems, Sales and Sales Force Efforts on New Accounts. Two weeks later, the general manager stood before them. “The trends are worse than we thought,” he said. “When we put all the figures and reports together, look at how our service problems have increased in the last few years”.

Manufacturing vice president: “I see why the sales force efforts cause service problems. We offer so many promises and special deals. If the customer wants it pink, we paint it. If they want it ten miles outside our normal delivery zone, we send the truck. This stresses the manufacturing and delivery functions”-pointing to the lower left-“and apparently it created havoc in customer service. But what’s the link between our service problems and sales?” [EVENTS]

General manager: “It’s not a one-on-one correspondence. Service problems can rise for a long time without any visible effect. But eventually customers hit a threshold point, where they’re too irritated to stay with us. You can see that threshold here”. “Despite our heroic efforts, they stopped buying from us”. [PATTERN]
Sales vice president: "As a result," he said "we focus even more on gaining more new customers. Which means service problems continue to go up, and sales eventually drop again, and we try even harder to get new accounts"

Marketing vice president: *Gloomily* "The harder we try to sell our products" said the marketing vice president gloomily, "the more sales we lose. It's a vicious spiral" [SYSTEMS]

CEO: Turns to the sales vice president. "Why do we keep doing this? How come, whenever sales drop, you push harder to get new customers?" It created havoc in customer service. But what's the link between our service problems and sales?"

Sales vice president: Walking to the board. "Well, we have to! We have to make our sales targets!" [MENTAL MODEL]

There was no need to say more. Acme annually set sales targets as part of their planning process. As each year unfolded, management would monitor these. If sales fell below the targets, pressure would arrive, in the form of incentives and bonuses, to get sales "back on track". It soon became clear that quick policy reforms, in themselves, would not achieve the desired results. The leverage, everyone realized, is the mental models of their employees—the prevailing motivations and assumptions held (and generally unvoiced) by people, which had allowed this system to remain in place so long, despite the harm it was doing to the company. Underlying almost every link of the cycle is a key assumption (shown as a thought balloon). Salespeople tacitly assumed that their job was primarily to “do whatever it takes to get a new customer”, which kept the pressure on Customer Service. The service staff generally assumed that salespeople were out of touch with the company’s needs. Neither group felt any responsibility to understand the other group’s activities or priorities. Changing this mental model might involving reshaping the compensation and incentive system, but it would also require shifting deeply held attitudes about the sales forces’ relationship with the rest of the company.

It took Acme senior management several months to find ways to deal effectively with their problem. They restructured sales targets: one of the few places where senior management had immediate leverage. They moved some their marketing people to a customer service task force, and invested even more in customer surveys and increasing delivery reliability. They established a quality-oriented initiative in manufacturing, with an emphasis on increasing flexibility. Finally, they continued to track trends and patterns of behaviour – with an eye to the systems underneath. This helped them close watch on which of their interventions were most worthwhile.

Senge (1992) argues that fixating on current events is misleading and cultivates myopia. Besides the breadth of sub-systems, that eludes most of us, systems are also structures with history that have been established into its own order. Structure is an aspect of systems that are deemed as a permanent configuration that has been reinforced over time (Senge 1992). Events, cultures and behaviours have rich, interconnected histories that intertwine to evolve to the matter that we know, as of today. History provides an explanation to the evolution of systemic structures that underlie most behaviours, cultures and
events. The blame on external events for organisational woes is convenient (Forrester 1994). A systemic structure may be described in many ways; as a paradigm, an approach or a method.

The concepts of interrelatedness and connectedness stem from the principle that systems must be understood as a whole, and as part of a system, feedback loops exist in influencing other parts of the system. Systems theories are underpinned by the principles of feedback and servo-mechanism from the fields of cybernetics and engineering, respectively. The principles of feedback and servo-mechanism suggest that there is a continuous reciprocal flow of influence within systems (Senge 1992).

Cusins (1994) argues that the key role that systems thinking plays in quality management, as an example, is that of feedback in ensuring that the subjective meaning of quality is captured by organisations and reflected in their value propositions. However, he also emphasises the difference between managerial and operational roles in quality management. He states that systems thinking at management level is generally conceptual and usually concerns superordinate systems and is composed of more than one system whereas at the operational level it involves mostly the physical/tangible aspects of a system (e.g. inputs) (Cusins 1994). Table 40 further elaborates these differences.
Table 40: Differences between Managerial and Operational Systems (Cusins 1994)

<table>
<thead>
<tr>
<th>Phase</th>
<th>Managerial</th>
<th>Operational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input</td>
<td>Inputs tend to be conceptual, often cited in the future, and general in nature. E.g. future business trends, technological advances, or economic variables space</td>
<td>Inputs tend to be tangible, immediate, and specific in nature. E.g. resources, tools, raw materials, working</td>
</tr>
<tr>
<td>Transformation process</td>
<td>Work almost exclusively related to concepts and information. Trends and beliefs about the future are transformed into visions and strategies, i.e. general descriptions of where they want the company to go, and how the company will get to where they want it to be</td>
<td>Work more physically related to materials and tangibles. Described more specifically, i.e. as procedures or job instructions. Listed as specific observable action steps to be taken in transforming the inputs into outputs</td>
</tr>
<tr>
<td>Outputs</td>
<td>Almost exclusively words, combined in a variety of ways, and which are very general in what they describe e.g. goals, policies, strategies, etc.</td>
<td>Almost infinite variety of tangible products, and some words, which are mainly specific in what they describe e.g. goals, policies, strategies, etc.</td>
</tr>
</tbody>
</table>

Cusins (1994) argues that it is important to recognise the difference between management and operators’ roles in the transformation process as this helps to delineate the roles in ensuring that quality is managed effectively. Cusins (1994) argues that total quality management is a judgement call in identifying the subjective boundaries of a system. Identifying the system boundaries is crucial as only then can management identify the inputs and outputs (both are relative depending on where the boundaries are drawn as an input into one system is an output of another).

Cusins (1994) states that systems thinking helps to improve quality management systems through job-related learning by acknowledging that both hard and soft systems play a role in the quality process. Hard systems are systems that involve machines and are easy to address, however, soft systems involves humans e.g. facets of people such as perception and attitudes, which is much more difficult to discern and address. Managing quality thus means that one has to manage people as well as machines. Cusins (1994) goes as far as to say that quality management is a myth because quality management is essentially effective people management. Last but not least, recognising that systems require feedback to maintain equilibrium informs quality management professionals that managing feedback loops are essential,
especially for people who are involved in understanding performance levels in terms of the organisation, production and their own learning and thereby performance.

Gao et al. (2002), in turn, argue that organisational learning can only occur with effective knowledge management processes in place. They further argue that soft systems methodologies can be used to manage knowledge acquisition, creation and dissemination. This is supported by Johannessen (1996) who views systemic thinking as the foundation of knowledge management and organisational learning. Table 41 below illustrates how various knowledge management subsystems can be supported by various soft systems methodologies. Soft systems methodologies play a crucial role in knowledge management as the most difficult part of knowledge management is managing the ‘soft aspects’ (e.g. person-to-person tacit knowledge exchange). Soft systems methodologies provide a philosophy and approach that can help organisations to enhance their knowledge management processes and organizational learning (Gao et al. 2002).
Table 41: Systems methodology and knowledge system (Gao et al. 2002)

<table>
<thead>
<tr>
<th>Knowledge subsystem</th>
<th>Embodied in</th>
<th>Function</th>
<th>Criteria</th>
<th>Management in action</th>
<th>Soft system method²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values, culture, ethics and moral</td>
<td>Corporate vision strategy, regulation, discipline rule and evaluation and reward system</td>
<td>Ability to apply and create knowledge</td>
<td>Humanity, fairness and honesty</td>
<td>Cultivate and nurture: trust, team spirit, and learning and share knowledge</td>
<td>SSD, IP, SSM, SAST, VSD, CSH, TSI, TOP</td>
</tr>
<tr>
<td>Scientific aspect</td>
<td>Words or electronic medium like reports, papers, patents and copyright</td>
<td>Industrial fields</td>
<td>Justification and falsification</td>
<td>Identify, precognition, direction, protect, support, promotion and motivation</td>
<td>SSD, IP, SSM, SAST, VSD, CSH, TSI, TOP</td>
</tr>
<tr>
<td>Technical aspect</td>
<td>Producing or working procedures, and words or electronic medium like reports, papers, patents, copyright, and manuals</td>
<td>Status in Industry</td>
<td>Advancement, new and applicability</td>
<td>Identify, precognition, direction, protect, support, promotion and motivation</td>
<td>SSD, IP, SSM, SAST, VSD, CSH, TSI, TOP</td>
</tr>
<tr>
<td>Managerial aspect</td>
<td>Corporate regulations, rules, structure, procedures, daily management activities, expert systems, decision-support system</td>
<td>Effectiveness and efficiency</td>
<td>Performance and applicability</td>
<td>Identify, codify, share, dissemination. Promotion and motivation</td>
<td>SSD, IP, SSM, SAST, VSD, CSH, TSI, TOP</td>
</tr>
<tr>
<td>Information</td>
<td>Information systems, management information system, organizational memory and knowledge repository</td>
<td>One of the main foundations of knowledge</td>
<td>Reliability and simplicity</td>
<td>Direction, support and motivation</td>
<td>Information science and theory</td>
</tr>
<tr>
<td>Data</td>
<td>Database and data warehouse</td>
<td>Foundation of information</td>
<td>Objectivity, accuracy and reliability</td>
<td>Direction, support and motivation</td>
<td>Information science and theory, data mining, and knowledge discovery in database</td>
</tr>
</tbody>
</table>

² Social systems design = SSD, Viable systems diagnosis = VSD, Interactive planning = IP, Soft system methodology = SSM, Strategy assumption surfacing and testing = SAST, Critical systems heuristics = CSH, Total systems intervention = TSI, Technical, organizational and personal perspectives = TOP
The discussion concerning systems thinking in relation to systems, as a tool enabled by a body of knowledge, fits well with the notion of knowledge creation and management that demonstrates its strong association with learning, specifically job-related learning.

The application of systems thinking in organisations also facilitates creativity. Few would doubt the potential helpfulness of systems thinking in addressing the complexity faced in organisations (Funke & Frensch 1995), especially when certain concepts such as dynamism intertwine between the two (systems and complex problems). Although many scholars (e.g. Mulej et al. 2004) have indicated the applicability and relevance of systems theory to organisations, there are limitations because the conceptualisation of organisations as systems is not straightforward. For example, Kast and Rosenzweig (1972) argue that GST cannot be applied to organisations as a whole as GST has a very different set of premises that are based on living organisms whilst organisations are not living organisms but are contrived entities. The comparison and use of ecology as an analogy to organisations must be limited as organisations may be systems but they are not natural systems. As Katz and Kahn (1966) state, “Social structures are essentially contrived systems. They are made of men and are imperfect systems. They can come apart at the seams overnight, but they can also outlast by centuries the biological organisms which originally created them The cement which holds them together is essentially psychological rather than biological. Social systems are anchored in the attitudes, perceptions beliefs motivations, habits, and expectations of human beings” (p 33). In addition, Rapoport and Horvath (1968) argue that the difference between organisation and an organisation as they state that “we see organization theory as dealing with general and abstract organizational principles; it applies to any system exhibiting organized complexity. As such, organization theory is seen as an extension of mathematical physics or, even more generally, of mathematics designed to deal with organized systems. The theory of organisations, on the other hand, purports to be a social science, it puts real human organizations at the center of interest. It may study the social structure of organizations and so can be viewed as a branch of sociology; it can study the behavior of individuals or groups as members of organizations and can be viewed as a part of social psychology; it can study power relations and principles of control in organizations and so fits into political science” (pp. 74-75).

Despite these criticisms, systems theory and systems thinking helps to further illuminate our understanding of organisations such as the inter-relatedness and interconnectedness of subsystems in the organisation and external factors in the suprasystem (Bogdanov 2003). In addition, instead of finding root causes, systems thinking informs us to identify levers,
and highlights that specialism causes myopia and this must be reflected on (Bogdanov 2003). In addition, Schwaninger (2001) argues that systems thinking and cybernetics provide a solid basis for developing trans-discipline management education (curriculum and research) with other social sciences such as public management and law, which is essential as a good model of management must reflect high levels of variety due to the complex nature of organisations. In addition, Schwaninger (2001) states that there are various levels in the management of organisations, which also reflect the layers that are present in systems. Schwaninger (2001) states that “At the three levels of management, different criteria of organisational fitness apply; (1) at the operative level, the criterion is that of efficiency, mainly in terms such as productivity, profitability and quality; (2) at the strategic level it is effectiveness in both the competitive and the cooperative sense; and (3) at the normative level it is legitimacy, defined as the ability to fulfil the claims of all relevant stakeholders” (p. 1214). Vallee (2003) proposed that the interrelatedness between observation, cognition and action needs to be considered together, where the ‘observer’ plays a central role. The systems thinker can be part of the system. If the systems thinker becomes part of the system, he/she will inevitably influence the system. Hence, it is crucial to be aware of and to anticipate one’s cognitive inclination.

2.6.7. Systems Thinking Dispositions

This section concerning systems thinking disposition draws primarily on the work of Frank (2010), specifically in his research in identifying the dispositions and capacity for systems engineering. Frank (2002; 2006; 2007), in turn, draws on the work of various scholars such as Senge (1992). Frank et al. (2007) argue that systems thinking is about optimisation not maximisation. Trade-offs are inherently present in systems, and that there are leverage points in systems that involve minimum effort but effective outcomes. Frank et al. (2007) developed the Capacity for Engineering Systems Thinking (CEST) Scale to assesses competencies for systems engineering (e.g. systems design). They argue that there is a precedent in terms of a systems approach in professional development. For example, the Project Management Institute’s (PMI) Project Management Body of Knowledge (PMBOK) contains references to the need to think in a systems manner for the successful completion of projects (Kerzner 2006). Frank et al. (2007) cites the Project Management Institute (2004) definition of systems as “as an integrated set of regularly interacting or interdependent components created to accomplish a defined objective, with defined and maintained relationships among its components and the whole producing or operating better than the simple sum of its components” (p. 37). Frank (2010) identified cognitive dispositions of successful systems professionals (i.e. engineering and information technology), in Table 42.
Table 42: General cognitive characteristics of successful systems professionals  
(Frank 2010)

<table>
<thead>
<tr>
<th>System engineers (Frank 2006)</th>
<th>IT System Professionals (Frampton, Thom &amp; Carroll 2006)</th>
<th>System engineering architects (Di Carlo &amp; Khoshnevis 2006)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding the whole system and seeing the ‘big picture’</td>
<td>Generalist</td>
<td>Whole brain thinking</td>
</tr>
<tr>
<td>Understanding interconnections</td>
<td>Creative</td>
<td>Creative</td>
</tr>
<tr>
<td>Understanding complex systems</td>
<td>Entrepreneurial</td>
<td>High tolerance for ambiguity</td>
</tr>
<tr>
<td>Think creatively</td>
<td>Able to think abstractly</td>
<td>Tolerance for incompleteness</td>
</tr>
<tr>
<td>Understanding the system without ‘getting stuck into the details)</td>
<td>See/ understand multiple viewpoints</td>
<td>Multifaceted</td>
</tr>
<tr>
<td>High tolerance for ambiguity</td>
<td>Open minded</td>
<td>Curious</td>
</tr>
<tr>
<td>Understand implications for change</td>
<td>Curious</td>
<td></td>
</tr>
<tr>
<td>Able to quickly gain insight to how a system works</td>
<td>Analytical</td>
<td></td>
</tr>
<tr>
<td>Understand analogies/ parallelism/ isomorphism between systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Able to adopt multiple perspectives in understanding a system</td>
<td>Curious, innovators</td>
<td></td>
</tr>
<tr>
<td>Considers other aspects of a systems (e.g. managerial, operational)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Engineering systems thinking involves the competencies of the ability to grasp the ‘big picture’ in understanding the whole. This involves comprehending the contribution of parts to the system, the interrelationships and synergy within the system (from its parts), and knowing the implications due to modifications of the parts in the system. In addition, engineering systems thinking encompasses the disposition to adopt different, broad and multiple perspectives (e.g. technical and managerial), and the capacity to acquire and apply knowledge from different disciplines. An engineering systems thinker should also possess effective analytical skills in understanding the environment that a system belongs to (e.g. suprasystem) and its ‘requirements’, and be an effective learner.
Systems thinking disposition must include the capacity to see the ‘whole’. Frank (2002) states that “The whole system is more than just the sum of its parts” (p. 1353), which is understanding and considering the whole system, and how each part/component inter-relates with other parts (Waring 1996). This is crucial in terms of problem solving as problems may not be solved by breaking the system down into its component parts. A problem may be due to the underlying structure of a system and/or the inter-relationships between its parts.

Having the disposition and capacity for system thinking will help the individual, as posited by Frank (2002), to be cognisant of the contributions of the various parts to the system. Whilst a system is more than just the sum of its parts, it is still nonetheless important to identify subsystems and their functions within the system as it enables one to better understand the system. Subsystems have may have different ‘modes of operations’. Some of the interconnections within the systems may not be observable. Inter-relationship can be viewed as a hierarchy and/or peer-to-peer (Frank 2002). In addition Frank (2006) argues that individuals must also recognise the synergy within the system (from its parts). Only by understanding the whole system and its parts, will an individual be able to comprehend the synergy that occurs within the system. Synergy is one of the most crucial aspects of systems, although it can be difficult to identify.

The ability to identify implications due to modifications of parts in the system infers that one understands the implications on the system of changing one part of a subsystem. Individuals with the disposition and capacity for systems thinking will also appreciate complexity better as systems are dynamic and not static. Frank (2002) states that “Dynamic complexity exists when a certain operation results in a certain series of consequences in one part of the system and a totally different series of consequences in other parts of the system. Dynamic complexity also exists when regular intervention produces results that are irregular” (p. 1354). Thus individuals with the disposition and capacity for systems thinking will also seek to gain inter- and multi-disciplinary knowledge.
2.7 **Multiple Perspective-Taking**

Multiple perspective-taking disposition is a type of higher-order thinking disposition and is an independent variable in the research model. This sub-section contains a discussion on the various definitions and forms of multiple perspective-taking to help understanding of the construct, namely, cognitive, affective and perceptual perspective-taking. This understanding is supported by a discussion of its antecedents in framing, ‘formulation’ and insight generation. This sub-section then examines a key existing measure of the construct, which helps to inform and justify the scale adopted for this study (further discussed in the Research Methodology chapter).

Johnson (1975) states that perspective-taking is “the ability to understand how a situation appears to another person and how that person is reacting cognitively and emotionally to the situation” (p. 241). Gorenflo and Crano (1998), alternatively, posit that perspective-taking as the capacity to “take on multiple perspective when processing information or forming decisions” (p. 164). Parker and Axtell (2001) argue that perspective-taking is essentially adopting another person’s view on a particular subject, whilst Barsalou (2008) conceptualise perspective-taking as a cognitive process that is motivated (targeted) and situational. These definitions indicate that multiple perspective-taking involves the ability to adopt different viewpoints, and may be viewed as a higher-order thinking construct.

Perspectives may take different shapes and forms such as different levels (e.g. individual, group or organizational), stages in a process (e.g. design, prototyping, production and sales) and roles (e.g. subordinate, manager, supplier and customer). Litchfield and Gentry (2010) posit that a perspective is a point of view that is a combination of knowledge and perception that is targeted at a particular subject or goal. They further argue that a perspective is developed by virtue of experience. For example, two individuals may have the same type and degree of knowledge, however, because their experiences in the application of the knowledge are different, their perspectives will differ.

The varied experiences of individuals result in unique ‘units’ of knowledge, which are stored in memory. However, how these units (also called exemplars) are subsequently structured is dependent on an individual’s ongoing experience (Nosofsky 1988), which then further shapes the individuals’ knowledge thereby increasing the uniqueness of the
Litchfield and Gentry (2010) use the example of individuals who have undergone similar professional training but who work in different cultural environments. When individuals work in systematically varied environments (e.g. different countries), their perspectives are almost assured to be different even if they perform the same job. However, individuals who undergo similar professional training over a substantial period will tend to have similar perspectives. Litchfield and Gentry (2010) also note that goals also play an important role in shaping perception. For example, professional managers and academics researching management may have similar preliminary training; however, as their professions have different goals, their perceptions and perspectives of management will diverge.

2.7.1 Higher-Order Cognition

Piaget (1932), in one of his experiments, demonstrated how age plays a role in perspective-taking, with only older children being able to do so compared to younger ones. Indeed, Harvey, Hunt and Schroder (1961) argued that being able to flexibly and accurately adopt multiple perspectives is an indication of higher-order thinking and the ability to deal with complexity. Perspective-taking is thus argued to be a form of higher-order thinking, and enables individuals to not only be cognisant of other aspects of knowledge but also to develop empathy, which is said to have played a major role in the development of the social capacity and intelligence amongst humans (Mead 1934; Piaget 1932). Bartunek, Gordon and Weathersby (1983) posited that ‘as people progress developmentally, their also thinking becomes more complex and abstract and, paradoxically, also more precise and specific. Correspondingly, they become increasingly able to empathize with others who hold conflicting views’ (p. 274).

Hyun and Marshall (1997) argue that perspective-taking is a crucial skill that is a catalyst to the development of other important capacities and skills such as knowing oneself and one’s limitations, self-concept and self-esteem, effective communications and effective social skills. In addition, they also posit that multiple perspective-taking plays an important role in negotiation as it helps in imagining the position of other parties and thereby, in turn, putting oneself in a more informed position. Figure 29 below illustrates the role that multiple perspective-taking plays in self-development:
**First-person perspective-taking = Single perspective-taking**

Egocentrism, ethnocentrism and cultural myopia direct the person's thinking and behavior. Knowing about self and examining one's own cultural paradigm, which has formed one's thinking and behaviour, are limited. Expectations of others' sense making of living, learning, problem-solving approaches, etc., are based on one's point of view, which is derived from one’s background. Inappropriate or unfair value judgements regarding others may occur in the person's social interaction.

**Second-person perspective-taking = Bi/Cross perspective-taking**

Ability to comprehend and assume that another person might have a different but equally reasonable perspective. Knowing about self and examining one’s self (e.g. own cultural) paradigm are active and ongoing, simultaneously, in a one-to-one interaction. Expectations of others’ sense making of living, learning, problem solving approaches, etc., which are based on one's point of view, are reconstructed and changed. Personal, ‘inner negotiation’ with the other person who is in contact occurs frequently, leading one to develop cross-cultural competencies and be willing to solve conflicts with others.

**Third-person perspective-taking = Multiple perspective-taking**

Ability to step out of one’s own (e.g. cultural) paradigm and assume that the existence of multiple realities inevitably leads to divergence in all human endeavour. Expecting diverse and multiple ways of making sense of living or learning provides problem-solving approaches in any social context. Realising that there was, are, and always have been different views derived from each individual’s unique background (e.g. culture). This realization leads to a willingness to explore, learn about, and respect diverse perspectives from various practices.

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**Figure 29: Perspective-taking and self-development (adapted) (Hyun & Marshall 1997)**

Litchfield and Gentry (2010) argue that perspective-taking is an imaginative process that requires individuals to be able to visualise in their minds the views of others, almost akin to metaphorically standing in the shoes of others (Storms 1973). The imaginative process is informed by the work of Barsalou (2008) in grounded cognition, which states that our minds are able to simulate actions and behaviours. Being able to effectively imagine the views of others can be construed as a higher-order ability and the process of imagination can be cognitive, affective and perceptual, which are discussed in more detail below.
2.7.2 **Cognitive, Affective and Perceptual Perspective-Taking**

There are three types of perspective-taking (Underwood and Moore, 1982). Multiple perspective-taking is partly viewed as either cognitive or affective (Parker & Axtell 2001), and in some cases perceptual (Litchfield & Gentry 2010). Multiple perspective-taking is a cognitive process that involves intellectually knowing the shape and form of another party’s perspective (Fagley, Coleman & Simon 2010). This form of cognitive process results in the expansion of knowledge. Litchfield and Gentry (2010) state that cognitive perspective-taking involves imaginative processes. Cognitive perspective-taking is a natural process as we gain knowledge about different aspects of life due to our own experiences (Carlile & Rebentisch 2003).

The other form of perspective-taking is affective perspective-taking, which is more popularly known as empathy. Affective perspective-taking essentially involves understanding the feelings of others. In some sense, affective perspective-taking does not only involve understanding the viewpoint of another but also involves respecting their views (Johnson 1975). Both cognitive and affective perspective thinking are reflected in Selman’s theory of social perspective-taking, which is essentially a cognitive process in imagining what another individual is thinking and feeling (Selma, 1980).

A less common type of perspective-taking is perceptual perspective-taking. Perceptual perspective-taking is of a visual/spatial form. This form of perspective-taking is usually embedded in the communication process, and is observed as an inquiring process across multiple perspectives (Storms 1973; Litchfield & Gentry 2010).

Both cognitive and affective perspective-taking are not mutually exclusive. Scholars have argued that cognitive and affective perspective-taking are linked with one another (Litchfield & Gentry 2010; Parker & Axtell 2001; Barsalou 2008). Parker and Axtell (2001) argue that affective perspective-taking is linked to moral development as they argue that individuals progress from being egocentric to more considerate, which is facilitated by their cognitive development to be able adopt the perspective of others and be more empathetic.

In another example, individuals who are adept at role-taking are not only able to imagine themselves in understanding the viewpoints, judgements and decision making of others, but by virtue of this cognitive perspective-taking, will also start to envisage how others may have felt. Hence, the intellectual process of perspective-taking helps to influence
empathy, which is affective perspective-taking. A subsequent impact of empathy is being able to make accurate attributions of the target individual’s behaviours. Empathy enables individuals to better understand the motives, capabilities and constraints of the other person, and thereby be able to know what they are capable of or not, what is possible or not (Parker & Axtell 2001).

Multiple perspective-taking can be developed as well as assessed. Weingartner and Klin (2009) demonstrate how perspective-taking can be developed using the simple activity of reading. They developed a vignette with two scenarios as part of a quasi-experiment and recruited students as participants. The vignette is provided in Table 43. Students were asked if the message in the vignette “Budget Movers certainly live up to their reputation” is sarcastic or sincere for the two scenarios, with positive and negative disambiguation information provided in each scenario. The disambiguation information in both scenarios was not accessible to Paco, one of the main characters in the vignette, which means that participants should have interpreted the message differently for both scenarios (i.e. one sarcastic and the other sincere) by tracking Paco’s perspective in the reading. Participants that provided the correct answers demonstrated effective perspective-taking ability (i.e. Paco’s perspective).
Bill recently accepted a job in North Carolina. He had lived in his New York apartment for five years, and had accumulated many things. Moving to North Carolina was going to be a huge task, so he arranged to get estimates from some professional movers. Bill was on a tight budget, so he was pleased with the low estimate from Budget Movers, the company his friend Paco recommended. This company also guaranteed to move his belongings with care, and assured Bill that nothing would get damaged. Several workers from Budget Movers arrived two weeks later, just as Bill finished packing.

Disambiguating Information:

Negative Event version
To make it to their next destination on time, the workers rushed to load Bill’s belongings into the truck. Several pieces of furniture were scratched, and two boxes were lost.

Positive Event version
Bill’s apartment was their last destination, and they were very careful loading his belongings into the truck. Not one piece of his furniture was scratched, and all of his boxes made it safely.

Backgrounding: Once Bill got settled into his new apartment, he wrote an email to Paco in New York, saying that

Critical Message: “Budget Movers certainly live up to their reputation.”

Conclusion: Paco wrote back two days later. He asked Bill what he thought of North Carolina.

2.7.3. Perspective-Taking, Framing and Formulating
Perspective-taking and framing are concepts that are interlinked, as adopting different perspective may help individuals to be able to frame a problem in multiple ways. For example, Cohen, Shumate and Gold (2007) cited the case of reframing the consequence of smoking to discourage people from smoking. Advertisements that framed smoking as a health concern did not have as much of an impact compared to framing smoking as a social problem that leaves smokers as social outcasts. In the context of problem solving, Einstein said that it better to spend more time framing and formulating the problem as this then shortens the time to solve it (Einstein & Infeld 1938).
Framing involves shaping the choices that are conveyed to a decision maker, by formulating the choices (i.e. how the problem is articulated and presented) (Baer et al. 2013). Quesada et al. (2005) assert that framing and formulation are critical aspects of any problem-solving process. They state that part of the issue with problem solving is in the understanding and framing/formulation of the problem. They state that this infers that some problems are in essence understanding-based problems, whilst some are search-based. The former intimates that simply understanding the problem will go a long way in solving it (i.e. structuring the problem in a way that helps the problem solver to potentially apply well-known solutions to it). Search-based problems, on the contrary, relate to problems that require more information, and requires going beyond just ‘better understanding’ the problem.

2.7.3.1. Framing

Whilst they are distinct, framing and formulating the problem are inextricably linked and dependent on one another. An example may be found in a seminal experiment by Kahneman and Tversky (1984), which led to the development of Prospect Theory. In demonstrating that rationality is not an omnipresent factor when people make decisions, they also showed that people reacted differently depending on how the problem and the subsequent solution is framed. In their famous experiment, they posed these two problems to undergraduate students:

Problem: Imagine that the US is preparing for the outbreak of an unusual disease, which is expected to kill 600 people.

- If Program A1 is adopted, 200 people will be saved (72%)*.
- If Program B1 is adopted, there is a one third probability that 600 people will be saved (28%).
- If Program A2 is adopted 400 people will die (22%).
- If Program B2 is adopted, there is a one third probability that nobody will die and two thirds probability that 600 people will die (78%).

* (numbers in parentheses indicate the percentage of respondents choosing a particular program).
Note that the “1” programs are framed in terms of saving live whereas the “2” programs are framed in terms of people dying. The results of the study showed that, while Programs A1 and A2, and Programs B1 and B2 are equivalent, the responses to the programs were different based on how the outcome was framed. When the outcome was framed in a positive, less-risky manner, a majority of the respondents selected Program A1 over Program A2. When the outcome was framed in terms of the probability of a high negative occurrence, most respondents selected Program B2 over Program B1. Tallman and Gray (1990) concluded that the selection of an option is dependent on how the possible outcome is framed. The implication of framing an outcome can also be extended to how problems are framed. The quasi experiment also illustrates how emotions play a major role in decision making.

Tversky and Kahneman (1981) argued that different frames (i.e. options) influence the way people perceive their options from unique vantage points, which then changes the perspective adopted. In the example presented, the different frames influenced the way participants viewed gains and losses. Framing primes individuals to adopt a certain perspective as they provided an analogy that links framing with perspective-taking:

"Alternative frames for a decision problem may be compared to alternative perspectives on a visual scene. Veridical perception requires that the perceived relative height of two neighbouring mountains, say should not reverse with changes of the vantage point. Similarly, rational choice requires that the preference between options should not reverse changes in frame. Because of imperfections of human perception and decision, however, changes of perspective often reverse the relative apparent size of objects and the relative desirability of options" (Tversky and Kahneman, 1981, p. 453)

Fagley et al. (2010), in interpreting this relationship between framing with perspective-taking, argue that frames shape the perspectives that individuals adopt, which in turn impacts on the perceived desirability of options and ultimately on the choices individuals make. The effects of framing can be mitigated as Fagley et al. (2010) state that individuals who are adept at multiple perspective-taking are able to switch perspective to match with the frames conveyed thereby nullifying the effects of framing.

2.7.3.2. Formulating and Insights

The framing of a problem inevitably impacts on how the problem is formulated. Problem formulation is the way a problem is defined and articulated (DeYoung et al. 2008). Problem formulation through restructuring and reorganisation is underpinned by the
Gestalt theorem (Wertheimer 1959), and is a form of productive thinking (applying experience from the past to solve problems is called reproductive thinking) (Adeyemo 1994). Problem formulation involves the identification of the current state, the goal (i.e. the future state), the constraints and the operators (e.g., procedures) in achieving the goal (Newell & Simon 1972). With problems that are well defined, the formulation is evident and is a given. For example, all aspects of the problem (i.e. the current state, goal, constraints and procedures) are sufficiently clear and the inability to solve the problem is potentially due to the lack of resources rather than because of the problem itself (DeYoung et al. 2008).

With ill-defined problems, the current state, goal and operators may be uncertain and/or opaque, such as many problems in life (Voss & Post 1988). In such situations reformulating or reframing the problem helps to solve the problem (DeYoung et al. 2008). Einstein noted that the formulation of the problem is more important than the solution (Einstein & Infeld 1938). Einstein asserted that how a problem is framed determines how easy or difficult it is to solve it.

DeYoung et al. (2008) state that sagacity is the key quality in problem formulation in determining aspects of the situation that are relevant, which is often the most complicated part of problem solving. Ill-defined problems become apparent when the problem solver is not able to define the current state or articulate future goals, considers the constraints insurmountable or finds the existing operators and problem-solving procedures inadequate (DeYoung et al. 2008). In facing such an impasse, insight occurs the moment when the problem solver is able to reformulate the problem to enable the problem to be solved (DeYoung et al. 2008). Insight problems are a special type of non-routine problems as the problem primes solvers to think in a direction that leads to inappropriate solutions, and thus requires restructuring/reformulation (Dow & Mayer 2004).

Problem formulation and insight problem solving are forms of pattern recognition. To illustrate this, an insight problem is as follows:

“Two men played five full games of checkers and each won an even number of games, with no ties, draws, or forfeits. How is that possible?

“They were not playing against each other.”
The insight problem takes advantage of the solvers assumption that two men are playing against one another simply because they were mentioned together in the same phrase (this question also intentionally primes the solver to presume as such). A problem solver gains insight when they realise that the statement relates to both men not playing against one another. The case demonstrates how the problem solver has to reformulate the problem to solve it (DeYoung et al. 2008).

2.7.4 Systems and Multiple Perspectives

Systems are generally complex, not only because there exists a near infinite number of variables but also because systems are dynamic. The dynamic characteristic of systems means to capture a system’s current state does not unequivocally provide an accurate image of the system, irrespective of the level of detail obtained. Systems are an agent of change within themselves and systems thinking is about understanding change (Senge et al. 1994). As systems exist and persist, changes occur throughout its entire chain. Finding the leverage points in systems to influence the direction of change is possible. Multiple perspective-taking is also closely linked with systems thinking. As discussed in the previous section, what constitutes as a system, its boundaries, subsystems and other constituents depends on the beholder. For example, what is a system or sub-system depends on the perspective adopted.

Lyons et al. (2003) argue that there are five levels of perspective that one must recognise and adopt when assessing systems; boundaries, frame (perspective), problem structure, interpretation of the structure, and identification of referents (tools of enquiry). Identifying system boundaries is a matter of negotiation as Geyer (1995) states that “two observers may be inclined to draw slightly different boundaries when talking about the same problem; and the same observer may draw the boundaries of a system to be studied differently tomorrow than today. Finally, even when the boundaries are not drawn differently as a result of time or observer dependence, they may be drawn in a different way because a different problem needs to be studied” (p. 9).

These dispositions will also help individuals to observe systems from different and multiple perspectives. Systems must be ‘viewed’ from different perspective such as technical, social, managerial and operational (Frank et al. 2007). For example, the National Health Service (NHS) in the UK can be understood from medical, governmental policy managerial and social perspectives.
Cabrera et al. (2008) argue that systems thinking is not content based and hence is not discipline-constrained. They argue that systems thinking is ‘pattern thinking’ that concerns the reiteration of outline and configurations and can be used as a ‘tool’ for evaluation. They stress that “system thinking is not something that one does, but is something that one gets” (p. 307).

Complex Adaptive Conceptual Systems (CACS), a term coined by Cabrera et al. (2008), denotes that concepts operate in an environment (i.e. a context) that enable concepts to give meaning to themselves. Concepts are abstractions that are made up of content (symbolic variables) and context (processing rules) (Cabrera & Colosi 2008). For example, the content of the concept of a ‘chair’ is ‘four legs’ (visual representation) and ‘for seating’ (functional representation). The content of concept facilitates a preliminary description of the boundaries of the concept, in other words it describes ‘what is the concept’. Context is the rules and patterns that underpins concepts, and is the most critical aspect of concepts. Cabrera et al. (2008) use the terms Distinction, System, Relationship and Perspective (DSRP) to describe context.

Rather than as a rigid framework, Cabrera et al. (2008) state that DSRP is a form of ‘pattern of thinking’ as patterns emphasise interaction between ‘objects’ rather than the ‘objects’ themselves. DSRP helps to elucidate the pattern of thought processes. Distinction differentiates the content of the concept relative to other concepts. The naming convention for a concept inherently creates a distinction from another concept. For example, a chair is distinct from a table, although a table may also have four legs, in that tables are not to be used as seats, and is called as such in differentiating its purpose. System describes if the content is part of or a whole system. For example, a chair can be part of a dining set but can be an entirely functional object on its own. Relationship depicts the content of a concept in a cause-and-effect relationship. The cause-and-effect and relationship is not taken in its literal sense as it endeavours to epigrammatically illustrate how one factor may shape another. For example, the design of a chair may be a function of the need for comfort. Perspective is delineated from a subject-object perspective. For example, a chair is an object that may take a different perspective depending on a person’s perspective, the subject. One person may value a chair for its material while another may value its design. Table 44 describes the DSRP process.
Table 44: Distinction, System, Relationship and Perspective (DSRP) rule set
(Cabrera et al. 2008)

<table>
<thead>
<tr>
<th>Concepts (content + context)</th>
<th>Context (processing rules/patterns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content (informational or symbolic variables)</td>
<td>(D)(S)(R)(P) &gt; [ DSRP ]</td>
</tr>
<tr>
<td></td>
<td>Distinction (D) &lt; &gt; [identity (i) &lt; &gt; other (o)]</td>
</tr>
<tr>
<td></td>
<td>System (S) &lt; &gt; [part (p) &lt; &gt; whole (w)]</td>
</tr>
<tr>
<td></td>
<td>Relationship € &lt; &gt; [cause € &lt; &gt; effect €]</td>
</tr>
<tr>
<td></td>
<td>Perspective (P) &lt; &gt; [subject (s) &lt; &gt; object (o)]</td>
</tr>
</tbody>
</table>

Systems thinking is not thinking systems but it is about thinking systemically (Cabrera et al. 2008). Cabrera et al. (2008) stressed on affect and effect outcomes between two concepts, which is exemplified by the DSRP rule set, where affect is material action taken or espoused by one concept and effect is the product of the material action on another concept. Systems thinking requires the consideration of affects and effects during the application of the DSRP rule set. The distinction or identity between two concepts, for example Alpha and Beta, results in four states linked in two inter-relationships:

1) The affect of Alpha’s identity (state one)
2) The effect of Alpha’s identity on Beta (inter-relationship one resulting in state two)
3) The affect of Beta’s identity (state three)
4) The effect of Beta’s identity on Alpha (inter-relationship two resulting in state four)

Cabrera et al. (2008) extend this notion to relationships, where the affect and effect of relationships on, for example, both Alpha and Beta, which results in two states linked to four inter-relationships. The two states are from the relations between the concepts, not the concepts itself, such as the affect of relations and the effect of relations. The four inter-relationships are:

1) The affect of relation from Alpha to Beta (inter-relationship three resulting in state five)
2) The affect of relation from Beta to Alpha (inter-relationship four resulting in state six)
3) The effect of relation on Beta from Alpha (inter-relationship five resulting in state seven)
4) The effect of relation on Alpha from Beta (inter-relationship six resulting in state eight)

The inter-relationships are not one of cause-and-effect but of one of interaction, for example, moderation and mediation effects. The states and inter-relationships between the concepts of Alpha and Beta naturally become a system, or part of a system, as systems are a collection and interdependence of parts (Mulej et al. 2004). As concepts and their interactions become prominent and mutually fortify one another, the system crystallises. The system then contains another four inter-relationships between the concepts and the system:

1) The affect of system membership from Alpha (inter-relationship seven resulting in state nine)
2) The effect of system membership on Beta (inter-relationship eight resulting in state 10)
3) The affect of membership from Beta (inter-relationship nine resulting in state 11)
4) The effect of membership on Alpha (inter-relationship 10 resulting in state 12)

These concepts of Alpha and Beta result in 10 inter-relationships and 12 states. Cabrera et al. (2008) also note that the states are just a snapshot of the system and the concepts itself may change due to the interactions and this will in turn change the system. The union of the concepts into a system is held by an individual, the observer. Hence, it is critical to consider the perspective taken, which is akin to thinking about the thinker.

There may be multiplicities of perspectives that can be adopted, for example from one or more selected states from the different 12 states, at varying degrees. The perspective rule of subject-object demonstrates that the interpretation of an object or a concept and the selection of the focal point within a system are dependent on the subjective view of the perceiver (Cabrera & Colosi 2008). The selection of the focal point and attributional factor in the perspective rule re-adjusts and re-arranges the concepts, interactions and relationships within the system resulting in some relationships being emphasised and some disregarded, intentionally or otherwise. Another consideration is the possibility that the observer is part of the system. In such situations, similar permutations resulting from the affect and effect factors from the observer (as a third concept) on each concept may materialise and increase the number of states and inter-relationships from the distinction, relationship and system rules. The states and outcomes of the DSRP can almost be infinite, mirroring systems.
Each of the DSRP rules may also be viewed as a concept on its own. Systems may also be viewed as a concept, for example the legislative system is conceptualised to be compared against the concept of the judicial system within the democratic system. The DSRP rules illuminate patterns that underlie concepts and systems, and can be applied to any body of knowledge (Cabrera et al. 2008). The patterns that underlie content may change the contents meaning and hence, the concept. Cabrera et al. (2008) claim that the DSRP is not novel and its application is implicitly used by everyone. Patterns, similar to a concept, are fluid and are both perceptual and behavioural. Perceptual patterns are perceived repetitive formations while behavioural patterns are observable recurring formations. The DSRP approach is aimed at changing the way of thinking to a form of systems thinking and its value lies in its composition, which underscores the principle of the gestalt where the whole is more than the sum of all its parts and the nature of the whole depends on the perspective adopted.
2.8. **JOB-RELATED LEARNING**

Job-related learning is a form of behaviour and is a mediating variable in the research model. This section discusses the theoretical underpinnings of learning from the perspective of behaviourism, cognitivism and constructivism. This section also examines the various ‘types’ of learning such as experiential learning, informal and incidental learning to further help understand its similarities and differences with the construct of ‘job-related learning’. This section also examines a key measures of the construct, in justification of the adoption of the scale for this study (further discussed in the Research Methodology chapter). In addition, this section discusses the construct of learning from experience and justifies the adoption of this construct in this study. Learning is a very broad field, with many theories, schools of thoughts, historical roots and perspectives. This section is not intended to outline the entire field but it will introduce the key concepts and theories that are relevant to the constructs of learning from experience and job-related learning.

2.8.1. **Learning**

Learning is an inherent process endowed upon humans (Sun & Scott 2003). Learning is crucial as it helps people to adapt to changes. Although learning is a natural activity, it is not necessarily the most efficient and effective if left on its own. Thus scholars have articulated various pedagogic approaches and andragogy principles (Pedler 1999; Ally 2008; D’Mello & Graesser 2012) in enhancing the effectiveness of learning. There is no particular ‘best practice’ for learning. Learning is contextual as it depends on the subject matter, motivation of learners, medium of learning (e.g. face-to-face or e-learning) and other various situational factors (Stacey 2003; Wong, Tatnall & Burgess 2014; Herrington & Parker 2013).

Whilst the notion of group and team learning, as well as organisational learning are important concepts, learning, first and foremost starts at the ‘individual’ level (Howard-Jones & McGurk 2014). Specifically, this refers to peoples’ cognition, motivation (as mentioned), their changes in behavior (e.g. skills) and the role of affect (e.g. emotions) in the process of learning (Crookall & Thorngate 2009; Mirvis 2008; Pekrun et al. 2002).

Each of the perspectives are not mutually exclusive and each contribute to our understanding to how individuals learn under different circumstances and constraints: For example, classroom (Bruner 1960), on the job training (Cheetham & Chivers 2001), coaching and mentoring (O’Neil & Marsick 2014). Learning can range from ‘surface
learning’ to ‘deep learning’ (Cano 2006) to transformative (Mezirow 1997; King 2009). The ‘type’ of learning that one gains depends on the need and also motivation: For example, intrinsic or extrinsic (Eccles & Wigfield 2002). Simple surface learning may involve a gain of a simple in skill such as knowing how to work with a word processor or it could be transformational in the sense that it impacts on people’s values and beliefs (Easterby-Smith 1997).

Argyris and Schon (1996) argue that there are two types of learning, single-loop learning and double-loop learning. Single loop learning is learning ‘what’ and ‘how’, whilst double-loop learning is about learning ‘why’. Single loop learning may be considered as surface learning and mere adaptation in terms of acquiring skills and behaving in a certain way as it is instrumental in achieving something. This method entails learning enough to achieve a standard without necessarily having to genuinely understand it (Argyris 1983). Double loop learning, on the contrary, concerns asking why and understanding the rationale. It is similar to deep learning (Argyris 2005) and to deutero learning, which concerns learning about the context in which action and consequences occur (Visser 2007).

The following section discusses the various learning approaches and the corresponding theories. Learning is a broad field and has many areas of specialisms. It is not the intention of this section to review each subfield in details but to acknowledge the richness of the field and to identify and then discuss the specific approach that the study has adopted (i.e. experiential learning).

2.8.2. Learning Theories
Wu et al. (2012), in their research on identifying learning theories that have been used in research on simulation game in higher education, identified four categories of learning theories: behaviourism, cognitivism, humanism and constructivism. Behaviourism involves a change in behaviour and has long been held as the ‘golden standard’ or indicator that learning has taken place (Thorndike 1913; Pavlov 1927).

Cognitivism asserts that learning involves primarily the mind. The process of learning is in one’s thinking and does not necessarily have to involve a change in behaviour (Wu et al. 2012). This category of learning relates to constructs discussed in this study specifically in regards to critical thinking, problem solving and metacognition. An example of a cognitivist approach to learning is Attribution Theory, which involves learners attempting to explain the results of a phenomenon (and may involve abductive
reasoning) (Weiner 1974). Another example is Elaboration Theory, which involves extending and broadening learning to other concepts and potentially to other fields and domains (Reigeluth 1983).

The third category of learning theories is constructivism, which views the learner as the developer and constructor of knowledge as they create their own understanding of reality through a subjective lens (Wu et al. 2012). An example of a constructivist learning theory is case-based learning, which is a form of apprenticeship-based learning-by-doing approach in structured small group sessions (in seminars) (Powell 2000). Another example is problem-based learning involves giving students the autonomy to learn through resolving ill-structured problems (McNulty, Crowe & VanLeit 2004). Situated learning, as another example, views learning as embedded in the context, activity and culture of the learning environment (Lave & Wenger 1990).

Humanism involves self-actualisation in a cooperative and supportive environment (in a structured environment of the lectures and seminars) (Kolb 1984). The epitome of a humanist learning approach is the experiential learning theory that is essentially a meaning-making process (Kolb & Kolb 2005) (further discussion concerning the experiential learning theory will be undertaken below). Table 45 below contains the examples of learning theories in each of the four categories.

Table 45: Types and characteristics of each learning principle (Wu et al. 2012)

<table>
<thead>
<tr>
<th>Learning theory</th>
<th>Examples:</th>
</tr>
</thead>
</table>
| **Behaviourism** | Principle: Direct instruction  
Representor: Engelmann and Carnine (1982)  
Keywords: Direct instruction, feedback, prior knowledge, specific teaching goal, distributed practice  
Principle: Programmed instruction  
Representor: Skinner (1954)  
Keywords: Sequence material, individualized instruction, feedback, initial behaviour, terminal behaviour, self-learning  
Principle: Social learning theory  
Representor: Bandura (1977)  
Keywords: Social learning, modelling, observation, imitation, self-regulation |
| **Cognitivism** | Principle: Attribution theory  
Keywords: Self-ascription, external attribution, internal attribution, self-attribution, motivation, reward or punishment  
Principle: Elaboration theory  
Representor: Reigeluth (1983)  
Keywords: Simple to complex, learner centred, analogies, elaboration  
Principle: Cognitive development  
Representor: Piaget (1969) |
<table>
<thead>
<tr>
<th>Learning theory</th>
<th>Examples:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Keywords: Cognitive development, schema, assimilation, accommodation, disequilibrium, equilibration, sensorimotor period, preoperational period, concrete operational period, formal operational period</td>
</tr>
<tr>
<td></td>
<td>Principle: Conditions of learning</td>
</tr>
<tr>
<td></td>
<td>Representor: Gagne (1965)</td>
</tr>
<tr>
<td></td>
<td>Keywords: Conditions of learning, transfer of learning, instructional event, diversity, reinforcement</td>
</tr>
<tr>
<td>Constructivism</td>
<td>Principle: Social development theory</td>
</tr>
<tr>
<td></td>
<td>Representor: Vygotsky (1978)</td>
</tr>
<tr>
<td></td>
<td>Keywords: Social culture, social development, zone of proximal development, scaffolding</td>
</tr>
<tr>
<td></td>
<td>Principle: Case-based learning</td>
</tr>
<tr>
<td></td>
<td>Representor: None. Idea came from problem-based learning in 1990s.</td>
</tr>
<tr>
<td></td>
<td>Keywords: Student-centred learning, critical thinking, problem solving</td>
</tr>
<tr>
<td></td>
<td>Principle: Cognitive apprenticeship</td>
</tr>
<tr>
<td></td>
<td>Representor: Vygotsky (1978)</td>
</tr>
<tr>
<td></td>
<td>Keywords: Learning by doing, cognitive apprenticeship, authentic practices, exploration, active learning, active thinking</td>
</tr>
<tr>
<td></td>
<td>Principle: Discovery learning</td>
</tr>
<tr>
<td></td>
<td>Representor: Bruner (1957)</td>
</tr>
<tr>
<td></td>
<td>Keywords: Inquiry-based instruction, prior knowledge, discovery learning, trial and error</td>
</tr>
<tr>
<td></td>
<td>Principle: Problem-based learning</td>
</tr>
<tr>
<td></td>
<td>Representor: None. Originally from medical school in 1960s.</td>
</tr>
<tr>
<td></td>
<td>Keywords: Problem-based, authentic (real world), problem solving, teacher as facilitator, learner centred</td>
</tr>
<tr>
<td></td>
<td>Principle: Situated learning</td>
</tr>
<tr>
<td></td>
<td>Representor: Lave and Wenger (1991)</td>
</tr>
<tr>
<td></td>
<td>Keywords: Authentic activity, learning situation, situated learning, apprenticeship, legitimate peripheral participation, meaningful learning, socially shared, distributed</td>
</tr>
<tr>
<td></td>
<td>Principle: Activity theory</td>
</tr>
<tr>
<td></td>
<td>Representor: Leon’t-ev (1978)</td>
</tr>
<tr>
<td></td>
<td>Keywords: Activity system, action, dynamic relations, mediated, structure, subject, objective</td>
</tr>
<tr>
<td></td>
<td>Principle: Actor–network theory</td>
</tr>
<tr>
<td></td>
<td>Representor: Latour (1987)</td>
</tr>
<tr>
<td></td>
<td>Keywords: Actor–network, actors can be human or non-human</td>
</tr>
<tr>
<td>Humanism</td>
<td>Principle: Experiential learning</td>
</tr>
<tr>
<td></td>
<td>Representor: Kolb (1984)</td>
</tr>
<tr>
<td></td>
<td>Keywords: Experiential learning, learning cycles, learning style, concrete experience, reflective observation, abstract conceptualization, active experimentation, diverger, assimilator, converger, accommodator</td>
</tr>
</tbody>
</table>

Table 45 is not comprehensive and is only meant to be illustrative. The learning from experience and job-related learning construct draws from the experiential learning theory of Kolb (1984). This approach has been selected to form the basis of the learning construct in this study as the ability to learn from experience and mistakes are a key
ability in innovation. As Einstein said that “Insanity is doing the same thing over and over again and expecting different results”. Although behaviourism is important, it does not provide insight into why and how people learn and the cognitivist approach is relatively well covered through the constructs of critical thinking and problem solving, which are included in this study. The following sections will contain a general discussion on the areas of behaviourism, cognitivism and constructivism prior to the focus on the humanist principle of learning in justifying the application of the construct.

2.8.2.1. Behaviourism

Behaviourism is the first approach to understanding how people learn (Lahey 2004). The basic principle underscored by this approach is that, as Lahey (2004) states, “any relative permanent change in behaviour brought about through experience” (p. 198). Behaviourism is primarily based on the work of Pavlov’s (1927) Classical Conditioning and Skinner’s (1954) Operant Conditioning. Classical conditioning is the association between a stimuli and a reaction. For example, if a dog is served dinner at the same time when a bell is tinkered, the dog will soon be conditioned to associate a tinker of the bell with dinner. Operant conditioning is similar but it concerns the notion of reward and punishment, where rewards reinforce certain behaviours and whilst punishment negates it. Learning, according to these two early theories, is said to have occurred if there is a relatively permanent change in behaviour.

Another theory in the behaviourism category is Bandura’s (1977) Social Learning Theory. Bandura argues that people learn from others around them. People identify role models and imitate their behaviours whilst they learn and identify their own style. For example, individuals who are new to management may learn the behaviours and styles from existing managers (e.g. in dealing with conflict, motivating staff, managing meetings), whilst they ‘find their feet’ in terms of their own style. Bandura also argued that people do not need to be personally rewarded or punished to acknowledge the merits of certain behaviours. They can learn vicariously through others (e.g. observing thieves punished with a jail term is good enough a lesson without having to experience it first hand). Social Learning Theory, in this respect, acknowledges that not all learning is by imitation, learning also involves cognition as people ‘work out’ in their minds what will suit them or not based on what they observed about and from others.

Nonetheless, these theories are limited as we are well aware that we can learn new things without having the need (or want) to change our behaviours. Alternatively, people may behave in a certain way in the way of imitation and not necessarily having had ‘learned’
anything: That is, not understanding why (Wu et al. 2012). Thus the learning is superficial and may not last long. Clearly, behaviourism has its merits but it is limited in its usefulness to certain contexts (e.g. sports).
2.8.2.2. **Cognitivism**

If behaviourism is considered as the ‘outcome’ of learning, then cognitivism may be considered as one of the antecedents of learning. Cognitivism essentially concerns how processing occurs in the mind. As mentioned, the discussion concerning higher-order thinking, intelligence and cognition covers many of the principles and concepts offered by cognitivist theories. This section, however, contains an introduction to how people transform data (e.g. gained from the stimulus) to knowledge and beyond. Bierly III, Kessler and Christensen (2000) illustrated this process by identifying four levels of processing as illustrated in Table 46.

**Table 46: Stages of the Learning Process and its Relationship with Level of Inputs and Outcomes (Bierly III et al. 2000)**

<table>
<thead>
<tr>
<th>Level</th>
<th>Definition</th>
<th>Learning Process</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>Raw facts</td>
<td>Accumulating truths</td>
<td>Memorisation (databank)</td>
</tr>
<tr>
<td>Information</td>
<td>Meaningful, useful</td>
<td>Giving form and functionality</td>
<td>Comprehension (information bank)</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Clear understanding of information (context)</td>
<td>Analysis and synthesis</td>
<td>Understanding (knowledge bank)</td>
</tr>
<tr>
<td>Wisdom</td>
<td>Using knowledge to establish and achieve goals</td>
<td>Discerning judgments and taking appropriate action</td>
<td>Better living/success (wisdom bank)</td>
</tr>
</tbody>
</table>

At the most basic level people learn by gaining ‘raw data’ (similar to accumulating truths) purely by capturing and memorising these facts. Next, in transforming data into information, individuals need to give ‘form’ and purpose to the data. For example, raw data that is organised into some tabular format may provide much more meaning, and the individual starts to recognise the significance of the data. At the ‘knowledge’ level, the individual gains a clear understanding of the information by analysing it and by ‘layering’ the information with context in synthesising what the information means in certain contexts. Last but not least, at the ‘wisdom’ level, individuals use knowledge to inform and improve their judgement. Knowledge is integrated with values in making decisions. Whilst knowledge is about ‘can we do this?’ wisdom is about ‘should we do this?’ (Srivastva & Cooperrider 1998).
2.8.2.2. **Constructivism**

Theories of learning in the constructivist category view learning as a process that considers the individual's own-world-view and how people construct their own reality and knowledge (Lainema 2009). Constructivism entails that learning is also about the person and learning is not just a generic process that involves transforming data to information, and information to knowledge for example. The context of the person must also be considered. Learning is integrated with what has been learned with one’s own mental schemas and mental models (Gunstone 1991). At a more mature/advanced level, constructivism may involve individuals re-examining their world-views (Bruner 1991).

For example, Boydell (1990) argues that people go through various stages of learning as shown in Table 47:

<table>
<thead>
<tr>
<th>Mode</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adhering</td>
<td>Working to standards or operating in ways prescribed by others, working from memory, applying rules, etc.</td>
</tr>
<tr>
<td>Adapting</td>
<td>Responding to variations from routine, recognising patterns and effects of changes, making changes to taught routines</td>
</tr>
<tr>
<td>Relating</td>
<td>Being in tune with what is happening, understanding at a deeper level what is going on and able to explain to others</td>
</tr>
<tr>
<td>Experiencing</td>
<td>Learning from experiences and using this as a basis for action, developing own ideas and theories of action</td>
</tr>
<tr>
<td>Experimenting</td>
<td>Needing to find things out by experimentation and discovery, developing new ways of doing things</td>
</tr>
<tr>
<td>Connecting</td>
<td>Realising that things are somehow inter-connected, seeking wider overviews, attempting to bring things together</td>
</tr>
<tr>
<td>Dedicating</td>
<td>Having a deep conviction and sense of purpose, able to find meaning in work, able to focus on essentials</td>
</tr>
</tbody>
</table>

Boydell’s (1990) seven modes of being and learning illustrates the level of ‘integration’ and meaning that learning can take place within an individual. However, such integration starts with individuals constructing their own knowledge. These levels are not in a strict hierarchical form and individuals may be ‘at different levels’ depending on what is being learned and its importance to the individual. For example, the concept of sustainability may be a concept that individuals merely ‘adhere’ to, whilst for some it is their raison d’être entailing the dedication of an individual’s entire purpose. Individuals may move from one mode to another. As people mature a wider selection of modes becomes available to them.
2.8.3. Experiential Learning

Similar to behaviorism learning from experience is a construct that assesses the ability of individuals to learn from their mistakes and errors, as Rickards, Chen and Moger (2001) state that learning from experience involves individuals being “...oriented toward learning from their experiences, thus permitting growth, change, adaptation, and creative problem-solving” (p. 245). Learning from experience is about being able to i) identify lessons to be learned through experience and that of others, ii) experiment with new ideas and iii) to be able to construct new mental schemas. Though ‘learning from experience’ can be said to be primarily informed by the humanist approach to learning (i.e. experiential learning theory), it is also acknowledge that the construct is also informed by the behaviourism, cognitivism and constructivism approaches.

Kolb’s (1984) Experiential Learning Theory is a popular theory and has been used to explain how people learn in a variety of scenarios (Kiili 2005; Armstrong & Mahmud 2008; Askeland 2003). A key premise of Experiential Learning Theory is that learning and action cannot be detached from one another (Nonaka & Takeuchi 1995; Argyris 2005). However, not all action can be translated into knowledge through learning as reflection also needs to occur (Kemmis 1985; Zundel 2013). In turn, the outcome of the reflection process needs to include some form of ‘trialing’ of new theories that the individual has developed (Schank & Abelson 1977; Kolb & Kolb 2005). Figure 30 illustrates the learning cycle in Kolb’s Experiential Learning Theory:

Kolb (1984) argues that people learn best from experiences, that is by doing. To further learn from specific experiences, individuals may want to observe others doing the same and to identify lessons that can be learned. At this point, individuals should reflect upon their own experiences and potentially those of others to generalise and conceptualise from the specific proceedings. Once concepts have been developed and the individuals have an
idea of how to improve, the next step that they should undertake is to experiment with these new ideas.

The reflection stage of Kolb’s cycle helps in contributing to the development of metacognition, which is essentially thinking about thinking (metacognition is discussed in its own section). Reflection helps with generative learning, which involves learning to be proactive (Senge 1992). However, it is the experiential aspect of the theory that makes learning from experience a compelling theory as it intuitive that many people can relate to and help them to become ‘better’ in self-actualising.

Criticism of this theory includes the notion that people only learn through trial-and-error, which is not the case as demonstrated by Bandura’s Social Learning Theory. In addition, there are also assertions that Kolb’s learning cycle lacks empirical support. Nonetheless, this theory is one of the most intuitive models that links reflection with skills (Leberman & Martin 2004; Mälkki & Lindblom-Ylänne 2012).

2.8.4. Informal and Incidental Learning
Learning takes many forms and occurs in varying degrees. People learn in formal ways such as when attending courses delivered in classrooms. People also learn informally such as learning from one another (e.g. social learning), from real-life experiences (as discussed above) and whilst on the job. Informal and incidental learning are just as powerful if not more powerful than formal learning.

Learning from one’s own actions, especially from mistakes, provides people with real impetus to not repeat the error and to improve. This is because real-life usually has severe penalties when errors are made. Thus, the lessons from learning from experience also generally has more longevity and remains with us in a more effectual manner compared to some lessons we learn in class, or from textbooks (Loon & Casimir 2008; Rickards et al. 2001; Marsick & Watkins 2001).

In an organisational sense, people also learn effectively whilst doing their jobs. Job-related learning is a form of informal and/ or incidental learning (Loon, Casimir & Bartram 2007). People become more adept at their jobs as they learn to adapt and overcome challenges whilst working e.g. be it the task itself, working with organisational policies and processes or within the informal organisation. Informal and incidental learning may lead to the development of tacit knowledge, as people may not be entirely aware that they are learning something new, which may then make it difficult for them to
articulate how they are able to do something competently (Marsick & Watkins 2001; Sanchez 2005).

2.8.5. **Learning and Innovation**

Baker and Sinkula (2002) argued that learning ultimately helps with organisations in being more innovative. Whilst this proposition is quite intuitive, Baker and Sinkula (2002) go further by specifying the types of learning that would correspond with different types of innovation, as shown in Table 2.21. They postulate that organisations that are weak in terms of market and learning orientation tend to have little or no deliberate consideration for the external environment. Learning modes are usually *conditioning or modelling* (imitation) of competitors. Any innovation is incremental. They further argue that organisations that have a strong market orientation but weak learning orientation are those that are *adaptive*. They are able to change according to the external environment but this is generally reactive.

Organisations that are strong in terms of both market and learning orientation are those that proactively attempt to shape their competitive environment. This type of learning is generative and involves meta-learning (e.g. double loop learning), which may lead to radical innovation. Whilst Baker and Sinkula’s (2002) model is premised upon learning at the organisational level, all learning has to take place at the individual level, first and foremost. Thus learning at the individual level must be emphasised as it provides a powerful base for organisations to develop innovation as shown in Figure 31.
Therefore learning is not just an activity that is exclusive to individuals but it is also an important construct in groups and organisations. Indeed, learning is a basic activity but its mastery may result in attaining unique competencies that provides one with competitive advantage. Learning starts with individual. It is crucial that an organisation’s employees are effective learners. Employees’ learning from doing their jobs better and from their general experience may be inevitably equipping themselves with the opportunity to be more innovative in terms of improving their own productivity, and how team and organisation-wide processes work. The collective innovation behaviour of individuals will ultimately benefit the organisation as a whole.

**Figure 31: Learning and innovation (Baker & Sinkula 2002)**

<table>
<thead>
<tr>
<th>Type of Marketing Firm</th>
<th>Interaction with the Environment</th>
<th>Type of Learning</th>
<th>Highest Effective Level of Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase III Marketing Firm</td>
<td>Strong market orientation, Strong learning orientation</td>
<td>Proactive attempt to alter the external environment</td>
<td>Meta-Learning: On-going evolution through adaptive and generative learning</td>
</tr>
<tr>
<td>Phase II Marketing Firm</td>
<td>Strong market orientation, Weak learning orientation</td>
<td>Reactive adjustments to changes in the external environment</td>
<td>Generative Learning: Learning entailing the replacement of theories-in-use</td>
</tr>
<tr>
<td>Phase I Marketing Firm</td>
<td>Weak market orientation, Weak learning orientation</td>
<td>Little or no deliberate consideration of the external environment</td>
<td>Adaptive Learning: Learning in the context of prevailing theories-in-use</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Modeling: Learning involving the transfer of prevailing theories-in-use</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Conditioning: Learning shaped by the application of rewards and punishment of behaviours</td>
</tr>
</tbody>
</table>
2.9. Creativity

Creativity is a form of behaviour (e.g. ideation) and is a mediating variable in the research model. This section discusses the construct in terms of its underpinnings, and concepts related to creativity. In particular we examine Guilford’s seminal work in particular the notions of divergent and convergent thinking that contribute to the construct of creativity. This section also examines a key measures of the construct, in justification of the adoption of the scale for this study (further discussed in the Research Methodology chapter). Section 2.1 contained a discussion on innovation and the dispositions on innovativeness. Section 2.2 contained a discussion on Higher-Order Thinking dispositions, whilst sections 2.3 to 2.7 contained discussions on the critical thinking, systems thinking, multiple-perspective-taking, problem solving, and meta-cognition. Section 2.8 contains a discussion on creativity including identifying the construct’s philosophical underpinnings, concepts that are part of and related to creativity, and the outcomes and applications of creativity.

2.9.1. Underpinnings of Creativity

There are various perspectives to understand creativity. However, this variability is sometimes the cause of misunderstanding as researchers adopt inconsistent views in their discussion and investigation of the subject matter (Smith 2005; Gaut 2010). A starting point in understanding creativity is in its philosophy, specifically the breadth of philosophical perspectives, such as epistemology (e.g. creativity as an activity, as a product, as an art form), axiology (e.g. the value of creativity), metaphysics (e.g. creativity in relation to imagination and virtue) and from a teleological perspective (e.g. purpose) (Gaut 2010). The philosophical perspective adopted depends on the situation e.g. aims of the research. In addition to the philosophical aspect of creativity, Kahl, da Fonseca and Witte (2009) asserts that researchers also have decisions to make in investigating creativity, specifically in regards to aspect (e.g. traits, product or process), level (e.g. individual or group) and approaches (e.g. qualitative vs quantitative). This study adopts the view of creativity from both psychological (i.e. philosophy of the mind) and personality perspectives, which is consistent with one of the central themes of the investigation relating to dispositions for higher-order thinking.

The debate concerning the association between creativity and intelligence generally remains unresolved (Sternberg 2005), although creativity is generally recognised as a cognitive process as a creative person is at times described as less rational. For example, the tendency for psychosis promotes creativity as it usually involves over-inclusive
thinking (Eysenck 1993). Some researchers have proposed that creativity is part of the broader construct of intellect (Guilford 1967), whilst others suggest that both are two separate processes with creativity more associated with personality (Eysenck 1993). There are three views concerning the factors that contribute to creativity: i) intelligence drives creativity, ii) personality drives creativity, and iii) creativity is a product of an interaction between intelligence and personality.

One line of reasoning is that intelligence is the primary antecedent of creativity as evidence from research does suggest that there is some association between creativity and intelligence. Kaufman (2006) posited that whilst creativity is highly correlated with fluid intelligence (the ability to process and apply knowledge) for individuals that have high intelligence, however, the correlation was not significant for those who have average intelligence. In addition, the correlation between creativity and crystallised intelligence showed an opposite pattern as there is a strong positive correlation for those with average intelligence but a non-significant correlation for those with higher intelligence (Kaufman 2006). Creativity may not be unanimously viewed as part of general intelligence (Wallach & Kogan 1965), however there are conjectures that true and effective creativity may only be achieved or attained if the minimum threshold level of intelligence is met (Runco 2004a). However, there is recognition of creativity as part of intelligence is reflected in theories such as Sternberg’s (1996) Triarchic Theory of Successful Intelligence.

There are compelling arguments that creativity is first and foremost linked to the dispositions of individuals. For example, in terms of the Big Five Personality traits (Batey et al. 2010), individuals who are open to experience tend to be more creative (Puccio & Grivas 2009). Other examples include the link between creativity and extraversion. Individuals who are extraverted tend to be friendlier (in a behavioural sense) and thus have a bigger social circles to learn from, which in turn may help to gives new ideas to the individual (Prabhu, Sutton & Sauser 2008). There are also suggestion that individuals that are mildly neurotic tend also to be quite creative (Eysenck 1993).

A third line of reasoning is that intelligence and personality both jointly influence creativity but in an interactive manner. This third view conjectures that there is an interaction between individuals’ personality and intelligence (Chiu et al. 1994; Ackerman 2005) that results in creativity (Prabhu et al. 2008). For example, Runco (2004a) argues that an important element of creativity is capacity. A ‘creative person’ has the innate capacity to be creative. Creativity may be viewed as something that occurs naturally in some individuals, a notion that is consistent with the nature versus nurture debate.
Creative people will tend to be better and more immersed when engaging in creative activity as they pursue activities that are more creative compared to those who are less creative. Compared to "non-creative" people, creative people are more likely to engage in activities that require creativity, are more likely to have creative ideas that are effective/useful. Creative people are more likely to be intrinsically motivated towards performing tasks that involve creativity than are non-creative people (Randel, Jaussi & Wu 2011). The motivation for creativity drives imagination and creative products (Runco 1999b). The disposition to be creative is positively related to positive affect experienced whilst engaging in creative activities. As a result, the effects of extrinsic motivators on creativity is likely to be less amongst creative individuals than amongst non-creative individuals.

There are also situational factors that may help to develop and enhance creativity such as knowledge and skills. From this perspective, creativity may be ‘learned’ to some degree, although creativity is usually not synonymous with skill (Gaut 2010). The interplay amongst the various aspect of creativity makes it a challenge, although not impossible, to isolate a single aspect of creativity. In addition, no single perspective explains creativity satisfactorily or in a meaningful manner. For example, whilst imagination may be important to creativity, imagination on its own is not a sufficient condition for creativity (Policastro 1999). Similarly, the role of creativity should not be overemphasised. Creativity is important but it is not a necessary element in all aspects of life. For example, whilst creativity may assist and expedite problem solving, however not all creative process are related to problem solving and not all problems require creativity (Runco 2004a).

2.9.2. Concepts related to Creativity
The concepts that underpin and/or relate to creativity, even within the narrow confines of psychology and personality, are very much varied. As an example, Runco (2004a) posit that creativity is associated with various processes such as synaesthesia (Domino 1989), perspective (new and multiple) (Runco 1999b), misjudgement (Runco 1999a), mindfulness (presence of mind) (Moldoveanu & Langer 1999), the (adept) use of metaphors (Gibbs 1999), development of logic (Johnson-Laird 1999), Janusian process (that involves the ability to consider and deliberate simultaneously on two very diverse perspectives) (Rothenberg 1999), leveraging upon intuition (Policastro 1999), developing insight (Sternberg & Davidson 1999), the positive effects of incubation (Smith & Dodds 1999), imagination (Singer 2009) and conceptualisation (Mumford, Olsen & James 1989). Nonetheless, whilst the preceding areas are valid perspectives of creativity, it is
important to focus on the most basic qualities of creativity to truly understand the essence of the construct (Sternberg 2005; Smith 2005), specifically in terms of its meaning.

Creativity is essentially about producing something that is novel, and valuable (Simon 2001). In a similar vein, Nijstad and Paulus (2003) claim that creativity is the development of original ideas that are useful. Nonetheless, in terms of where novelty and originality are concerned, Boden (2004) qualified these criteria of creativity in the form of two standards, $H$-creativity and $P$-creativity. $H$-creativity is historical creativity where no one has ever had the idea before. $P$-creativity is psychological creativity where the individual has not had that idea before although it may have occurred to others before. Value (usefulness) is another essential quality of creativity on par with novelty and originality, as the creative product must demonstrate and provide some utility. Value is relative to the context that the creative product is situated in (ideas that are divorced from reality are just inane ideas). Thus, an effectual theory of creativity is one that explains the production of something that is novel (original) and is of value (useful).

2.9.3. **Guildford’s Structure of Intellect Model**

The most elementary understanding of creativity is based upon Guilford’s (1967) Structure of Intellect (SI) model (Kaufman 2006). The SI model views the mind as a processor that takes inputs and processes them to create outputs. Guilford’s SI model is represented (and best visualised) by a three-dimensional cube that includes five types of content, five classification of mental operations and six categories of products (Guilford 1967) (see Figure 32).
Figure 32: Guilford’s Structure of Intellect (Guilford 1967).

Content relates to the sensory and receipt of information, which may be audio (information obtained through hearing), visual (information obtained through seeing), symbolic (numbers, alphabets), semantic (abstract meaning) or behavioural (information communicated via the acts of others) (Guilford 1967). Mental operations are the processes applied to the content, and involves memory (ability recall information), cognition (be aware of and comprehend), divergent (generate multiple solution), convergent (ability to deduce) and evaluation (appraise value) (Guilford 1967).

The outcome of the mental processes is units (single piece/item of knowledge), classes (categorisation of items of knowledge through common attributes), relations (association amongst units such as in terms of order, chronology and other types of relations), systems (more elaborate structures and networks linking knowledge compared to relations), transformation (conversion of knowledge such as that in different context) and implication (prediction/inference or knowledge) (Guilford 1967).

Guilford’s SI model is useful particularly due to the identification and conceptualisation of the divergent and convergent production. Other researchers have also adopted a similar process view of creativity. For example, Boden (2004) asserted that creativity is a process that involves combinational (combination of ideas), exploratory (uncharted territory/
space) and transformational (new thoughts never thought before) processes. The following sections provide discussions of divergent thinking and convergent thinking.

2.9.3.1. **Divergent Thinking**
Creativity can be described as divergent, subjective, diffuse, generative or visual thinking (Glassner & Schwarz 2007), with divergent thinking being the most popular indicator of creativity (Torrance 1974; Torrance 1971; Guilford et al. 1978). Guilford’s SI model is seminal (Richards 2001) because it highlights and positions divergent thinking as a cognitive ability (Runco 2004a) that is a central feature of creativity. Divergent thinking involves developing ideas that are very different from one another, even to the extent that the ideas may conflict with one another. The development of unrelated ideas help with developing new perspectives such as placing existing concepts into new contexts and/or new concepts within existing contexts. An example is the best-of-class benchmarking that involves comparing customer service efficiency and effectiveness in different contexts such as banks, theme parks and restaurants. Creativity is not only just about connecting the dots but also disconnecting things and relating them to other things (Gaut 2010).

There are a number of ways in assessing individuals’ divergent thinking ability. The three most popular and accepted tests of divergent thinking are the Torrance Tests of Creative Thinking (Almeida 2008), Guilford’s Alternate Uses (Guilford et al. 1978) and Wallach and Kogan test (Wallach & Kogan 1965). The common dimensions of the three divergent thinking assessment are originality, fluency and elaboration. Originality is the degree of novelty or newness of the idea. Originality also refers to the quality of the idea in terms of appropriateness, relevance and impact (Ames & Runco 2005). Fluency refers to the volume or quantity or breadth of the ideas. Elaboration refers to the level of detail that accompanies the ideas. Another dimension of divergent thinking relates to flexibility, which refers to the type of idea that has been produced in different categories.

2.9.3.2. **Convergent Thinking**
Convergent thinking is usually associated with critical thinking rather than creativity (Renaud 2008). However, creativity relies on logic as well as intuition (Runco 2004b). Divergent thinking moves non-linearly, almost in web form, whilst convergent thinking tends to be more linear and tends to move towards a single solution (DeYoung et al. 2008). Convergent thinking is a form of pattern recognition (Ansburg 2000; Schooler, Ohlsson & Brooks 1993) that parallels the notion of clustering hypothesised by Tassoul and Buijs (2007). If the information presented is unwieldy and seemingly random, the
first step involves clustering the information or ideas according to various affinities to make it easier to process in finding that ‘one answer’ (Tassoul & Buijs 2007). Convergent thinking is a process that helps individuals to come up with that one ‘answer’.

In addition, convergent thinking is also about ‘seeing beyond the obvious’. For example, convergent thinking may involve the cognitive ability of making relationship amongst ideas that are seemingly unrelated. Convergent thinking may also involve going beyond the information provided, some of which may be intentional ‘decoys’ or diversions, in identifying the underlying issues and/or solutions. Convergent thinking contributes to insight problem solving (DeYoung et al. 2008). Insights are the process that moves the individual from not knowing how to solve a problem to suddenly knowing a solution (Mayer 1995).

Insight is the understanding, discernment and/or perception that enables individuals to view a subject with new penetrating perspective (Wertheimer 1959). Insight problems are different from other types of problems in three ways. The first involves misdirecting (or failing to direct) the retrieval process, which potentially includes having ‘decoys’ in the problem. Secondly, solvers are not able to recall the processes that lead them to the answer in solving insight problems (whereas solvers usually trace their problem solving steps for normal problems) (Ben-Zur 1989). Thirdly, insight solution results in the solver going “Aha!”, which is considered central to the phenomenon of insight problem solving (Bowden & Jung-Beeman 2003).

An important element of insight problem solving is fixation (Maier 1931) and incubation (Carruthers 2002). Fixation is the excessive focus on something or someone that inhibits the solver in considering other prospects in solving a problem (Smith & Blankenship 1991). There are two types of fixation, ‘functional fixedness’ (Duncker 1945) and ‘context-induced set’ (Schooler et al. 1993). An example of ‘functional fixedness’ is the inability of solvers to imagine other uses of a hammer other than to pound a nail (Carruthers 2002). An example of context-induced set may involve the natural priming of subjects to think in certain way due to their situation or context such as a formula for a type problem. Creativity facilitates frame breaking (DeYoung et al. 2008), which involves evading fixation in observing and perceiving problems and seeing the problem from other (advantageous) perspectives.

Incubation is also an important element of convergent thinking in facilitating the ‘Aha!’ moment. Incubation is the gestation period involving the mind in subconsciously working
to solve a problem whilst the solver is doing something else (Smith & Blankenship 1991). Two critical elements of incubation is thus, removing the solver from the activity of solving the particular problem, and time. Time is an important element in convergent thinking as it takes time for the mind to make links, and move from idea to idea in discovering the ‘remote associate’ (Mednick 1968). The ‘eureka’ or ‘aha’ moment in creative insight takes time as it is a protracted process (Wallace 1991).

Mednick (1968) developed the Remote Associate Test (RAT) to simulate classical insight problems and assess convergent thinking (Chermahini, Hickendorff & Hommel 2012). Classic insight problems were not amenable to testing as they were usually too complex and thus participants usually were not able to complete sufficient number of items within the specified time frame reducing the reliability of the data collected (Bowden & Jung-Beeman 2003). The RAT can be taken without specific/expert knowledge. Most RAT items involve three words that are seemingly unrelated. However, there is one specific word that is related to each of the three words in different ways. For example, three words of ‘Same’/‘Tennis’/‘Head’ are related to the word answer of ‘Match’. *Same* is a synonym to *match*. *Match* makes a compound word with *head* as in *matchhead*. Finally, *match* is a semantically associated with *tennis* as in *tennis match*. The RAT thus necessitates solvers to think in a ‘convergent’ manner in discovering the answer.

Although divergent thinking is a necessary quality of creativity, it is insufficient. Creativity is a process that uses both hemispheres of the brain and thus involves both divergent and convergent thinking (Tassoul & Buijs 2007). However, it is conjectured that there is mid-point step between divergent and convergent thinking. Tassoul and Buijs (2007) posited that ‘clustering’ is a step that bridges divergent and convergent thinking. They argue that the many and varied ideas resulting from divergent thinking are more effectively managed by the mind through this intermittent step that ensures that ideas become more ‘structured’ prior to convergent processing. Clustering is a bottom-up process that groups ideas according to some form of natural affinity via the creation of rules and structures along the way (i.e. not via pre-determined categories).

Tassoul and Buijs (2007) argue that there are four types of clustering; object, morphological, functional and gestalt clustering. Object clustering is the affinity amongst ideas that are based on observable, superficial qualities (e.g. colour, shape). Morphological clustering is the identification of pattern in the grouping of ideas and concepts. Functional clustering is to group ideas and concepts to together that serve a practical purpose. Finally gestalt clustering, though this may appear as an oxymoron,
concerns synthesis such as providing a comprehensive explanation or developing a sustainable solution for a problem (Tassoul & Buijs 2007). The clustering of ideas, thus, facilitates the mind to identify commonalities or shared attributes in the ideas.
CHAPTER THREE – RATIONALE FOR THE HYPOTHESES

This chapter provides the rationale for the hypothesised relationships between the five higher-order thinking dispositions (i.e., critical thinking, problem solving, metacognition, systems thinking and multiple perspective-taking), job-related learning, creativity and innovation. In particular, this chapter is organised into six main sections, each containing a discussion that develops the relevant hypothesis. Section 3.1 provides the rationale for the hypothesis that job-related learning mediates the relationship between critical thinking and creativity (Hypothesis 1). Section 3.2 provides the rationale for the hypothesis that job-related learning mediates the relationship between problem solving and creativity (Hypothesis 2). Section 3.3 provides the rationale for the hypothesis that job-related learning mediates the relationship between metacognition and creativity (Hypothesis 3). Section 3.4 provides the rationale for the hypothesis that job-related learning mediates the relationship between systems thinking and creativity (Hypothesis 4). Section 3.5 provides the rationale for the hypothesis that job-related learning mediates the relationship between multiple perspective-taking and creativity (Hypothesis 5). Section 3.6 provides the rationale for the hypothesis that creativity mediates the relationship between job-related learning and innovation (Hypothesis 6).

3.1 CRITICAL THINKING, JOB-RELATED LEARNING AND CREATIVITY

This section argues why and how (i) critical thinking is related to job-related learning, (ii) critical thinking is related to creativity, and (iii) job-related learning is related to creativity. Finally, based on the three conjectures, it is hypothesised that job-related learning mediates the relationship between critical thinking and creativity.

3.1.1 Critical Thinking and Job-Related Learning

Critical thinking disposition is an outcome and a predictor of other abilities such as learning (Williams & Stockdale 2003). In addition to addressing biases, fallacies and the indiscriminate use of heuristics, critical thinking has been associated with other numerous higher-order thinking abilities such as effective problem solving and decision making, and ultimately a more meaningful life experience (Giancarlo & Facione 2001).

From a broader perspective, critical thinking is a vehicle for a fulfilling life and is deemed to be an important factor for success in life (Irani et al. 2007). Critical thinking does so by
developing individuals to be effective learners. Halx and Reybold (2006) argue that there are three philosophical underpinnings of critical thinking; logic that involves valid and invalid reasoning, epistemology that includes the exploration of the origin, nature and limits of knowledge and ethics that involves examining the morality of actions. These underpinnings provide a sense of the holistic development that an individual may go through in becoming a critical thinker.

Halx and Reybold (2006) state that critical thinking enables one to become sagacious, as they say that “a critical thinker is neither dogmatic nor gullible” (p. 4), and pragmatic as they assert that “Aristotle advised that we should not demand more certainty than the subject allows” (p. 6). Facione (2006) argues that critical thinking contributes to a more satisfying life as it enables one to be inquisitive to develop general knowledge, become and remain well-informed, be alert to opportunities, believe in the reasoned-inquiry process, open-minded to different perspectives, willing to consider and understand alternative views, fair in evaluation, honest about one’s own biases, prejudices as well as prudent and able to suspend judgment.

Celuch and Slama (2002) posit that critical thinking is about dealing with change through lifelong learning. They state that critical thinking is a deliberately planned behaviour, and integral to lifelong learning. Critical thinking helps individuals to deal with accelerating change through learning. Critical thinking they argue can be observed as planned behaviour as it requires will/volition as well as ability. They base their argument on the Theory of Planned Behaviour (Fishbein & Ajzen 1975). They describe critical thinking as involving positive attitudes, in addition to volition and ability. This intimates to the importance of dispositions and interest. Therefore an individual is more likely to engage in critical thinking if they have self efficacy and self belief that they are highly capable at critical thinking. Self-efficacy and perceived control are thus crucial for effective critical thinking. Celuch and Slama (2002) assert that attitudes, motivation and self-identity play a role in lifelong learning, as well as in critical thinking.

Critical thinking also helps to shape academic learning and educational performance. The development of the disposition to think critically may facilitate the development of actual critical thinking skills and other higher-order thinking skills. For example, Ennis (1985) suggests that the development of critical thinking may involve the further exploration of one’s own thoughts thus the further development of mindfulness. Paul (1995) agrees and states that there are similarities between critical thinking and mindfulness. He states that critical thinking is a mode of thinking and is helped by thinking through one’s thinking.
Halx and Reybold (2006) argue that the link between critical thinking and thoughtfulness is inherent as they posit that there is some overlap between the definitions as both involve heightened awareness of one’s own learning and thought processes.

Zoller et al. (2000) support this view in stating that critical thinking helps to develop awareness as it increases control over one’s own thinking, whilst Celuch and Slama (2002) state that effective critical thinkers are able to self-assess (e.g. double-loop learning) and continuously improve. The development of hard critical thinking skills will help individuals to meet the ‘standards’ of critical thinking. Table 48 provides some examples of Socratic questions that may help one to attain each ‘standard’.

**Table 48: Standards for Judging Critical Thinking (Foundation for Critical Thinking 1997)**

<table>
<thead>
<tr>
<th>Clarity</th>
<th>Could you illustrate what you mean?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Could you give me an example?</td>
</tr>
<tr>
<td></td>
<td>Could you elaborate further?</td>
</tr>
<tr>
<td>Accuracy</td>
<td>How could we check on that?</td>
</tr>
<tr>
<td></td>
<td>How could we find out if that was true?</td>
</tr>
<tr>
<td></td>
<td>How could we verify or test that?</td>
</tr>
<tr>
<td>Precision</td>
<td>Could you be more specific?</td>
</tr>
<tr>
<td></td>
<td>Could you give me more details?</td>
</tr>
<tr>
<td></td>
<td>Could you be more exact?</td>
</tr>
<tr>
<td>Relevance</td>
<td>How does that relate to the problem?</td>
</tr>
<tr>
<td></td>
<td>How does that bear on the question?</td>
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<tr>
<td></td>
<td>How does that help us with the issue?</td>
</tr>
<tr>
<td>Depth</td>
<td>What factors make this a difficult problem?</td>
</tr>
<tr>
<td></td>
<td>What are some of the complexities of this question?</td>
</tr>
<tr>
<td></td>
<td>What are some of the difficulties we need to deal with?</td>
</tr>
<tr>
<td>Breadth</td>
<td>Do we need to look at this from another perspective?</td>
</tr>
<tr>
<td></td>
<td>Do we need to consider another point of view?</td>
</tr>
<tr>
<td></td>
<td>Do we need to look at this in other ways?</td>
</tr>
<tr>
<td>Logic</td>
<td>Does all of this make sense together?</td>
</tr>
<tr>
<td></td>
<td>Does your first paragraph fit in with your last?</td>
</tr>
<tr>
<td></td>
<td>Does what you say follow from the evidence?</td>
</tr>
<tr>
<td>Significance</td>
<td>Is this the most important problem to consider?</td>
</tr>
<tr>
<td></td>
<td>Is this the central idea to focus on?</td>
</tr>
<tr>
<td></td>
<td>Which of these facts are most important?</td>
</tr>
</tbody>
</table>
Nonetheless, critical thinking can also be viewed as a ‘soft skill’ as it addresses the blend of concepts such as truth, knowledge and beliefs (Bowell & Kemp 2005). Lampert (2006) adopts this ‘soft view’ of critical thinking competencies as she asserts that it should be described as *habits of the mind* rather than *higher-order thinking*. It is clear that critical thinking as a skill and a disposition are both crucial. However, Dewey (1933) opines that disposition may have the edge in terms of primacy as he states that “*if we were compelled to make a choice between these personal attributes and knowledge about the principles of logical reasoning together with some degree of technical skill in manipulating special logical processes, we should decide for the former*” (p. 34).

Mackinnon (2006) asserts that there are a number of methods to develop both critical thinking skills and disposition. Examples include debating about contentious issues (e.g. creationism vs evolution) as this fosters sound argumentation skills and also evokes strong emotions. Other methods may include concept mapping as it enables students to ‘link’ the patterns of their thoughts and helps them to become more reflective practitioners and critical thinkers (Mackinnon 2006). The use of inquiry-based learning (Facione 2006) also helps to develop reflective skills, which then turns critical thinking dispositions into critical thinking skills (Lamm et al. 2011).

Critical thinking helps individuals to be more efficient and effective in their learning and thus better in problem solving in the workplace (Ricketts & Rudd 2004). Rudd, Baker and Hoover (2000) link critical thinking to problem solving by stating that “*critical thinking is a reasoned, purposive, and introspective approach to solving problems or addressing questions with incomplete evidence and information and for which an incontrovertible solution is unlikely*” (p. 5). Safi and Burrell (2007) share a similar view when they state that critical thinking is a conscious effort and a deliberate process that enables the thinker to accurately analyse information, organise ideas, draw inferences, evaluate arguments and be effective in problem solving, which reflects a typical complete learning process.

Pascarella and Terenzini (1991) states that critical thinking plays a key role in learning to solve workplace problems as it helps to “*identify central issues and assumptions in an argument, relationships, make correct inferences from data, deduce conclusions from information or data provided, interpret whether conclusions are warranted on the basis of the data given, and evaluate evidence or authority*” (p. 118). Although they state that some aspects of critical thinking, learning and problem solving may overlap, they regard them as different constructs. For example,
Friedel et al. (2008b) differentiate between critical thinking and problem solving as they argue that “problem solving is a linear process of problem realization and solution finding, whereas critical thinking is an overlying set of abilities that facilitates the problem solving process” (p. 73). Friedel et al. (2008b) conducted a study on critical thinking and problem solving, and found that the constructs of critical thinking and problem solving are potentially more independent than previous research has indicated. There are conjectures that learning differentiates the two, as critical thinking first and foremost influences effective learning, which then in turn helps the development and implementation of effective solutions to problems.

Critical thinking should facilitate job-related learning as it helps to make better decisions by improving the evaluation of information and how information is used in the decision-making process in the workplace (Petress 2004). For example, critical thinking helps individuals to learn from the evaluation of the options based on the criteria of sufficiency, relevance, reliability, consistency, recency, access and objectivity (Natale & Ricci 2006). Sufficiency is the evaluation of evidence that is based upon the adequacy in support for the claims, propositions and arguments put forth. In terms of relevance, the evidence is assessed based on germane issues and matters at present, whilst reliability concerns the presence of a good track record of support for the logic underpinning the arguments (Natale & Ricci 2006). Consistency pertains to the elements in the evidence in that they are both internally and externally consistent with one another: For example, in terms of what is known through direct observations, the experiences of others as well as from other sources. Recency is evaluated on the basis that the evidence and its supporting elements are current and not out-of-date. Access is about having the evidence, its elements and others supporting materials open and available for verification, whilst objectivity concerns the use of evidence and other supporting materials that are fair and undistorted.

Safi and Burrell (2007) support the view of Natale and Ricci (2006) as they state that critical thinkers are effective in learning as they consider all crucial aspects in decision making such as evidential, conceptual, methodological and contextual. They argue that critical thinking is crucial to helping individuals to learn and process information, such as summarising and teasing out the most relevant and important information from large amounts of detail. Spitzer and Evans (1997) go further in arguing that critical thinking in leadership and management decision making involves cutting through the clutter and demystifying the myths. In addition, Natale and Ricci (2006) state that, in addition, critical thinking contributes to effective team performance by promoting healthy conflict
and enabling people to learn to how to deal with conflict, which enhances the quality of decisions. Facione (2006) argues, counter to popular belief, that critical thinking involves being collaborative, "critical thinking is thinking that has a purpose (proving a point, interpreting what something means, solving a problem), but critical thinking can be a collaborative, non-competitive endeavour" (p. 3).

In summary, critical thinkers ask many questions before making decisions as they are more concerned about understanding the reasoning behind an ‘answer’ rather than being concerned about the ‘right answer’. This orientation helps those with a critical thinking disposition to be effective life-long learners (Celuch & Slama 2002). Critical thinkers tend to be effective learners because of the associated attributes of hard work, persistence and conscientiousness. Critical thinking, like learning, involves hard work and is not something that can be done or mastered in a casual or leisurely manner (Williams et al. 2004). Dewey (1933) argued that critical thinking is similar to learning as both require dedication and persistence. In addition, Friedel et al. (2008a) state that critical thinking is linked with job-related learning as both are deliberate and sometimes require reflectiveness. Based on the preceding discussion, we can postulate that critical thinking is positively correlated to job-related learning.

3.1.2 Critical Thinking and Creativity

The benefits of critical thinking are clear, and as Elder and Paul (1994) argue, critical thinking is at the heart of the future of every society in the world. However, developing critical-thinking skills is not easy and students are generally resistant to it as Kroll (1992) states that students are generally more comfortable with ‘ignorant certainty’ and ‘intellectual confusion’. Indeed, it is clear that developing critical-thinking skills takes effort as the most common descriptors are ‘purposeful’, ‘reasoned’ and ‘goal-directed’, which suggest that critical thinking is not an ‘everyday’/typical behaviour (Schamber & Mahoney 2006).

Critical thinking can be viewed as a ‘hard skill’ as it involves meaning, deductive logic and inductive logic, dealing with rhetoric and fallacies, and argument reconstruction (Bowell & Kemp 2005). The ‘hard skill’ perspective can be helpful for managers in ways such as developing paths and patterns in terms of reasoned judgment especially when the variables in a particular situation are continuously changing and evolving. This also extends to understanding how to build a group consensus in regards to complex and intricate matters, and learning to encourage others and also in ensuring that consideration
is given to the ideas of others (Safi & Burrell 2007). Celuch and Slama (2002) identify
the following steps outlined by the Foundation for Critical Thinking (1997) in
developing the hard skills of critical thinking (Table 49).

Table 49: How to Assess Elements of Critical Thinking (Foundation for Critical
Thinking 1997)

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>All reasoning has a PURPOSE.</td>
</tr>
<tr>
<td></td>
<td>• Take time to state your purpose clearly.</td>
</tr>
<tr>
<td></td>
<td>• Distinguish your purpose from related purposes.</td>
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<tr>
<td></td>
<td>• Check periodically to be sure you are still on target.</td>
</tr>
<tr>
<td></td>
<td>• Choose significant and realistic purposes.</td>
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<tr>
<td>2)</td>
<td>All reasoning is an attempt to FIGURE something out, to settle some Question, solve some PROBLEM.</td>
</tr>
<tr>
<td></td>
<td>• Take time to clearly and precisely state the question at issue.</td>
</tr>
<tr>
<td></td>
<td>• Express the question in several ways to clarify its meanings and scope.</td>
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<tr>
<td></td>
<td>• Break the question in sub-questions.</td>
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<tr>
<td></td>
<td>• Identify if the question has one right answer, is a matter of mere opinion, or requires reasoning from more than one point of view.</td>
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<tr>
<td>3)</td>
<td>All reasoning is based on ASSUMPTIONS.</td>
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<tr>
<td></td>
<td>• Clearly identify your assumptions and determine whether they are justifiable.</td>
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<tr>
<td></td>
<td>• Consider how your assumptions are shaping your point of view.</td>
</tr>
<tr>
<td>4)</td>
<td>All reasoning is done from some POINT OF VIEW.</td>
</tr>
<tr>
<td></td>
<td>• Identify your point of view.</td>
</tr>
<tr>
<td></td>
<td>• Seek other points of view and identify their strengths as well as weaknesses.</td>
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<tr>
<td></td>
<td>• Strive to be fair-minded in evaluating all points of view.</td>
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<tr>
<td>5)</td>
<td>All reasoning is based on DATA, INFORMATION &amp; EVIDENCE.</td>
</tr>
<tr>
<td></td>
<td>• Restrict your claims to those supported by the data you have.</td>
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<tr>
<td></td>
<td>• Search for information that opposes your position as well as information that supports it.</td>
</tr>
<tr>
<td></td>
<td>• Make sure that all information used is clear, accurate, and relevant to the question at issue.</td>
</tr>
<tr>
<td></td>
<td>• Make sure you have gathered sufficient information.</td>
</tr>
<tr>
<td>6)</td>
<td>All reasoning is expressed through, and shaped by, CONCEPTS and IDEAS.</td>
</tr>
<tr>
<td></td>
<td>• Identify key concepts and explain them clearly.</td>
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<tr>
<td></td>
<td>• Consider alternative concepts or alternative definitions to concepts.</td>
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<tr>
<td></td>
<td>• Make sure you are using concepts with care and precision.</td>
</tr>
<tr>
<td>7)</td>
<td>All reasoning contains INFERENCES or INTERPRETATIONS by which we draw CONCLUSIONS and give meaning to data.</td>
</tr>
<tr>
<td></td>
<td>• Infer only what the evidence implies.</td>
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<tr>
<td></td>
<td>• Check inferences for their consistency with each other.</td>
</tr>
<tr>
<td></td>
<td>• Identify assumptions which lead you to your inferences.</td>
</tr>
<tr>
<td>8)</td>
<td>All reasoning leads somewhere or has IMPLICATIONS and CONSEQUENCES.</td>
</tr>
<tr>
<td></td>
<td>• Trace the implications and consequences that follow from your reasoning.</td>
</tr>
<tr>
<td></td>
<td>• Search for negative as well as positive implications.</td>
</tr>
<tr>
<td></td>
<td>• Consider all possible consequences.</td>
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</tbody>
</table>
There is also the issue of whether critical thinking is domain general or domain specific. Whilst, Schamber and Mahoney (2006) consider critical thinking as both general and specific, there are others such as Williams and Worth (2002) who argue that subject-specific measures of critical thinking can be said to be more predictive and amenable to change, although they acknowledge that the results are mixed and that domain-general measures have greater utility across different areas. Nonetheless, it is argued that critical thinking promotes creativity in domain-general circumstances (i.e. problem solving) as it requires the individual to first ‘figure out’ what is going on.

Both aspects of critical thinking, as a skill and a disposition, have to be developed together so that they positively reinforce one another. As such, critical thinking and creativity share a similar notion in that both the ‘hard skills’ and dispositions must be fostered for the construct to manifest itself. Creativity does require the ‘hard skills’ of divergent and convergent thinking but also the disposition to be open to new ideas.

The development of critical thinking helps to foster the development of creativity (Zoller et al. 2000). The reconciliation of competing and conflicting information promotes and even necessitates creativity in ‘thinking out of the box’ (Lampert 2006). This is not unexpected as Williams and Worth (2002) state that this is why the development of critical thinking skills is one of the priorities in higher education, as it helps to promote higher thinking skills.

Indeed, according to some scholars, critical thinking goes hand-in-hand with creativity. For example, Fisher (2001) argues that critical thinking should be termed ‘critico-creative’ thinking as it involves some creativity in structuring arguments using credible evidence. The term critico-creative thinking is used to emphasise the “positive imaginative aspects” (p. 13) of critical thinking, and not just the negative connotation induced by the term ‘critical’. Renaud and Murray (2008) argue that critical thinking and creativity have at least the same ‘status’ because critical and creative thinking both make up ‘productive thinking’ (which in turn is synonymous with the upper constructs in Bloom’s taxonomy of evaluation, synthesis and analysis), whilst Kakai (2000) asserts that creativity and critical thinking are higher-order thinking skills, and both overlap greatly with one another, and cannot be completely separated.

The definition of critical thinking by some authors includes what critical thinking does. And in some of these definitions they allude to the development of creativity as a result of critical thinking. This is pointed by Edwards (2003) in her review of critical thinking in
nursing. The key feature to note, according to Edwards (2003), is that irrespective of the approaches or definition adopted, there is always an element of creativity in critical thinking. For example, of the four characteristics of critical thinking by Walters (1986); i) method of problem solving and ii) problem analysis, iii) problem formulation and iv) problem and solution fit, the latter two characteristics relate to creativity as they involve thinking out of the box in shaping non-routine problems into a perspective that can be analysed, and in developing novel solutions. In addition, part of a definition offered by Alfaro-LaFevre (1999) includes being resourceful in developing new strategies in problem solving. In addition, the nine elements of critical thinking put forth by Daly (1998) of knowledge, cognitive skills, complex reasoning, argumentation, beliefs, action, problem identification, evidence, and last but not least also involves imagining/visualising alternative frames of possibilities, which is a creative process. Finally, Clark-Birx (1993) identified five aspects critical thinking; a positive attitude of openness and enquiry, knowledge and experience, meta-cognition and ability to reflect, integration of multiple levels of views and perspective-taking. The components of openness and perspective-taking are highly linked to creativity as openness is to entertain new ideas, whilst perspective-taking helps with enhancing the stimulus for creativity by ‘seeing things’ from various angles. Based on the preceding discussion, we can postulate that critical thinking is positively correlated to creativity.

3.1.3 Job-Related Learning and Creativity

Job-related learning is crucial for creativity. Job-related knowledge helps individuals to gain relevant knowledge concerning their jobs, workplaces and organisations. Such knowledge is the fuel for the process of divergent thinking and ideation. In addition, without knowledge, without knowing, it is more difficult for individuals to make links between different points, issues and/or ideas.

Job-related learning helps individuals to be creative in two ways. The first is by accumulating knowledge to facilitate divergent thinking (ideation) and convergent thinking (being able to link issues together requires knowledge of the issues in the first place). Secondly, job-related learning not only helps individuals to just gain knowledge but also to be aware of the nature of knowledge. Individuals who are effective in job-related learning recognise that knowledge is fluid and that ‘truth’ cannot be taken for granted.
There are four qualitative ways of knowing: absolute, transitional, independent and contextual (Baxter Magolda (1999)). The absolute way is when the knower believes that there is either a right or wrong way. This way is usually either related to very few specific domains or the naivety of the knower. Thus, when involved in job-related learning the individual focuses on absorbing knowledge. In this regards, the individual’s approach to any assessment is to simply regurgitate what has been learned. The transitional way, occurs when the individual believes that the knowledge is certain in some areas and uncertain in others. At this stage, the knowledge gained as part of job-related learning helps the individuals to begin questioning knowledge itself and the focus of learning is on understanding so that critical evaluation can take place.

In the independent way of knowing, there is the assumption that knowledge is mostly uncertain. Here, the individual is proficient at job-related learning. The individual acknowledges and accepts that ‘knowledge’ is in many cases subjective as it is influenced by people’s beliefs and opinions. The individual in turn starts to develop his/her own beliefs and stances, although he/she needs to be encouraged be reflective. The individual’s progresses by developing his/her independent views and therefore becomes more conscious that he/ she has the liberty to be more creative. The final, contextual way is the acceptance that most knowledge is uncertain and the individual does not necessarily believe that ‘everything goes’ but that one judges knowledge based on its context. What is knowledge thus involves understanding how knowledge is constructed and applied. The evidence and credibility to claims of knowledge (as with judgements and opinions) becomes crucial as knowledge is subjective.

Fyfe, Rittle-Johnson and DeCaro (2012) add to the notion that knowledge is complex. The production of knowledge is also dependent on people’s individual differences such as prior knowledge, which in turn is explained by the individual’s memory and cognition load. The production of knowledge depends on what the individual already knows (and believes). Fyfe et al. (2012) argue that job-related learning and knowledge are processes of discovery and the way the world is interpreted is subjective due to an individual’s personality and interests (Ackerman & Beier 2003). The state of knowledge in the individual is also affected by motivation. Individuals who are more knowledgeable may be motivated, and those who are motivated may be more willing to test themselves in less structured and challenging environments compared to those who are less motivated (reverse-order effects) (Fyfe et al. 2012). Thus, the ‘knower’ plays a key role in the accumulation, production and creation (being creative) of knowledge.
Understanding the knowledge is as important as the context. This notion is supported by von Glasersfeld (1995) who argued that new knowledge arises from learners’ active construction in applying their own unique prior knowledge in making sense of the world at large. Schuh (2003) states that contextual knowledge can be enhanced through learner-centred/ context-focused (i.e. job-related learning) instruction that encourages learners to draw upon their experience and interpretations. The construct of job-related learning concerns accumulating new domain-specific knowledge that can directly help to improve job performance, and thereby enhance new job-related skills and to be creative in the workplace.

Individuals who are effective in job-related learning tend to experience some form of emancipation in terms of knowledge. These individuals tend to feel at liberty in knowing that there is not just ‘one way’ of doing things and this enhances the likelihood of looking for and finding new ideas and ways of undertaking work. As a result, job-related learning is likely to make one more imaginative and inventive with respect to work-related issues. Based on the preceding discussion, we can postulate that job-related learning is positively correlated to creativity.

It has been postulated, based on the discussion provided in Section 3.1.1, that critical thinking is positively correlated to job-related learning. Additionally, based on the discussion provided in Section 3.1.2, it has been postulated that critical thinking is positively correlated to creativity. Finally, based on the discussion provided in Section 3.1.3, it has been postulated that job-related learning is positively correlated to creativity. The following hypothesis is therefore proposed:

Hypothesis 1: Job-related learning mediates the relationship between critical thinking and creativity.
3.2. Problem Solving, Job-Related Learning and Creativity

This section argues why and how (i) problem solving is related to job-related learning, and (ii) problem solving is related to creativity (the argument that job-related learning influences creativity is discussed in Section 3.1.3). Finally, based on the three conjectures, it is hypothesised that job-related learning mediates the relationship between problem solving and creativity.

3.2.1 Problem Solving and Job-Related Learning

Chang et al. (2007) argue that effective problem solving is linked to various aspects of an individual ranging from cognitive, affective, and behavioural facets. Similarly, Heppner et al. (1995) state that problem solving involves “cognitive, behavioral, and affective coping activities aimed at altering the cause of a stressful problem” (p. 280). Heppner and Krauskopf (1987) define problem solving as “…a goal-directed sequence of cognitive and affective operations as well as behavioural responses for the purpose of adapting to internal and external demands or challenges” (p. 375), whilst Raven (2000) defined problem solving as “…it [problem solving] involves initiating, usually on the basis of hunches or feelings, experimental interactions with the environment to clarify the nature of a problem and potential solutions. […] In this way they [the problem solvers] can learn more about the nature of the problem and the effectiveness of their strategies. […] They can then modify their behaviour and launch a further round of experimental interactions with the environment” (p. 479). D'Zurilla et al. (2004) define problem solving as “the self-directed cognitive-behavioral process by which an individual, couple, or group attempts to identify or discover effective solutions for specific problem encountered in everyday living” (p. 12). They posit that problem solving is a skill, which refers to cognitive and behavioural activities.

An important assumption from the definitions provided by Heppner and Krauskopf, Raven and D'Zurilla, Nezu and Maydeu-Olivares is that individuals are able to change strategies and tactics as part of the problem-solving process. This means that as a result of the problem-solving process, people learn. They learn to change frames of mind when required, they learn as they gain more insight into the nature of the problem, and they learn to identify and develop solutions to address the problem. Problem solving leads to effective learning as it challenges individuals in various ways. Quesada et al. (2005) posit that problem solving is dependent on a number of factors and may be viewed as a
collection of skills, capabilities and affect traits. They argue that problem solving involves both ‘task’ and planning-based skills. Task skills are required to solve problems but the ability to plan the way forward in addressing the problem is equally important, which of course may also be part of the problem that needs to be addressed. Problem-solving competencies are characterised in many ways and underpinned by various factors such as cognitive abilities, dispositions and motivations, which comprehensively contribute to the development learning skills.

The cognitive aspect of problem solving is important as it is the mental ability of individuals that facilitates learning in the identification and development of solutions (as mentioned as part of the reasoning process). Nonetheless, the passive aspect of cognition is just as important as the active (i.e. reasoning) aspect specifically when it involves incubation. The hypothesis underlying the phenomenon of incubation is that during this period nodes in the brain are activated, thus allowing the solver to make more connection thus facilitating problem solving (Sio & Rudowicz 2007). However, there may be other explanations such as forgetfulness or the incubation period merely being a form of rest that helps to deal with mental fatigue (Dodds, Smith & Ward 2002).

A problem-solving disposition engages individuals in both a cerebral manner and an affective manner. When an individual engages in problem solving he/she learns from the process in identifying the problem and in evaluating the feasibility of the solutions. In addition, when an individual engages in problem solving, they learn to be persistent and tend to persevere.

A key aspect of learning is the development of effective metacognitive abilities also help to negate dysfunctional mental processes such as fixation (Smith & Blankenship 1991). Individuals have an Einstellung, or a mental set, that naturally or artificially primes them to think in certain ways (Luchins & Luchins 1959), which is, fixation. Fixation also relates to the tip-of-the-tongue (TOT) phenomenon (Jones 1989) and can be induced. For example, TOT occurs when words that sound like the target word (i.e., interlopers) are used in conjunction with the target words inducing a form of fixation (Smith & Blankenship 1991). A period of mentally removing oneself from a problem helps to solve a problem (Sio & Rudowicz 2007). This is important as individuals learn when to focus on a problem and when to ‘let go’ momentarily.

Problem solving helps people to realise that human cognition will always be limited, hence learning helps to overcome this limitation. Starling (1992) notes that the limitation
of effective problem solving may be inherently due to the limitations of cognition. He states that studies have shown that people’s intuitive inferences, predictions and diagnoses do not conform to laws of probability theory and statistics. In addition, individuals are limited by biases and bounded rationality. Thus, by attempting to address problems, individuals start to learn about their own limitations and this informs their future approaches to problem solving.

Von Der Weth and Frankenberger (1995) argue that there are other attributes that contribute to learning through problem solving that are equally if not more important than cognitive capability (Von Der Weth & Frankenberger 1995). Learning from effective problem solving relies on an amalgamation of facets such as motivation, emotions, personality traits and thinking styles (Spering, Wagener & Funke 2005; O’Loughlin & McFadzean 1999). Von Der Weth and Frankenberger (1995) found that effective learning and problem solving by engineering designers are primarily due to domain-specific knowledge, the effective use of heuristics in developing rules for rule-making (heuristics competence), willingness to consider external information, perseverance, self-confidence in novel and complex situations and the ability to reflect on behaviour for learning. Learning is an important element in problem solving as the activity of problem solving is highly iterative as it involves considering and evaluating alternatives (Starling 1992).

Heppner et al. (1995) state that effective problem solving is dependent on personality traits, which also shape problem-solving styles. An individual’s style and preferences play a significant role in how he/she approaches and addresses problems (Shaw, Selby & Houtz 2009). Evidence suggests that problem-solving dispositions are associated with academic achievement (Heppner & Baker 1997). Disposition to problem solving is linked to attitudes towards change. An individual who is more disposed to approaching problems (rather than avoiding problems) tends to have more positive attitudes towards change (Heppner & Baker 1997). O’Loughlin and McFadzean (1999) argue that possessing the ‘right’ disposition for problem solving helps to unlock problem-solving skills and capabilities in individuals. For example, some individuals may be intelligent and have effective capabilities in problem solving. However, if such individuals do not have the perseverance, self-efficacy and are impulsive, they may not be able to leverage upon the hard skills that they possess as they will give up easily and or come up with the wrong solutions.

Chang et al. (2007) state that there are three problem solving styles (i.e., reflective, reactive and suppressive) that may impact on how well an individual learns. The
reflective style involves cognitive-affective dimensions in problem solving and is characterised by a systematic manner in dealing with problems. The reactive style involves cognitive-behavioural dimensions and is associated with impulsivity. The suppressive style involves cognitive-behavioural-affective dimensions that are characterised by denial or avoidance of problems. Spering et al. (2005) assert that different emotions (i.e. positive and negative) elicit different types of problem-solving strategies and thus learning. The reflective style of problem solving would therefore lead to better/more job-related learning.

There are generally two categories of problems, domain general (e.g. in life) and domain specific (e.g. in the workplace or related to one’s occupation). One may reason that domain-general problems are highly dependent on individuals’ reasoning skills in working out a solution to a problem. However, domain-specific problems most likely will require specific knowledge. For example, there may be idiosyncrasies that are unique to a particular domain that one must know about in order to solve the problem. In such situations, job-related learning becomes more crucial as it is the accumulation of unique/specific knowledge that then becomes imperative. Such knowledge-intensive situations (Quesada et al. 2005) inherently compel individuals to have high levels of job-related learning. In addition, job-related learning is also necessitated when an individual needs to learn about new approaches to problem solving (in addition to learning about specific inputs required). Based on the preceding discussion, we can postulate that problem solving is positively correlated to job-related learning.

3.2.2 Problem Solving and Creativity
Creativity is an essential outcome of problem solving (Lee & Cho 2007). Creativity is necessitated by problem solving in terms of problem construction (i.e. problem framing and formulation), information gathering, concept selection and multiple perspective-taking (Osburn & Mumford 2006). Creativity is necessitated by problem solving as it helps individuals to pre-empt the effectiveness of their solutions by forecasting the impact and effects of the solutions (Osburn & Mumford 2006).

Heppner and Baker (1997) assert that personal attributes such as confidence, self-efficacy and curiosity, as well as the ability to control impulsiveness also has an impact on the quality of the problem-solving process. This notion is supported by Wenke (2005) as he asserts that effective problem solving is an interplay amongst various factors including motivational and cognitive factors that then impacts on outcomes such as learning.
Problem finding, as part of the problem solving process, for example plays a significant role shaping creativity as it is not just about the problems per se as it also involves the recognition of a desirable situation (Jay & Perkins 1997). Problem finding is synonymous with various terms such as problem recognition and detection, problem expression and articulation, problem identification and construction, problem definition and creative discovery (Dudek & Côté 1994; Runco 1994; Runco & Okuda 1988). Problem finding influences creativity as it is uses both divergent and convergent thinking.

Problem finding is not necessary in all situations. Well-defined problems do not need the problem-finding step as the current and goal state, as well as the constraints and operators are usually well defined thus leaving little room for the need for problem finding (Lee & Cho 2007). Problem finding is most useful with ill-structured problems as such situations necessitate the problem solver to use their own resources to ‘find the problem’. Thus the success of problem finding is dependent on how structured a problem situation is be it ill-structured, moderately structured and/or well-structured. It is expected that the more structured the problem, the easier it is to ‘find’ the problem (due to the situation itself rather than to the actor). The more ill-structured a problem the more creativity is required.

Problem solving and creativity are closely intertwined, and concepts such as creative problem solving reflect this close relationship between the two constructs. Creative problem solving is about looking at problems in a new way (Danielson & Mitchell 1995), which is similar to insight problem solving. The key difference is that creative problem solving is more associated with divergent thinking. Creative problem solving was initially developed by Osborn (1979) and was conceptualised as a process involving a series of three steps: fact-finding, idea-finding and solution finding. These steps are similar to the steps in problem solving. It emphasises understanding the problem, also called mess finding (Arbesman & Puccio 2001). Mess finding involves being cognisant of a problem and appreciating its complexities in terms of all aspects of the problem. Osburn and Mumford (2006) assert that penetration and forecasting skills are key aspects of creative problem solving. Penetration is understanding and identifying the causes, resources and restriction of the problem, whilst forecasting concerns the projection of positive and negative outcomes of the solution.

A positive problem solving disposition helps to cultivate other attributes such as self-awareness and regulation (Rahim & Minors 2003), as well as creativity (Osburn & Mumford 2006), which are also important contributors to effective problem finding,
framing, formulation and solving. Based on the preceding discussion, we can postulate that problem solving is positively correlated to creativity.

It has been postulated, based on the discussion provided in Section 3.2.1, that problem solving is positively correlated to job-related learning. Additionally, based on the discussion provided in Section 3.2.2, it has been postulated that problem solving is positively correlated to creativity. Finally, based on the discussion provided in Section 3.1.3, it has been postulated that job-related learning is positively correlated to creativity. The following hypothesis is therefore proposed:

*Hypothesis 2: Job-related learning mediates the relationship between problem solving and creativity.*
3.3. **METACOGNITION, JOB-RELATED LEARNING AND CREATIVITY**

This section argues why and how (i) metacognition is related to job-related learning, and (ii) metacognition is related to creativity (the argument that job-related learning influences creativity is discussed in Section 3.1.3). Finally, based on the three conjectures, it is hypothesised that job-related learning mediates the relationship between metacognition and creativity.

3.3.1 **Metacognition and Job-Related Learning**

Metacognition disposition enables individuals to learn more effectively on the job as it enhances individuals’ awareness of their cognitive processes, and thus enables them to be more perceptive in their evaluation of their own learning (Thomas & McRobbie 2001). Being able to effectively assess their own learning helps individuals to determine the magnitude and intensity of knowledge that they gain. This in turn allows individuals to better understand and construct their own cognitive strategies when learning (Veenman et al. 2006). Coutinho (2007) supports this assertion as he observes that individuals with effective metacognition tend to be better in their education and achieve academic success. Indeed, metacognition enables individuals to gather information about their own learning styles, and learning and cognitive strategies in light of different problems (Wenden 1998). A number of scholars recognise this inherent link in the form of metacognitive learning (Garner & Alexander 1989), metalearning (White & Gunstone 1989), deutero learning (Bateson 1983), and triple-loop and double-loop learning (Argyris 2005; Tosey et al. 2011).

The essence of metacognition is its monitoring function rather than as a function of knowledge. ‘Knowledge about knowledge’ is essentially individuals’ beliefs about their knowledge and not necessarily their knowledge *per se*. In other words, what individuals’ believe about their own knowledge may be erroneous. Nevertheless it is likely that, as individuals further develop their metacognitive skills, their ‘approximation of their own knowledge’ becomes more accurate. Ultimately, it is the monitoring function in metacognition that is most crucial. Monitoring helps individuals to know how well they are doing in their learning, and how well they are developing and progressing (Coutinho 2007).

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3 Metacognition self-consciousness is referred to metacognition (MC) in short from hereon.
Metacognition influences job-related learning by first promoting self-regulated learning. Langan-Fox et al. (2002) argue that “self-regulatory processes are critical determinants of performance and of the development of competencies. Self-regulation is an important mechanism for initiating changes in resource allocation policy toward a task and occurs when people adopt difficult goals and perceive themselves to have adequate skills to complete the task. Components of self-regulation include self-monitoring and self-evaluation” (p. 109). Metacognition and self-regulation are intricately linked (Wenden 1998).

The term self-regulated learning is used interchangeably with both metacognition and self-regulation (Alexander 2008). The work of Fox and Riconscente (2008) shows that metacognition, self-regulation and self-regulated learning are inter-related, whilst Brown (1987) states that the three are “incestuously related” (p. 66). Efklides et al. (2006) state that metacognition and self-regulation go hand-in-hand because metacognitive experiences are crucial for self-regulated learning as metacognitive experiences are “feelings, judgements/estimates and thoughts people are aware of during task processing” (p. 5). The integration between metacognition and self-regulation is reflected in some measures such as the Motivated Strategies for Learning Questionnaire (MSLQ) (Artino Jr 2005).

Dinsmore, Alexander and Loughlin (2008) argue that whilst metacognition, self-regulation and self-regulated learning are inter-related they are fundamentally quite different from one another. They posit that metacognition is endogenous constructivism that concerns reflection of new and existing cognitive structures and schemas that emphasise learner development and learner-environment interactions. Self-regulation appears to be an exogenous constructivism phenomenon that take cues from the external environment, whilst self-regulated learning is both endogenous and exogenous constructivism. Nonetheless, all three work together in a productive way. Dinsmore et al. (2008) state that meta-cognition, self-regulation and self-regulated learning are “a marriage between self-awareness and the intention to act” (p. 404). Table 50 provides the differences and relationships amongst metacognition, self-regulation and self-regulated learning as per Fox and Riconscente (2008).
Table 50: Difference between metacognition, self-regulation and self-regulated learning (Fox & Riconscente 2008)

<table>
<thead>
<tr>
<th>Interpretive framework</th>
<th>Metacognition</th>
<th>Self-regulation</th>
<th>Theorist</th>
<th>Orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knower</td>
<td>Actor</td>
<td>James</td>
<td>Self</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>Agency</td>
<td>Vygotsky</td>
<td>Language</td>
<td></td>
</tr>
<tr>
<td>Object of knowledge</td>
<td>Object of action</td>
<td>Piaget</td>
<td>Other/object</td>
<td></td>
</tr>
</tbody>
</table>

Schunk (2008) states that whilst there are strong links amongst meta-cognition, self-regulation and self-regulated learning, each is defined differently. Metacognition is a form of cognitive activity that facilitates the regulation of any cognitive aspects (Flavell 2004). Self-regulation concerns being engaged in observing oneself, self-judgment and self-reaction in attempting to assess and influence one’s external environment (Bandura 1986). He states that self-regulated learning is the process of activating and sustaining cognition and behaviours in attaining learning goals (Zimmerman 1986). Lajoie (2008) argues the difference between self-regulation and metacognition. Self-regulation is about planning, monitoring effectiveness, testing and re-evaluating strategies, whereas metacognition is about knowledge about cognition. Metacognition is more about the mind that triggers judgements and evaluations, whereas self-regulation concerns the interaction with the environment in stimulating the individual’s self-regulation responses.

Pintrich and De Groot (1990) argue that self-regulation is the ‘parent’ construct and subsumes metacognition because self-regulation comprises dimensions of metacognition (i.e. planning, monitoring and modifying cognitions). Eccles and Wigfield (2002) state that individuals with high levels of self-regulation and self-regulated learning are those who are active in terms of metacognition, their own motivations and behaviour especially in terms of their own learning and in attaining personal goals. These views are supported by Kaplan (2008) who asserted that the phenomenon of self-regulation action incorporates metacognition. Cotterall and Murray (2009), conversely, intimate that self-regulation is part of metacognition as the individuals who score high on self-regulation are those that have metacognitive skills involving planning, organising, self-instructing, self-monitoring (of various stages of the learning process). Both are highly inter-related and have a synergistic relationship. Individuals with metacognition are better able to self-regulate and become able learners and high performers. Metacognition plays a significant role in addressing maladaptive forms of coping (Spada, Mohiyeddini & Wells 2008b).
Metacognition helps individuals to appreciate contextual and situational factors that are involved in their learning (Veenman et al. 2006). Thus, metacognition enables the effective transfer of learning especially within the workplace (Fisher 1998) and determines the durability of learning (Georghiades 2000). Transfer of learning is the application of something that has been previously learned in a relatively new and/or different context compared to when the initial learning took place (McKeachie 1987).

There is a difference between transfer and application (application is a sub-set of transfer), as transfer involves (a) recognition of similarity between the two contexts, (b) acknowledgement of what worked in the past could work elsewhere, (c) mental testing of the application of previously learned concepts to new contexts, and (d) attempts to apply existing knowledge/skills to new contexts (Georghiades 2000).

The role of metacognition in the transfer of learning is explained by Georghiades (2000); “metacognition as a process of reflecting upon, and taking action about, one’s learning, occurs as a potential solution to this problem. Similarly, one can argue that positive impact of successful metacognitive instruction can be extended to students’ abilities to both transfer and to retain conceptions for a longer time. The equation is as follows: by being reflective, revisiting the learning process, making comparisons between prior and current conceptions, and being aware of and analysing difficulties, learners gradually maintain deeper understanding of the learned material. One can, therefore, safely make two assertions: first, it is more likely that the person who holds better understanding of a certain concept will be able to identify the use and purpose of this knowledge, to handle learned material in a different manner and to explore potential use of this material under a number of different circumstances. Put differently, maintaining better understanding sets the bases for successful transfer. Secondly, better understanding means: (a) greater ability to utilize learned material, in order to meet the learner’s needs, and (b) greater confidence regarding learned material. These outcomes can be related to longer durability of conceptions: (i) the more a newly learned scientific conception serves the needs of the learner, the longer it will last, and (ii) the learner who is confident about what he or she knows will have no reason to regress to the ‘safety’ of any personal prior misconceptions” (p. 128)

Wenden (1998) states that metacognitive knowledge makes transfer of learning much more effective and therefore helps individuals to gain and apply new knowledge within the workplace. This is because metacognitive knowledge facilitates the selection of appropriate strategies. The choice of strategies is then discerned within a specific context in identifying the best strategy to apply in a particular situation. She argues that there are
two views of transfer of learning that must nonetheless be considered, the motivational view and the methodological view. The motivational view regards self-efficacy and belief as necessary. The learner must believe that he/she is able to transfer learning and that this process will be successful. In this methodological view, both strategic and task knowledge are crucial and necessary for the process of transfer of learning to take place. Mindfulness is promoted when the learner learns about the similarities and differences between previous learnings tasks. Transfer of learning is most effective when both self-efficacy and effective strategies are present.

Metacognition increases awareness of self and environment and thus provides individuals with opportunities to self-regulate, which in turn also helps them to better develop and influence their learning strategies Veenman et al. (2006). Metacognition helps individuals to know and recognise/understand their zone of proximal development and how to progress to the next level (Wenden 1998). However, like many other intellectual skills, metacognition does not develop fully on its own and requires personal reflection and evaluation.

Individuals with high levels of metacognition tend to achieve better academic success than do individuals with low levels of metacognition (Thomas & McRobbie 2001). These individuals develop strategies to learn more effectively, use the right approaches and skills to solve problems and to correctly estimate their performance levels and can recalibrate when required (Coutinho 2007), all of which lead to better academic success (Dunning et al. 2003). Metacognitive knowledge helps with the effectiveness of overall learning (Dickinson 1995), specifically text comprehension (Brown, Armbuster & Baker 1986), facilitates recall (Flavell 1979) and the completion of new types of tasks (Vann & Abraham 1990), improves rates of progress in learning (Victon & Lockart 1995) and improves the quality of learning (Pintrich, Marx & Boyle 1993). The use of metacognition in learning characterises the approach taken by expert learners (Baker & Brown 1984).

Kuhn and Dean (2004) argue that metacognition is a bridge between cognitive psychology and educational practice. Metacognition, they argue, bridges the two families of intellectual skill; inquiry and argumentation. Metacognition can be procedural (i.e. involving awareness and management of one’s own thinking), or declarative (i.e. involving broad general understanding of thinking and knowing). Metacognition is crucial for effective skill acquisition in the workplace (Langan-Fox et al. 2002). Individuals with highly developed metacognitive skills usually have a diverse repertoire
of strategies that they can use for acquiring skills. For example, skilled listeners with high metacognitive strategies have twice as many learning strategies than those with less skills in listening (Vandergrift 2005).

Metacognition is a powerful predictor of learning (Wang, Haertel & Walberg 1990) and individuals with high levels of metacognition are better learners (Flavell (2004). Metacognition enables individuals to create positive affective states (e.g. emotional stability) that can help them to learn more effectively (Thomas et al. 2008). Based on the preceding discussion, we can postulate that metacognition is positively correlated to job-related learning.

3.3.2 Metacognition and Creativity

Metacognition promotes creativity by facilitating divergent and convergent thinking. It helps to prompt introspection resulting in individuals asking themselves if they are ‘seeing things’ from different angles in improving the quality of ideas (Flavell 2004). Flavell (1979) argues that a healthy level of monitoring of thoughts helps with being adaptive as it makes individuals more aware, and ready to change. Metacognition, through the monitoring of thoughts (Cartwright-Hatton 1997), becomes more crucial as complexity increases and sensitises people to new ideas (Smilk et al. 2008).

Metacognition disposition helps individuals to address novel problems because nove problems require individuals to be able and willing to monitor and adjust their strategies by reflecting on the results attained hey have already achieved (Hoffman & Schraw 2010). Metacognition is most effective when skill-based and rule-based behaviour and decision-making processes are not appropriate such as with in ill-structured problems (Langan-Fox et al. 2002). Metacognition helps to solve ill-structured problems (Sigler & Tallent-Runnels 2006) by helping individuals to be more creative. Whilst content and domain knowledge are essential for effective problem solving, metacognition makes the process more effective by enabling the learner to monitor the process and revise any errors. Metacognition is more about helping individuals to develop new rules/methods when faced with ill-structured, novel and complex problems.

Fisher (1998) elaborates on how metacognition helps the solving of novel problems through creativity. He suggests that metacognition enables individuals to firstly be aware of and recognise that there is a problem. Metacognition also enables the individual to identify and define the elements present in the problematic situation. Next metacognition
helps the individual to be able to represent the problem in the form of a mental map that also enables the individual to compare this map with other maps, which involves both divergent-thinking and convergent-thinking processes. The next step facilitated by metacognition is the ability to plan how to proceed, determining the resources required and setting goals. The last step is in helping to evaluate the effectiveness of the solution after it has been implemented and in informing the individual of known knowns and known unknowns.

Fisher (1998) states that the presence of metacognition in the creativity and novel problem-solving process may not always be obvious. He argues that metacognition plays a role in various levels of awareness; tacit use (not entirely being aware that metacognition is playing a role), aware of use (consciously aware but not ‘explainable’), strategic use (able to organise and use metacognition in a strategic manner), and reflective use (reflecting on thinking before, during and after problem solving in assessing one’s effectiveness and how to make improvements).

Fisher (1998) also argues that the effective use of mental frames is influenced by metacognition and is what differentiates the expert from the novice. Fisher (1998) states “in solving complex problems a novice typically needs to focus on each part of the task, whereas the expert recalls the appropriate technique or ‘thinking frame’ from past experience, enabling their thinking to be concentrated at a broader and more strategic level. Experts are able to review and process larger chunks of information than novices because their thinking is strategic rather than localised. Experts tend to categorise their knowledge whereas novices need to focus afresh on each individual task. This research points out the importance of emphasising the structure rather than the surface features of a task, for encouraging learners to generalise their learning and to make links between experiences” (p. 6-7).

The process articulated by Fisher (1998) shows that experts with metacognitive skills are predisposed to creative ideas due to their ability to ‘chunk’ and re-categorise information, which enables them to gain more insights through convergent thinking. This is observed as high-road information processing that involves deliberate and mindful extraction of principles, rules and ideas to be applied in another context (Perkins & Salomon 1992), thereby increasing the opportunities for creative ideas to flourish. This is in contrast to the low-road information processing adopted by novices.
Metacognition is related to a range of mental aptitudes such as intelligence, reading, mathematics and memory. However, individuals with high metacognition have been found to be better at creatively solving problems (Swanson 1990). Metacognition compensates for low aptitude. Metacognition may also compensate, to a certain degree, for the lack of domain-specific knowledge. This is supported by Al-Hilawani (2003) as he asserts that students with high metacognition used fewer steps in problem solving compared to those with low metacognition (and in turn high aptitude was required for individuals with low metacognition), which may be due to their ability to be more creative in the way in which they approach problem solving. Based on the preceding discussion, we can postulate that metacognition is positively correlated to creativity.

It has been postulated, based on the discussion provided in Section 3.3.1, that metacognition is positively correlated to job-related learning. Additionally, based on the discussion provided in Section 3.3.2, it has been postulated that metacognition is positively correlated to creativity. Finally, based on the discussion provided in Section 3.1.3, it has been postulated that job-related learning is positively correlated to creativity. The following hypothesis is therefore proposed:

_Hypothesis 3: Job-related learning mediates the relationship between metacognition and creativity._
3.4 SYSTEMS THINKING, JOB-RELATED LEARNING AND CREATIVITY

This section argues why and how (i) systems thinking is related to job-related learning, and (ii) systems thinking is related to creativity (the argument that job-related learning influences creativity is discussed in Section 3.1.3). Finally, based on the three conjectures, it is hypothesised that job-related learning mediates the relationship between systems thinking and creativity.

3.4.1 Systems Thinking and Job-Related Learning

Senge (1992; 1994) argues that although systems thinking can be said to be a method, tool or even a set of principles, it is most helpful if it is conceptualised as a tool underpinned by a body of knowledge. Senge et al. (1994) defines systems thinking as “A conceptual framework, a body of knowledge and tools that has been developed over the past fifty years, to make the full patterns [of interconnections of elements associated with an event conceived as a whole] clearer, and to help us see how to change them effectively” (p. 7).

A system is something that ‘hangs together’, however, how well something hangs together depends on the quality of perception of the observer in ‘causing’ elements in the system to come together. This notion was highlighted in the soft systems methodologies approach as the individual’s model of reality is what really matters in systems thinking (Wreme & Sorrenti 1997).

All systems have a core systemic structure, however, ‘structure’ in this sense is a ‘pattern’ of interrelationship amongst the key subsystems (or components) in the system. Systemic structures are built consciously and unconsciously (Senge 1992). Systems thinking is about the whole, however humans are fallible and it is difficult for us to see the entire ‘whole’. Thus sometimes we have to be selective and make trade-offs in terms of what we focus on. Systems thinking is about recognising ramifications and trade-offs. Systems thinking is about attempting to adopt a different view of a system (Senge et al. 1994).

Senge (1992) outlines some principles of systems thinking; i) there is always a time lag between a cause and its effect, thus drawing conclusions too quickly may be erroneous, ii) all systems have leverages and the most effective action is usually the subtlest, iii) always consider the latent effect of elements, iv) quick wins will always unravel quickly as it means that only symptoms are addressed and not the root cause. This is similar to
how sometimes today’s solution becomes tomorrow’s problems. In addition, v) systems also include intangibles such as perceptions, attitudes and emotions, vi) when applying systems thinking, do not select problems that are non-recurring (one-offs), and vii) ask ‘why’ to find a series of events. He suggest that we avoid fixation on events, and focus on systemic explanations. When applied to an organisational context, these principles help individuals to better learn about their jobs as they are able to understand how their jobs and the work that they do relates to the organisational context such as the organisation’s strategy, systems, processes, teams, and individuals’ roles and responsibilities.

Systems thinking involves identifying underlying structures (Senge et al. 1994). Underlying structures are interleaved over time and solidifies into an accepted convention. The identification of underlying structures and leverages in a system helps to understand a system and the mechanics that it thrives on. Systems have an optimal growth rate that cannot be accelerated without risking adverse outcomes to the entire system. Understanding a system and identifying its leverages enables the effective manipulation and influence of certain outcomes. Leverages are analogous to the root causes of problems, in contrast to ‘events’ that may be analogous to the symptoms of a problem. Addressing the root causes of problems is at the leverage point of a system. By viewing the organisation, groups and their jobs from a systems viewpoint, individuals will significantly learn more about their job.

The nature of feedback that is emphasised in systems thinking significantly influences individuals learning specifically in terms of how they expect and use feedback from their actions as part of their learning process. It can be argued that systems thinkers proactively seek out feedback to learn from thereby enhancing job-related learning in the workplace. Cause-and-effect do not necessarily equate with time and space (Senge et al. 1994). Hence, at times people do not directly experience the consequences of their actions. The scale of ‘causes’ and the magnitude of effects may not correspond synchronously in terms of proportion and location. This poses a challenge to systems thinking as it is only human nature to find relationships between matters that are in a direct cause-and-effect manner. However, these cause-and-effect relationships tend to become a pattern over time (Senge et al. 1994). They are subtle due to delays and intervals but they may intensify and escalate due to reinforcement over time. Senge (1992) argues that problems are shared throughout a system though addressing a problem does not require addressing the entire system but at the system’s leverage points (Senge 1992). Systems thinking also facilitates job-related learning in terms of emphasising interconnections such as those amongst process quality, throughput pressure, reliability and maintenance (Jambekar 2000).
Systems thinking enhances job-related learning through the creation of knowledge. Montuori (2000) argues that systems thinking concerns a “mutual exchange of influence” (p. 64) and helps people to see interrelationships within and external to organisations in ensuring that any changes made are holistic and the consequences of any proposed change are recognised. This view is supported by Rosenthal (2003), who states that systems thinking emphasises learning (i.e. feedback loops) and that by being able to recognise patterns and relationships within and across domains, system thinking and practice will help individuals to develop solutions that communicate, understand and ‘improve’ systems. Ultimately organisational learning is an outgrowth of systems thinking, and is considered as systems thinking in ‘action’ (Montuori 2000).

Systems thinking compel individuals to learn more about their jobs in the context of the organization and teams that shows how it is interconnected to these other ‘systems’. In addition, the language of systems thinking helps individuals to adopt a non-linear view of their jobs and work, and how their action and behaviours has implications on others. Systems thinking also influences individuals to appreciate and look for feedback, which is a mechanism for informal learning. Finally, the various systems methodology helps individuals to learn about different viewpoints of an organisation. Based on the preceding discussion, we can postulate that systems thinking is positively correlated to job-related learning.

3.4.2 Systems Thinking and Creativity

Systems thinking promotes creativity as it compels individuals to ‘see’ the whole, be cognisant of relationships between different parts of a system (e.g., an organisation) and hence facilitate understanding the different viewpoints from which problems can be seen thereby fostering the discovery of creative solutions. A systems thinking disposition promotes non-linearity in one’s thinking, and helps to create awareness of the interconnections between elements within and between systems. Understanding a system requires the conscientious consideration of the context involved, the integration of social and technical elements, and their corresponding formal and informal relationships that create a foundation for emergent patterns.

Systems thinking also promotes creativity by fostering perceptiveness. This perceptiveness comes from understanding the whole system, the relationships between different aspects of a system and the boundaries of each aspect (Keating, Kauffmann & Dryer 2001). Perceptiveness also results from systems knowledge, which enables the
systems thinker to effectively approach systems-based problems or initiatives. Perceptiveness thus facilitates the identification of root causes, the accurate interpretation of patterns and resulting consequences. As a result, an individual with the tendency to utilise systems thinking is likely to find solutions that simultaneously address multiple concerns (i.e., concerns of other parties or aspects of the system involved in the problem) and such solutions are likely to be novel because most individuals tend to look at only one aspect of the system (usually their own) when dealing with a problem.

Another example of how systems thinking promotes creativity is through anasynthesis, which is a compound word of analysis and synthesis (Johannessen 1996). Johannessen (1996), in using the term systemic thinking synonymously with systems thinking, explains that whilst systems thinking is about identifying patterns, patterns do lend themselves to be easily used meaningfully. For example, patterns are usually circular with no obvious starting and ending ‘points’, and thus it is difficult to identify cause-and-effect relationships (Johansen 2007). Thus Johannessen (1996) asserts that it is crucial to analyse and synthesize in parallel. He states that “A basic idea in the systemic approach to a research problem is that no idea can be fully understood until it is incorporated into an organised field of knowledge. In this, system ideas can be interwoven with other knowledge, and gain support from the latter. The systemic approach is based on a system-theoretical ontology, where the world is seen as a system consisting of subsystems, and an epistemology combining realism and rationalism. The aim of the systemic approach is to understand, predict, and control. The methods include analysis as well as synthesis, generalisation and systematisation” (p. 33).

Analysis is about ‘how’ and involves dividing a system to assess each part on its own, followed by an aggregation of the parts in understanding the whole, whilst synthesis is ‘why’ and involves expanding the system to comprehend the wider system (suprasystem) that the system is part of, followed by disaggregating the system to understand the specific functions of each system/subsystem. Johannessen (1996) argues that systemic thinking requires both and is termed as anasynthesis, in avoiding the traps inherent in both reductionist and expansionist perspectives. Parallels can be drawn between anasynthesis (analysis and synthesis) and divergent and convergent thinking, which are the foundations of creativity.

The notion of the ‘whole’ that is advanced by systems thinking helps individuals to improve organisations as they view it as a system. The system that is the organisation
contains various elements such as people, roles and processes. By virtue of thinking in this non-linear form, individuals start to visualize how expansive and interrelated elements influence each other. It is this appreciation of how elements intersect that may give rise to creativity where novel ideas emerge. Based on the preceding discussion, we can postulate that systems thinking is positively correlated to creativity.

It has been postulated, based on the discussion provided in Section 3.4.1, that systems thinking is positively correlated to job-related learning. Additionally, based on the discussion provided in Section 3.4.2, it has been postulated that systems thinking is positively correlated to creativity. Finally, based on the discussion provided in Section 3.1.3, it has been postulated that job-related learning is positively correlated to creativity. The following hypothesis is therefore proposed:

*Hypothesis 4: Job-related learning mediates the relationship between systems thinking and creativity.*
3.5  **MULTIPLE PERSPECTIVE-TAKING, JOB-RELATED LEARNING AND CREATIVITY**

This section argues why and how (i) multiple perspective-taking is related to job-related learning, and (ii) multiple perspective-taking is related to creativity (the argument that job-related learning influences creativity is discussed in Section 3.1.3). Finally, based on the three conjectures, it is hypothesised that job-related learning mediates the relationship between multiple perspective-taking and creativity.

**3.5.1 Multiple Perspective-Taking and Job-Related Learning**

Individuals with a disposition to look at things from multiple perspectives learn more as each perspective contributes to their knowledge and understanding. This is especially important in the workplace when there are different perspectives (e.g. operational, managerial and health and safety) that one can adopt when looking at processes or problems. Indeed, Litchfield and Gentry (2010) posit that multiple perspective-taking helps to mitigate (though not eliminate) the miserly but natural cognitive processes that are inherently biased such as stereotyping and information-simplification heuristics (e.g., the availability heuristic). The more capable an individual is at adopting more perspectives, the more knowledge they gain, and thereby broaden their horizons and often develop unique ways of seeing things. Multiple perspective-taking also enhances cooperation between individuals by developing empathy. Multiple perspective-taking involves conscious effort and how well perspective-taking is engaged depends on a case-to-case basis. Nonetheless, those with a disposition for multiple perspective-taking may find this cognitive process easier to engage in across various situations.

Being mentally flexible and curious are characteristics that may shape the development of multiple perspective-taking (Parker, Wall & Jackson 1997) and hence facilitate job-related learning. Individuals who are flexible and not dogmatic have a higher chance of being able (and wanting) to ‘see’ things from a different perspective. In addition, individuals who are curious about their jobs and how their jobs relate to the jobs of others would also have a better chance of being able to relate to others and see the ‘big picture’ (i.e., multiple perspective-taking is linked to systems thinking). As a result, the tendency to adopt multiple perspective-taking should enhance job-related learning because of the willingness to accept alternative points of view and consider issues from different angles.

Multiple perspective-taking is likely to lead to the development of ‘bisociation’ and thus facilitate job-related learning. Bisociation refers to the ability to associate one idea in two
different contexts (Koestler 1964). In addition, multiple perspective-taking also helps to develop dialectical thinking (Basseches 2005), which involves the ability to understand issues from a variety of, and even contradictory, perspectives and be able to reconcile these perspectives. Multiple perspective-taking and bisociation are important given the high specialism that is required in contemporary occupations that tend to cultivate a ‘siloh’ mentality or perspective. Multiple perspective-taking helps to breakdown these silos and contribute to the job holder’s knowledge about their job in relation to the jobs of others. Based on the preceding discussion, we can postulate that *multiple perspective-taking is positively correlated to job-related learning.*

### 3.5.2 Multiple Perspective-Taking and Creativity

A multiple perspective-taking disposition helps to shape individuals’ sense of creativity. Indeed, Bass and Avolio (1997) posit that leaders can play an important role in stimulating creativity among followers by encouraging followers to adopt multiple perspective-taking in order to challenge existing assumptions about how tasks should be performed and thus find novel solutions to existing problems. In addition, Mom, van den Bosch and Volberda (2009) argue that multiple perspective-taking facilitates individuals to develop behaviours that enable them to network better and work more effectively with others, which are skills that are crucial for idea generation and innovation.

A multiple perspective-taking disposition facilitates understanding various aspects of organisations such as improving organisational performance (Holloway 2009), marketing and seeking sponsorship (Daellenbach, Davies & Ashill 2006) enhancing the design and delivery of curriculum that involves topics concerning multiculturalism and/or a multicultural audience (Hyun & Marshall 1997) and improving organisational diversity and inclusion by mitigating discrimination (e.g. racial, religious, social class, function) (Todd, Bodenhausen & Galinsky 2012). When looking for solutions to complex problems, especially ill-defined ones or ones that involve multiple parties, the disposition for multiple perspective-taking enables an individual to consider problems from the viewpoints of various stakeholders and thus the individual is likely to look for solutions that satisfy more criteria than simply meeting his/her own needs. As a result, creative solutions are likely to emerge.

Scott and Bruce (1994) stressed that individuals who are creative and true innovators are those who are adept at every part of the innovation process and thereby are able to adopt different perspectives to suit the varied requirement at each stage. Other scholars such as
Carlile and Rebentisch (2003) and Zahra and George (2002) also argue that multiple perspective-taking is crucial for innovation as it helps to integrate various types of knowledge.

Multiple perspective-taking also helps to improve communication skills as it enables an individual to gain knowledge about how others perceive and think, and therefore provides them with a basis for developing and relating empathy (Litchfield & Gentry 2010). This is important in the innovation process as this skill helps individuals to gain ideas for the creative process to take place. Multiple perspective-taking helps to increase an individual’s and an organisation’s absorptive capacity (Zahra & George 2002) and also ambidexterity (Markides 2013). For example, through the process of bisociation, individuals are able to perceive and understand two opposing and even incompatible perspectives, which consequently augments an individual’s ability to appreciate and absorb varied phenomena. In addition, multiple perspective-taking facilitates the ability to not only host contradictions (Mom et al. 2009) but to work with them productively. This is important for creativity as it helps the development of novel ideas by converging seemingly unrelated or even contradictory factors. Based on the preceding discussion, we can postulate that multiple perspective-taking is positively correlated to creativity.

It has been postulated, based on the discussion provided in Section 3.5.1, that multiple perspective-taking is positively correlated to job-related learning. Additionally, based on the discussion provided in Section 3.5.2, it has been postulated that multiple perspective-taking is positively correlated to creativity. Finally, based on the discussion provided in Section 3.1.3, it has been postulated that job-related learning is positively correlated to creativity. The following hypothesis is therefore proposed:

*Hypothesis 5: Job-related learning mediates the relationship between multiple perspective-taking and creativity.*
3.6 **JOB-RELATED LEARNING, CREATIVITY AND INNOVATION BEHAVIOUR**

This section argues why and how (i) job-related learning is related to innovation behaviour, and (ii) creativity is related to innovation behaviour (the argument that job-related learning influences creativity is discussed in Section 3.1.3). Finally, based on the three conjectures, it is hypothesised that creativity mediates the relationship between job-related learning and innovation behaviour.

3.6.1 **Job-Related Learning and Innovation Behaviour**

Job-related learning helps to promote innovation behaviour as it equips individuals with the knowledge and skills that would help them to transform creative ideas into commercially viable innovative products and services. It is argued innovation behaviour is premised upon individuals’ learning a variety of knowledge.

Job-related learning can involve learning informally about one’s job not only with respect to the tasks and responsibilities of one’s job but also about how one’s job impacts the overall organisation. Being able to effectively learn informally is crucial as not all innovation projects always go according to plan. Hence, being able to learn on-the-job, being astute to learn (recognise and be aware) from incidental events may be crucial in ensuring that innovation behaviour is sustained especially when barriers are experienced and no formal process is in place to address this. Job-related learning can result in obtaining factual, conceptual and procedural knowledge.

Factual knowledge is similar to the notion of the ‘absolute way’ of knowledge put forth by Baxter Magolda (1999). This type of knowledge usually relates to matters such as terminology (as per the dictionary) and knowledge of specific details and elements (the periodic table of elements and chemistry). Factual knowledge is suited for elementary cognitive (rote) learning (Moskal 2010) and is usually very much memory dependent (more so than is ‘understanding’, for example).

Huitt (2011) argues that factual knowledge is fundamental in many areas of life and is one of the most basic aims of job-related learning (or any form of learning). He states that factual knowledge can be reinforced through understanding, such as interpreting and summarising, and applying mathematical formulae. In addition, factual knowledge can be enhanced through analysis such as categorising words or by evaluating certain articles.
Factual knowledge is vital for innovation behaviour as it enables an individual to solve technical issues.

Conceptual knowledge involves knowledge of theories, models and frameworks (Anderson et al. 2001). Conceptual knowledge also includes comprehension principles that relate to, govern and underpin a domain (Rittle-Johnson & Alibali 1999), as well as the understanding of generalisations, classification and categorisation (Anderson & Krathwohl 2001). Rittle-Johnson and Star (2009) argue that having conceptual knowledge provides individuals with the ability to recognise and explain key concepts in a domain. It also allows for analogical reasoning based on familiarity with the concepts and examples (Gentner 2005).

Conceptual knowledge is essentially ‘knowing that’ particularly in a relational sense of the link between two subject matter (Byrnes 1992) that may facilitate innovation behaviour. Hiebert and Lefevre (1986) argue that conceptual knowledge involves knowledge that is rich in relationships. Kieren (1993) posits that conceptual knowledge is the interweaving of formal knowledge and intuition. In other words, conceptual knowledge is the ‘linking’, ‘interweaving’ and ‘interconnectedness’ amongst discrete information and knowledge (Hallett, Nunes & Bryant 2010).

Procedural knowledge is the understanding that facilitates the execution of action in the ‘correct’ sequence in solving a problem (Rittle-Johnson & Alibali 1999). Examples of procedural knowledge are knowledge criteria in determining when to use the appropriate domain specific techniques, methods and procedures (Huitt 2011). Procedural knowledge is ‘knowing how’ (Byrnes 1992) and are ‘goal-directed action sequences’.

Procedural knowledge is crucial during the prototyping and project management phase of any innovation initiative. Rittle-Johnson and Star (2009) argue that procedural knowledge enables one to have the ability to undertake a sequence of actions in solving a problem, which can refer to both familiar and novel problems.

The procedural aspect of job-related learning is partly experiential learning (or learning-by-doing) and is recognised as a crucial aspect of organisational life and management education (Kolb 1984). Experiential learning in job-related learning helps to transform experiences into job-related knowledge. Metacognitive knowledge and skills are crucial in ‘translating’ procedural knowledge into conceptual knowledge. This is achieved through effective reflection that helps to integrate experiences into conceptual knowledge.
This new conceptual knowledge may then be applied to enhance procedural knowledge. Procedures can be enacted relatively independent of meaning such as the type of innovation that is being implemented. Procedural knowledge enables procedural flexibility, which involves the ability to incorporate new knowledge (e.g., creative ideas) in multiple ways to solve problems (Rittle-Johnson & Star 2009). Knowledge about the processes required to manage tasks and resources when rolling out a new product/service is crucial when attempting to implement creative ideas.

Job-related learning helps to accumulate knowledge and skills that are both domain/subject specific (i.e. related to the specific innovation project) and domain general (e.g. such as project management). Chia and Holt (2008) state that initiatives such as innovation projects are situated as they occur within organisations and some parts of the process are difficult to imitate. Job-related learning is also dynamic as it changes with the pace of work in organisations. This is similar to the nature of innovation behaviour, which is about being adaptive in being innovative in improving how tasks are performed. Job-related learning helps individuals to be comfortable with risk and uncertainty, which is omnipresent in any innovation process. Job-related learning helps to fill any gaps that may be present and that require individuals to make certain assumptions when making sense (i.e. sensemaking) of situations (Schwandt 2005). This assumption of knowledge is crucial as the practice of innovation management involves skilled in-situ (e.g. coping with uncertainties).

Job-related knowledge also reflects the individual’s procurement/attainment of knowledge that is internal and external to the organisation (Wang, Gray & Meister 2014). The combination of these knowledge types and sources may create knowledge structures that may help individuals to overcome job-demands (Loon & Casimir 2008), enhance job performance (Scott, Lonergan & Mumford 2005) and last but not least innovation behaviour (Scott & Bruce 1994; Patterson, Kerrin & Gatto-Roissard 2009a). Based on the preceding discussion, we can postulate that job-related learning is positively correlated to innovation behaviour.

### 3.6.2 Creativity and Innovation Behaviour

Creativity for its own sake is not as valued as creativity that produces ideas that help solve problems or that become the catalyst for other ideas (Runco et al. 2001). This notion is consistent with that of innovation, whereby something is only considered an innovation if it provides value.
Creativity is considered to be one half of innovation (Patterson et al. 2009a; von Stamm 2008) in the sense that innovation behaviour is premised on creativity. The key distinction between creativity and innovation is that creativity is a cognitive activity that leads to the generation of novel ideas whereas innovation is the idea implemented. Innovation behaviour therefore refers to the actions that are undertaken to transform a creative idea into an innovation, such as a new product or service.

Whilst there are several psychological theories of creativity, the most fundamental are the divergent- and convergent-thinking theories. Divergent thinking is the expansion of ideas, whilst convergent thinking is a linear process that looks for that ‘one answer’, which may involve insight. Creativity is unique in different domains and context. In an organisational sense, creativity is valued because of the ideas that it produces to help solve ill-structured organisational problems and to help organisations to innovate.

Creativity is a necessary and effective way of responding to evolutionary changes and to innovate. Creativity helps in the adaptation to new situations and contexts, and in solving problems as they arise. Creative thinking occurs when an individual solves a problem using a novel solution (Guilford 1967). Divergent and convergent thinking, together with insight problem solving, helps to solve problems that are ill-defined (Dow & Mayer 2004) through creative problem solving. Insight problems are problems that necessitate restructuring the problem before solution development can take place (DeYoung et al. 2008). However, insight problem solving should not to be mistaken as a coping mechanism as the reformulation of problems through creative problem solving does indeed involve solving the problem and it is not about just ‘moving the goalpost’. Nonetheless, creativity may not just serve as a reactive/adaptive device but also as one that is proactive (Heinzen 1994). With creativity, individuals and even organisations can innovate far greater.

Useful creative ideas in organisations help address issues or take advantage of opportunities at the job, team and organisational levels. Effective ideational behaviours are observed at every level of organisational life, job, team and organisational level. At the job-level, ideational behaviour may involve combining tasks to enhance effectiveness of the job. At the team-level, ideational behaviour may result in better communications and team co-ordination. At the organisational-level, ideational behaviour may involve improve organisational processes in delivering better products and services to customers.
Ideas are concepts that are generally new or novel in respect to the context that it is conceived and applied. Runco et al. (2001) posit that ideation involves actual overt behaviours and actions that reflect an array of facets in terms of the “use of, appreciation of, and skill with ideas” (p. 393). Ideation occurs in all aspects of life: social, family and in the workplace.

Some individuals are more disposed to having ideational behaviours than are others. These individuals tend to come up with ideas on a regular basis. For example, individuals may have ideas about how to solve problems that they may have in their jobs or in their general workplace. Ideas may also be used to improve the way they work in order to be more effective and efficient in a way that is similar to innovation behavior that continuously strives to improve the workplace. Individuals who demonstrate ideational behaviour tend to be active thinkers and like to play around with ideas such as applying ideas in one area to another (e.g. concepts in marketing to operations), or combining ideas. Thus creative individuals tend to also be innovative. Based on the preceding discussion, we can postulate that creativity is positively correlated to innovation.

It has been postulated, based on the discussion provided in Section 3.6.1, that job-related learning is positively correlated to innovation behaviour. Additionally, based on the discussion provided in Section 3.6.2, it has been postulated that creativity is positively correlated to innovation behaviour. Finally, based on the discussion provided in Section 3.1.3, it has been postulated that job-related learning is positively correlated to creativity. The following hypothesis is therefore proposed:

Hypothesis 6: Creativity mediates the relationship between job-related learning and innovation behaviour.

3.7 SUMMARY

The rationale for six hypotheses has been presented in this chapter. The overarching theme of the first five hypotheses is that the relationship between each of the five higher-order thinking dispositions and creativity is mediated by job-related learning. In the following chapter, the research methodology for this study will be discussed.
4.0 CHAPTER FOUR – RESEARCH METHODOLOGY

4.1 INTRODUCTION

This chapter contains a discussion and justification of the research methodology and the elements of the research design adopted. The study’s research philosophy and paradigm are first discussed in Section 4.2, which then informs the research strategy. Section 4.3 contains a detailed justification of the research methodology and research design, in particular, the purpose of the study, the type of investigation pursued, the unit of analysis, time horizon of the study, extent of the researcher’s interference in the data collection process and the study’s setting. Section 4.5 contains a discussion of the quantitative data collection method adopted. A key part of this section involves reporting the reliability and validity of the measures used in this study, which have been developed and tested by other scholars. A brief discussion of the questionnaire’s design is provided followed by a justification of the sampling approach and the administrative procedures in the distribution and collection of the questionnaire. This section also contains a discussion on data analysis that provides a rationale for the statistical techniques adopted. The ethical considerations of the research are then outlined in Section 4.6 and this is followed by a discussion in Section 4.7 on the key limitations of the research methodology and design.

4.2 RESEARCH PHILOSOPHY AND PARADIGM

Research philosophy involves addressing fundamental questions such as what constitutes as research, what is knowledge that is related to undertaking research (e.g. used to inform the research and expected knowledge to be gained), and what is the value of research (e.g. of a particular research design) (Bryman & Bell 2011; Saunders, Lewis & Thornhill 2009; Hair Jr et al. 2003). The ontological perspective concerns establishing what is reality and what is real (Neuman 2014). The epistemological perspective concerns the theory of knowledge and involves ascertaining the true nature and scope of knowledge (Neuman 2014). Axiology is the study of value and whilst is mainly used in the study of ethics and aesthetics, it may also be linked to the study of innovation specifically in terms of the value that research of this nature brings about (Neuman 2014).

The philosophical bases of ontology, epistemology and axiology are used to underpin and develop the research methodology. From an ontological perspective, this study views reality as not only objectively observable but also measureable. In terms of epistemology,
this study views knowledge as a matter that can be translated into testable hypotheses. Whilst knowing what is true knowledge may not be entirely viable, the process of falsification (Popper 1963) helps scholars to get closer to the truth. Axiology concerns the nature of value or ‘worth’ of something.

The philosophical bases inform the research paradigm adopted. According to (Kuhn 1970), a paradigm is a worldview that is unique in its own right. The uniqueness of each paradigm means that paradigms are not comparable as Ticehurst and Veal (2000; cited in Cavana et al., 2001, p. 8) state “a paradigm reflects a basic set of philosophical beliefs about the nature of the world. It provides guidelines and principles concerning the way research is conducted within the paradigm. The methods and techniques used in the research should be in sympathy with these guidelines and principles”. The uniqueness of each paradigm stems from, for example, the ontological, epistemological, axiological and methodological foundations of each paradigm (Easterby-Smith, Thorpe & Jackson 2012).

There are a number of paradigms in research, however, the two most common are the positivist and interpretivist paradigms and they are usually considered to be bipolar opposites (Saunders et al. 2009; Bryman 2012; Wood & Welch 2010). Generally, the positivist paradigm presumes that there are universal laws and knowledge is objective (Niglas 2001), and that the researcher and the object of research can be completely independent of one another. In contrast, the interpretivist paradigm presumes that the world is subjective and there are only a few universal laws. Furthermore, individuals constructs their own reality and the focus of research usually concerns focusing on the subjective experiences of individuals. Cavana et al. (2001) state that the interpretivist paradigm “present a rich and complex description of how people think, react and feel under certain contextually specific conditions” (p. 9). The purpose of Table 3.1 is not to compare both paradigms against one another per se (as paradigms are not meant to be comparable), but rather to illustrate their meanings in terms of i) reason for research, ii) nature of social reality, iii) human nature, iv) human agency, v) role of common sense, vi) how theory looks like, vii) an explanation that is true, viii) good evidence, ix) relevance of knowledge and x) place for values (Neuman 2014). Table 51 summarises the differences between the two paradigms:
Table 51: Differences between Positivist and Interpretivist paradigm (Neuman 2014)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Positivist paradigm</th>
<th>Interpretivist paradigm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reason for research</td>
<td>To discover natural laws so people can predict and control events</td>
<td>To understand and describe meaningful social action</td>
</tr>
<tr>
<td>2. Nature of social reality</td>
<td>Stable pre-existing patterns or order that can be discovered</td>
<td>Fluid definitions of a situation created by human interaction</td>
</tr>
<tr>
<td>3. Human nature</td>
<td>Self-interested and rational individuals who are shaped by external forces</td>
<td>Social beings who create meaning and who constantly make sense of their worlds</td>
</tr>
<tr>
<td>4. Human agency</td>
<td>Powerful external social pressures shape people’s actions; free will is largely illusion</td>
<td>People have significant volition; they develop meanings and have freedom to make choices</td>
</tr>
<tr>
<td>5. Role of common sense</td>
<td>Clearly distinct from and less valid than science</td>
<td>Powerful everyday theories used by ordinary people</td>
</tr>
<tr>
<td>6. Theory looks like</td>
<td>A logical, deductive system of interconnected definitions, axioms, and laws</td>
<td>A description of how a group’s meaning system is generated and sustained</td>
</tr>
<tr>
<td>7. An explanation that is true</td>
<td>Is logically connected to laws and based on facts</td>
<td>A description of how a group’s meaning system is generated and sustained</td>
</tr>
<tr>
<td>8. Good evidence</td>
<td>Is based on precise observations that others can repeat</td>
<td>Is embedded in the context of fluid social interactions</td>
</tr>
<tr>
<td>9. Relevance of knowledge</td>
<td>An instrumental orientation is used; knowledge enables people to master and control events</td>
<td>A practical orientation is used; knowledge helps us embrace/share empathetically others’ life worlds and experiences</td>
</tr>
<tr>
<td>10. Place for values</td>
<td>Science is value free, and values have no place except when choosing a topic</td>
<td>Values are an integral part of social life; no group’s values are wrong, only different</td>
</tr>
</tbody>
</table>

The positivist paradigm concerns discovering natural laws and assumes that there is a pre-existing pattern of order that can be discovered. This paradigm sees human nature as being guided by rationality and self-interest, and that people are shaped by their environment and free will is largely an illusion. The paradigm also views human common sense as an inferior construct compared to science (Neuman 2014). Theory is premised upon a deductive system and truth is connected to laws and underpinned by knowable facts. In relation to what constitutes ‘good’ evidence, this paradigm argues that such evidence is based upon precise observation, and knowledge is used to help people master their environment (Neuman 2014). Furthermore, science is considered to be value-free (Neuman 2014).
The interpretivist paradigm on the other hand concerns understanding meaning as constructed by individuals and in social action, and that the nature of reality is fluid, underpinned by human interaction (Neuman 2014). This paradigm also views human nature as one that involves creating meaning and sense making, and that people have their own volition and free will. This paradigm presumes that people’s theories-in-use are powerful agencies that shape the world external to the individual (Neuman 2014). Theory, in this paradigm, is linked to how people generate meaning in systems and people’s interpretation is what qualifies something as truth. ‘Good’ evidence is embedded in social systems and knowledge is used to give better meaning to life and values play a significant role in research (Neuman 2014).

The adoption of a research paradigm is also informed by the methodology that is appropriate for addressing the research problem and, to a lesser degree, one that the researcher is comfortable with. As Cavana et al. (2001) state that “typically, quantitative research methods are used with the positivist research paradigm, and qualitative methods are used within the interpretivist paradigm” (p. 34). However, both are complementary to one another as Figure 33 depicts (Pandit 1996; Cavana et al. 2001). Qualitative research involves inductive reasoning in exploring and describing a new phenomenon in contributing to the formulation of relationships and propositions. Quantitative research complements qualitative research by translating the propositions into testable hypothesis, which then involves collecting and analyzing data to decide if hypotheses are to be accepted or rejected, through the process of falsification (Popper 1963), and based on these new findings, theory is modified.

![Figure 33: Relationship between inductive and deductive reasoning (Cavana et al., 2001)](image)

This study adopts the positivist paradigm, for a number of reasons. The first reason relates to the nature of the research problem, which is partly based upon the ‘maturity’, gap in literature and knowledge in the field of innovation. Innovation can be considered as a well-established field of study and is a phenomenon where there is some effective
understanding in some areas (Tidd & Bessant 2010; Wolfe 1994a; Shaw et al. 2013; Kinnie et al. 2012a). However, as discussed in previous chapters, there is paucity in terms of the study of innovation behaviour in relation to higher-order thinking dispositions. Secondly, whilst the literature has provided some indication of the relationship between individual-related factors and innovation behaviour, the research problem articulated highlights that the lacunae is related to an absence in literature that verifies and explains the relationship between innovation behaviour and higher-order thinking dispositions. Thus a positivist paradigm is adopted to address the aforementioned gaps.

4.3. RESEARCH STRATEGY

The research paradigm informs the research strategy. A research strategy prescribes how research will be undertaken (Yin 2009; Remenyi 2002). Whilst there are various permutations of a research strategy, Yin (2009) nevertheless argues that there are four typical forms, namely experiment, survey, archival research, history and case study, and these four generally cover a comprehensive spectrum of research (Yin 2009; Bowen 2009). These research strategies may be compared in terms of the type of research questions they address, the requirement in controlling events in relation to the research and whether there is a need to focus on contemporary data. Table 52 summarises what each of these strategies entails.

Table 52: Relevant situations for different research strategies (Yin 2009)

<table>
<thead>
<tr>
<th>Research Strategy</th>
<th>Type of Research Question</th>
<th>Requires Control Over Events?</th>
<th>Focus on Contemporary data?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>How, Why</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Survey</td>
<td>Who, What, Where, How Many, How Much</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Archival analysis</td>
<td>Who, What, Where, How Many, How Much</td>
<td>No</td>
<td>Yes/ No</td>
</tr>
<tr>
<td>History</td>
<td>How, Why</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Case study</td>
<td>How, Why</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

As a key criterion concerning research methodology is the coherence of its elements, it follows that the research strategy adopted is informed by the research paradigm. In the case of this study, the positivist paradigm suggests that the research strategy of experiment and survey are potentially most appropriate. Although case studies may also be included, it is excluded as there are no predefined boundaries of a population (e.g. organisation and industry) that is specified in this research.
Thus, between the ‘options’ of an experimental and a survey-based research strategy, this study adopts the latter as the research requires a broad degree of questions to be addressed. These questions are who (e.g. white collar workers), what (i.e. innovation behaviours and higher-order thinking dispositions), how many (sample size in relation to the generalisability of the study) and how much (in relation to the correlation and probability scores of relationships amongst the variables). In addition, the survey research strategy does not require any control over events but there is a focus on contemporary data (i.e. primary data). The next step involves addressing the research methodology and, justifying the decisions concerning the various elements considered in the research design.

4.4. **Research Methodology and Design**

Research methodology is a systematic and coherent approach to undertaking research. Hussey and Hussey (1997) state that a research methodology is “an approach to tap the entire process of undertaking a study” (p. 20). As with any form of methodology (e.g. project management), each step informs the proceeding steps (e.g. qualifying new options and/or discounting existing options). For example, the research design must be informed by and should be consistent with the research paradigm adopted (Henn, Weinstein & Foard 2006).

The choice of design elements in a research plays a crucial role in shaping the coherence of the research methodology (Remenyi 2012). Whilst there are many research design elements, Cavana et al. (2001) outline the key research design elements and provide some choices that may be available to the researcher (Figure 34).
The key elements that each researcher must consider and address are clarity concerning the purpose of the study, the type of investigation undertaken, the unit of analysis, the time horizon, the extent that the researcher will interfere in the data collection process (e.g. manipulation) and the setting of the study. In addition, depending on whether the study is classified as qualitative or quantitative, there are different sets of considerations that the researcher must address. The research design is considered as a blueprint as it specifies the details of the research project (Teddlie & Tashakkori 2009). Research design is almost akin to addressing the proverbial ‘who’, ‘what’, ‘when’, ‘why’ and ‘how’ questions in a study.

### 4.4.1. Purpose of Study

The purpose of the study is the primary determinant of most of the other elements in the research design (Teddlie & Tashakkori 2009). There are essentially four options, exploration, description, hypothesis testing and case study (Cavana et al. 2001). The first three options reflect the nature and process of research as suggested in the section concerning the relationship between inductive and deductive reasoning.
When a new phenomenon is recognised, the purpose of the research is exploratory. There are no preconceived notions or knowledge as very little, if anything, is known about the phenomenon. The spirit of the research is to probe and find out as much as possible (e.g. what it is, what it is not, boundaries, potential/indicative causes and consequences) (McGivern 2006). Once the phenomenon has been explored, the next step is to describe the phenomenon. At this stage more precision is required, as there is a need to articulate and specify all that is known about the phenomenon. At the next stage, concepts are formed and potentially propositions (concerning relationships between concepts) are put forward (Gill & Johnson 2010). This leads to what researchers term as the quantitative stage of research. The hypothesis testing stage involves the operationalisation of the constructs (e.g. concepts) into measurable variables. Hypotheses are established and statistical techniques are used to test the hypothesised relationships amongst the variables (Henn et al. 2006).

Case studies are unique ‘purposes of study’, and may involve exploration, description and hypothesis testing, a combination or all three. The key area of concern of case studies is to provide an in-depth understanding of the selected case (Collis & Hussey 2009).

The purpose of this study is to test hypotheses as it aims to explain the relationships amongst several constructs/variables. This study is not a case study as it does not involve limiting the scope of the research to a certain case such as a particular organisation, sector or occupation.

4.4.2. Type of Investigation

Once the purpose of the study has been established, the next step is to identify the type of investigation. Cavana et al. (2001) state that there are generally four types of investigations; clarification, correlational, causal and experimental.

An investigation to clarify is one that follows from the exploratory and/or the descriptive ‘purposes’. A clarification investigation illuminates the elements that are present and the potential relationships between the elements. Clarification investigation may be considered as a form of appreciative inquiry (Bryman 2004; Cooperrider, Whitney & Stavros 2008) in that its primary aim is to allow researchers to recognise and give credence to the merits of a phenomenon that differentiates it from others. This ‘type’ of investigation may involve adopting different perspectives on the same phenomenon.
A correlational investigation is suitable for hypothesis testing, as are causal and experimental investigations (Hair Jr et al. 2006), and is the type of investigation adopted in this study. The aim of a correlational investigation is to test relationships amongst variables. Nonetheless, although a correlational investigation and a causal investigation are similar in many ways, a causal investigation has a more rigorous and stringent methodology that enables claims of causality to be made. A causal investigation involves the control of factors that may contribute to explaining changes in a dependent variable. The techniques used in causal investigations go beyond the use of statistical techniques as they may involve the changes in the physical settings and environment (Field 2009).

Experimental investigations, in turn, are similar to causal investigations. However, experimental investigations involve more than just identifying causation but also causation under different situations, which involves manipulation and the use of control groups.

4.4.3. Unit of Analysis

There are various units of analysis such as individuals, dyads, groups, organisations and even machines. Specifying the unit of analysis is crucial as it clarifies the elements that are being studied (Cavana et al. 2001). Being clear on the ‘unit of analysis’ helps to identify the parameters of the subject that is being studied. For example, if individuals are the unit of analysis that means only attributes that are related to the individual level will be considered such as the individuals’ attitudes and personality.

The unit of analysis also determines the breadth and scope of elements that may be included in the study. For example, if the unit of analysis is organisations, then elements such as the individuals, dyads (relationships), groups as well as organisational systems, process and politics may also be included in the study (Cavana et al. 2001).

In addition to the unit of analysis, the notion of ‘level of analysis’ may also be helpful (Yurdusev 1993). For example, a study may involve research into decision-making in departments but the researcher may find it difficult to identify the boundaries of what constitutes as a department. Thus, in such a situation the researcher may elect to specify the ‘level of analysis’ by specifying, for example, the level that is below the executive or divisional level but above team level in defining what is meant by departmental level. Typically, levels of analysis are expressed as micro (e.g. individuals), meso (e.g. organisational) or macro (e.g. nation) (Yurdusev 1993).
The unit of analysis in this study is individuals. The dependent variable of innovation behaviour considers the behaviours of individuals, whilst many of the independent variables concern the thinking dispositions of individuals.

4.4.4. Time Horizon
Another key consideration in the research design is the whether the data are collected within a narrow window of time or in intervals over a relatively long period of time (Hussey & Hussey 1997). The former is known a cross-sectional (also known as one-shot) study, whilst the latter is known as a longitudinal study. Clearly the choice between the two depends on the intention of the study.

A cross sectional study is primarily concerned with capturing data at a certain point in time (Denscombe 2010). The passage of time is not a factor that is considered or under investigation in cross-sectional studies. The key concerns are the constructs and how they relate to one another. Longitudinal studies, in contrast, deem the passage of time to be important (Denscombe 2010). In addition, longitudinal studies may be used to enhance the rigour of the data collected as it mitigates the effects of moods and potentially other extraneous factors that may influence the way participants respond to a survey.

In this study, the data are collected at two points in time with a gap of at least 60 days between the two collections. The constructs measured at each collection are based upon the hypothesised direction of occurrence as far as possible. An advantage of collecting data in two stages is that a longitudinal design enables a better understanding of cause-effect relationships. Another advantage is that it reduces task demands placed on participants and mitigates fatigue that may be experienced by the participants due to the length of the survey. The measures that are completed in Stage 1 and Stage 2 are shown below in Figure 35.
<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2 – post 60 days</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Critical thinking:</strong></td>
<td><strong>Job-related learning</strong> (3)</td>
</tr>
<tr>
<td>– engagement (11 items)</td>
<td></td>
</tr>
<tr>
<td>– maturity (8)</td>
<td></td>
</tr>
<tr>
<td>– innovativeness (7)</td>
<td></td>
</tr>
<tr>
<td><strong>Problem solving:</strong></td>
<td><strong>Creativity:</strong></td>
</tr>
<tr>
<td>– positive problem orientation (5)</td>
<td>– job (5)</td>
</tr>
<tr>
<td>– rational (5)</td>
<td>– team (5)</td>
</tr>
<tr>
<td>– systematic (5)</td>
<td>– organisation (5)</td>
</tr>
<tr>
<td><strong>Metacognition</strong> (15)</td>
<td><strong>Innovation behaviours</strong> (5)</td>
</tr>
<tr>
<td><strong>Systems thinking:</strong></td>
<td><strong>Risk aversion</strong> (6 items)</td>
</tr>
<tr>
<td>– the whole (9)</td>
<td></td>
</tr>
<tr>
<td>– interdisciplinary knowledge (5)</td>
<td></td>
</tr>
<tr>
<td><strong>Multiple perspective-taking</strong> (4)</td>
<td><strong>Social desirability</strong> (5)</td>
</tr>
</tbody>
</table>

**Figure 35: Constructs in stage one and stage two (developed by author)**

The constructs in the questionnaire are ordered in the same order in which they appear in the conceptual model. Specifically, the independent variables are presented first, followed by the mediating variables of job-related learning and creativity, then the dependent variable of innovative behaviour. The order of the variables reflects a ‘natural’ order of events as it is expected that individuals’ dispositions will impact on both their learning and their creativity, and ultimately on their innovation behaviour.

### 4.4.5. Extent of Researcher Interference

As the purpose and intent of the research suggest, the extent of the researcher’s interference is minimal (Cavana et al. 2001). The data collected are simply the individuals’ responses to the items in the questionnaire. There is no manipulation involved as the responses required from the participants’ are explicit (rather than tacit) knowledge of their own thinking dispositions, job-related learning, creativity and innovation behaviour.

In addition to the items, parts of the survey contain some explanation. Notes and instructions were provided for the problem solving measures to ensure that the participants had the same understanding of the context in which problem solving occurs, as problem solving may have different connotations (e.g. work-related versus personal).
Although there are no manipulations in the study, a number of control variables are included. The purpose of the control variables is to ensure that the variables measured are not latently influenced by factors that are not explicitly in the conceptual model but which are likely to impact on some of the variables in the model (Podsakoff & Organ 1986; Crowne & Marlowe 1960).

4.4.6. Study Setting
Consistent with the rest of the research design, the study setting is non-contrived as no manipulation is necessary and this helps to enhance ecological validity (Cavana et al. 2001; Niglas 2000). A contrived study setting is necessary when the study involves manipulation of the physical environment that the research takes place in and necessitates the researcher to have control over what the participants are exposed to (Cavana et al. 2001). As the study requires the participants’ genuine and instinctive responses, a non-contrived study setting is more appropriate. Participants are free to complete the questionnaire where and when it suits them. Whilst the study is in relation to their workplace, some items also relate to their ‘typical’ characteristics/traits.

4.4.7. Quantitative Research Method
As proposed by the positivist research paradigm, this study adopts the perspective that phenomena can be identified and measured. Thus, the data collection method reflects this assumption as a survey questionnaire is to be used. This section contains a discussion on the reliability and validity of the adopted measures. It also outlines the design of the questionnaire and the sampling method adopted. The final sub-section discusses the administrative procedures involved in distributing and collecting the survey questionnaires.

4.4.7.1. Measures: Validity and Reliability
The discussion concerning validity and reliability in this sub-section relates to the measures that are used to operationalise the constructs in the conceptual model. Validity is the degree to which a measure measures what it is supposed to measure. Validity concerns the accuracy and soundness of a measure (Spreitzer 1995; Lewis & Saunders 2012). There are several types of validity: face, content, representational, construct, convergent, discriminant, criterion, concurrent and predictive validity (Anastasi & Urbina 1997).
Face validity is the most ‘basic’ assessment of a measure as it involves assessing whether a measure ‘appears’ to be measuring the construct (Zikmund et al. 2010). Content validity is similar to face validity as it is also a non-statistical type of validity. However, content validity is more than just ‘common sense’ as it considers whether the measure comprehensively reflects all the domains (e.g. sub-elements) of a construct (Anastasi & Urbina 1997). For example, does the measure of critical thinking dispositions contain all the domains that relate to the theory. A similar notion to this is representational validity (also termed as translation validity), which concerns how well an abstract concept is translated into a test or inventory (Walliman 2011; Bryman & Bell 2011).

Whilst, construct validity is similar to content and representational validity, it requires not just theoretical but also empirical support (Remenyi 1996). The estimation of construct validity may involve assessing its internal structure and its relationship with constructs that it should be related to and as well as constructs that it is distinct from. Convergent validity is the degree in which a measure correlates with other constructs that it are theoretically related (Cavana et al. 2001). For example, literature (and in some cases empirical evidence) may suggest that critical thinking disposition is correlated with dispositions for effective problem solving. Discriminant validity is in contrast to convergent validity as it is the degree to which a measure correlates with other constructs that are theoretically unrelated (Cavana et al. 2001). For example, extraversion is in theory unrelated to conscientiousness (Chamorro-Premuzic et al. 2006b).

Criterion validity is the degree to which a measure correlates with a particular criterion that is already known and regarded as valid (Cavana et al. 2001). For example, measures of self-efficacy may be validated against the established criterion of problem solving disposition. Concurrent validity is the degree to which a measure correlates to a particular criterion when both measures are applied at the same time (i.e. measures are completed concurrently) (Cavana et al. 2001). For example, an individual may complete self-reports for both self-efficacy and problem solving disposition inventories at the same time. Predictive validity is similar to concurrent validity; however, predictive validity can only be claimed if the two inventories are measured at two different points in time (Cavana et al. 2001). For example, self-efficacy is measured first with problem solving disposition measured some time later.

Reliability refers to the dependability and consistency of a measure (Bryman & Bell 2011). In terms of the operationalisation of constructs, there are three types and assessment of reliability; test-retest reliability, parallel-forms reliability and internal
consistency reliability (Saunders et al. 2009). Test-retest reliability involves administering the same inventory to the same group of individuals at different points in time. Parallel-forms reliability involves mixing up the items and creating two sets of questionnaires which are then administered to the same group of individuals at the same time. Internal consistency reliability is a statistical method that assesses how well the items in a measure are correlated to each other (Cronbach 1990). There are four methods for testing internal consistency reliability: test average inter-item correlation, average item-total correlation, split-half reliability, and Cronbach’s alpha, which is the most popular method (Cavanaugh et al. 2001).

**Critical Thinking**

The University of Florida Engagement Maturity Innovation (UF/EMI) critical thinking scale was developed based on the California Critical Thinking Dispositions measure (Facione, Facione & Giancarlo 2000b). The UF/EMI measure is both valid and reliable (Irani et al. 2007). Lamm et al. (2011), Friedel et al. (2008a), Ricketts and Rudd (2004) and Bisdorf-Rhoades et al. (2005) all reported adequate validity of the measure. Irani et al. (2007) report that the reliability estimates for each dimension of the scale are:

Engagement = 0.906, Maturity = 0.787 and Innovativeness = 0.797. All three dimensions of the UF/EMI were used in the present study.

The items that were used to measure critical thinking are as follows and Appendix 1 provides an explanation of any adaptations that were made to the original items:

**Critical Thinking Engagement (CTE)**

CTE1: I look for opportunities to solve problems.
CTE2: I am interested in many issues.
CTE3: I am able to relate to a wide variety of issues.
CTE4: I enjoy finding answers to challenging questions.
CTE5: I am a good problem solver.
CTE6: I am confident that I can reach a reasonable conclusion.
CTE7: I am able to apply my knowledge to a wide variety of issues.
CTE8: I am able to explain things clearly.
CTE9: I ask good questions when trying to clarify a solution.
CTE10: I present issues in a clear and precise manner.
CTE11: I keep on working on things until I get them right.
Critical Thinking Maturity (CTM)
CTM1: I listen carefully to the opinions of others even when they disagree with me.
CTM2: I am likely to change my opinion when I am given new information that conflicts with my current opinion.
CTM3: I try to consider the facts without letting my biases affect my decisions.
CTM4: I can get along with people who do not share my opinions.
CTM5: I consider how my own biases affect my opinions.
CTM6: I try to find multiple solutions to problems.
CTM7: I ask many questions when making a decision.
CTM8: I believe that most problems have more than one solution.

Critical Thinking Innovation (CTI)
CTI1: I enjoy learning about many topics.
CTI2: I ask lots of questions in a learning environment.
CTI3: It is important to be well informed.
CTI4: I enjoy solving problems.
CTI5: I enjoy learning even when I am not in school.
CTI6: I search for the truth even when it makes me uncomfortable.

Problem Solving
The social problem solving scale (social problem solving inventory – revised; SPSI-R) has been found to be valid as Sadowski, Moore and Kelley (1994) found that the items loaded on five factors using confirmatory factor analysis. In addition they verified the criterion validity of the SPSI-R scale due to its relationship with social skills. Chang and D'Zurilla (1996) demonstrated the concurrent validity of the dimension of positive problem orientation with optimism and positive affectivity, and negative problem orientation with pessimism and negative affectivity. D'Zurilla and Chang (1995) reported the following Cronbach alphas for the dimensions positive problem orientation = .76, negative problem orientation = .91, rational problem solving = .92, impulsivity/carelessness style = .83, and avoidance style = .88. Test and retest reliabilities with a three week gap ranged from .72 (positive problem orientation) to .88 (negative problem orientation). The dimensions of positive problem solving orientation and rational problem solving from the SPSI-R (D'Zurilla et al. 2002) are used in this study.

Heppner and Peterson (1982) developed personal the problem solving inventory (PSI), which comprises three dimensions: factors problem-solving confidence, approach-
avoidance style and personal control. They and Corcoran and Fischer (1994) report that this inventory exhibits good construct and concurrent validity. The PSI is correlated with a number of other problem solving and intellectual ability tests such as the ‘level of problem solving skills estimate form’ (LPSSEF), the school and college ability test (SCAT, Series II), Missouri college English test (MCET), and Missouri mathematics placement test (MMPT), and disposition-based inventories such as the Rotter internal-external (I-E) locus of control. Empirical support for the PSI has been reported in MacNair and Elliott (1992), Dixon, Heppner and Anderson (1991) and Elliott et al. (1991). They also report that the personal PSI also has good reliability scores; problem-solving confidence = .85; approach-avoidance style = .84; personal control = .72; and total inventory = .90. This study uses the approach avoidance or “systematic” dimension as the other personal PSI dimensions overlapped with the dimensions of positive problem solving orientation and rational problem solving that are used from the SPSI. The items that were used to measure problem solving are as follows and Appendix 2 provides an explanation of any adaptations that were made to the original items:

Positive Problem Orientation

PTPPO1: When my first efforts to solve a problem fail, I know if I persist and do not give up too easily, I will be able to eventually find a good solution.

PSPPO2: When I have a problem, I try to see it as a challenge, or opportunity to benefit in some positive way from having the problem.

PSPPO3: Whenever I have a problem, I believe that it can be solved.

PSPPO4: When problems occur, I like to deal with them as soon as possible.

PSPPO5: When I am faced with a difficult problem, I believe that I will be able to solve it on my own if I try hard enough.

Rational

PSR1: Whenever I have a decision to make, I try to predict the positive and negative consequences of each option.

PSR2: When I have a problem to solve, one of the first things I do is get as many facts about the problem as possible.

PSR3: Before I try to solve a problem, I set a specific goal so that I know exactly what I want to accomplish.

PSR4: After carrying out a solution to a problem, I try to evaluate as carefully as possible how much the situation has changed for the better.

PSR5: When I am trying to solve a problem, I think of as many options as possible until I cannot come up with any more ideas.
Systematic
PSS1: After I have tried to solve a problem with a certain course of action, I take time and compare the actual outcome to what I thought should have happened.
PSS2: When confronted with a problem, I stop and think about it before deciding on the next step.
PSS3: When making a decision, I weigh the consequences of each alternative and compare them against each other.
PSS4: I try to predict the overall result of carrying out a particular course of action.
PSS5: I systematically compare alternatives and making decisions.
PSS6: When I am confused by a problem, one of the first things I do is survey the situation and consider all the relevant information.
PSS7: When I have a problem, I think of as many solutions as I can to solve it.
PSS8: When confronted with a problem, I rely on my emotions to find the causes of the problem.

Metacognition
Cartwright-Hatton et al. (2004) reported the metacognitions monitoring measure to be valid and reliable. Criterion validity was verified using a paired samples t-test, and concurrent validity was found by examining its correlation with the following measures
Revised Children’s Manifest Anxiety Scale (RCMAS) = .35, p < .001, Leyton
Obsessional Inventory-Child Version (LOI-CVS) = .45, p < .001 and Children’s Depression Inventory-Short Form (CDI) = .25, p < .01. The Cronbach alpha is .79 and the test-retest correlation is .83. The items that were used to measure metacognition are as follows and Appendix 3 provides an explanation of any adaptations that were made to the original items:
MCog1: I am constantly aware of my thinking.
MCog2: I pay close attention to the way my mind works.
MCog3: I think a lot about my thoughts.
MCog4: I constantly examine my thoughts.
MCog5: I monitor my thoughts.
MCog6: I am aware of the way my mind works when I am thinking through a problem.
MCog7: I often question my thoughts.

Systems Thinking
The systems thinking scale was developed by Frank et al. (2007) as part of a broader measure termed the ‘capacity for engineering systems thinking’ (CEST). This measure
was developed as a nominal scale with five factors; i) ‘seeing the big picture’, ii) ‘using interdisciplinary knowledge for conceptualising the solution’, iii) ‘analysing the needs/requirements’, iv) being a systems thinker, and v) implementing managerial considerations. Upon examining the items, it was deemed that only the first two factors were specifically related to systems thinking, because the third factor concerned analysing customer requirements, the fourth factor is related to dispositions such as being a good learner (which is already captured in some of the other measures) and the fifth factor has elements such as understanding and knowing budgets.

The following Cronbach alpha scores were reported for the systems thinking scale; 0.836 (Frank et al. 2007) and 0.855 (Frank 2010). The entire measure shows satisfactory construct validity and predictive validity. Construct validity was demonstrated in a confirmatory factor analysis that showed the items load on five factors (Frank 2010). Predictive validity was evidenced in two test when supervisors evaluated the systems engineers by completing the measure, as this shows that the measure predicted supervisor’s expectations of the system engineers, and the correlation analysis revealed scores of .39 (p = .053) (Frank et al. 2007) and .4 (p = .05) (Frank 2010) (acceptable predictive validity results range from 0.17 to 0.64). The items that were used to measure systems thinking are as follows and Appendix 4 provides an explanation of any adaptations that were made to the original items:

**Systems Thinking The Whole (STTW)**

STTW1: When I'm doing my job, I need to know the big picture.

STTW2: When I undertake a task, I need to know how it fits in with the overall organisational system

STTW3: I don't like to be involved with details; I prefer to deal with the organisation’s systems.

STTW4: It is important for me to improve the overall work system.

STTW5: When I undertake a task, I look at the how it is related to what other people are doing.

STTW6: It is important for me to know what other employees in my department do.

STTW7: I am happy to start working on a new task even if I am only given a general description of what I need to do.

STTW8: When I encounter a problem, I think of how my proposed solution affects other departments/employees.

STTW9: I take interest in the activities of colleagues from other disciplines that are part of my team.
**Systems Thinking Interdisciplinary Knowledge (STIDK)**

**STIDK1**: I think that every employee should gain interdisciplinary knowledge and general knowledge in several fields.

**STIDK2**: It is important for me to acquire knowledge in fields other than my specialisation.

**STIDK3**: A good professional needs to be both an expert in his/ her area and also understand other areas relevant to their work.

**STIDK4**: Any professional should be aware of all other aspects their work (e.g. technical, financial, marketing, human resources).

**STIDK5**: It is important to me to attain knowledge in areas that are not my main area of expertise.

**Multiple Perspective-Taking**

A search of the literature failed to find an established measure for multiple perspective-taking. Hence, it was necessary to either create a new measure or to modify a measure for a related construct: It was decided to do the latter. Bass (1985) conceptualised transformational leadership as consisting of multiple dimensions, including 'intellectual stimulation'. This type of leadership involves the leader encouraging followers to adopt new approaches to solve old problems, view problems from various angles, reframe problems, and challenge established ways of doing things. In essence, these leadership behaviours encourage followers to view problems from different perspectives.

The multifactor leadership questionnaire (MLQ), which was developed by Bass and colleagues, is a well-established measure of three leadership styles: transformational, transactional and laissez faire. The MLQ items for intellectual stimulation were modified and used to measure multiple perspective-taking. The intellectual stimulation items from the MLQ have been used and assess by various scholars and show a high degree of reliability and convergent validity. For example, in a study involving a total of 3786 participants from 14 independent samples from organisation across the world, Avolio, Bass and Jung (1999) found strong factor loadings for all four of intellectual stimulation items ranging from .71 to .81. In terms of reliability, they found that the internal consistency was above .70. In terms of predictive validity, intellectual stimulation has been shown to be significantly and positively correlated to both leadership effectiveness and satisfaction with the leader. The items that were used to measure multiple perspective-taking are as follows and Appendix 3 provides an explanation of any adaptations that were made to the original items:
MPT1: I re-examine ways of doing things to see if they are up to standard.
MPT2: I look at problems from many different angles.
MPT3: I try new ways of looking at how to complete assignments.
MPT4: I seek differing perspectives when solving problems.

**Job-related Learning**
The job-related learning measure was developed by Loon and Casimir (2008). The items measure the recent learning of job-related skills and knowledge. Each item started with “In the last 2 months” to reflect learning that has occurred after data for Stage 1 were collected. Loon and Casimir (2008) reported that the job-related learning scale has adequate internal reliability. The items that were used to measure job-related learning are as follows and Appendix 6 provides an explanation of any adaptations that were made to the original items:

- JRL1: I have acquired a lot of new job-related knowledge.
- JRL2: I have learnt a lot of things that have helped me to perform my job better.
- JRL3: I have acquired a lot of new job-related skills.

**Creativity**
The construct of creativity was measured using the Runco Ideation Behavioural Scale (RIBS) (Runco et al. 2001). Runco et al. (2001) reported that the measure demonstrated discriminant validity with participants’ grade point average (GPA) (n = 90) was .106 (p = .319), and two scales; the Premature Closure Scale (six items) = .32 and for the Openness to Divergence Scale = .34. The reported Cronbach alpha is .91. Only a number of items from factor one was used as the authors argued that this factor appears to be most direct measure of creativity. Creativity was measured at three levels: job, team, and organisation. The items that were used to measure creativity are as follows and Appendix 7 provides an explanation of any adaptations that were made to the original items:

**Job**
CreateJob1: I have many ideas on how to improve the way I do my job.
CreateJob2: I come up with a lot of ideas or solutions to problems related to my job.
CreateJob3: I come up with ideas or solutions my colleagues have never thought in relation to our jobs.
CreateJob4: I am good at combining ideas in ways that others have not tried in order to improve the way we our jobs.
CreateJob5: I have ideas about how to improve things related to my job.
**Team**

CreateTeam1: I have many ideas to improve how my team works.
CreateTeam2: I come up with a lot of ideas or solutions to problems related to how my team works.
CreateTeam3: I come up with ideas or solutions my colleagues have never thought in relation to how our team works.
CreateTeam4: I am good at combining ideas in ways that others have not tried to improve the way our team works.
CreateTeam5: I have ideas about how to improve things related to how my team works.

**Organisation**

CreateOrg1: I have many ideas to improve how my organisation works.
CreateOrg2: I come up with a lot of ideas or solutions to problems related to how my organisation works.
CreateOrg3: I come up with ideas or solutions my colleagues have never thought in relation to how our organisation works.
CreateOrg4: I am good at combining ideas in ways that others have not tried to improve the way our organisation works.
CreateOrg5: I have ideas about how to improve things related to how my organisation works.
**Innovation Behaviour**

The construct of innovation behaviour was measured using Scott and Bruce (1994) scale. Scott and Bruce (1994) examined the correlation between an objective measure of individuals’ history of innovation behaviour from their organisation’s archives and their supervisor’s rating of the individuals using the innovation behaviour measure. They reported concurrent validity for the innovation behaviour measure ($r = .33$, $p > .001$). They also reported a Cronbach alpha of .89 for the scale. The items that were used to measure innovation are as follows and Appendix 8 provides an explanation of any adaptations that were made to the original items:

- Innovate 1: In the last 2 months, I have searched out new technologies, processes, techniques and/or product ideas.
- Innovate 2: In the last 2 months, I have generated creative ideas.
- Innovate 3: In the last 2 months, I have promoted and champion ideas to others.
- Innovate 4: In the last 2 months, I have investigated and secured funds needed to implement new ideas.
- Innovate 5: In the last 2 months, I have developed adequate plans and schedules for the implementation of new ideas.
- Innovate 6: I am innovative

**Control Variables**

Two control variables were included in the survey. The control variables are social desirability and risk aversion.

**Risk Aversion**

Mandrik and Bao (2005) define general risk aversion “as an individual's degree of negative attitude toward risk arising from outcome uncertainty” (p. 533) and developed the general risk aversion (GRA) scale. They found the GRA scale had concurrent validity with the risk aversion in product usage scale (Raju 1980) and discriminant validity with an innovativeness scale (Price & Ridgway 1983). They reported a Cronbach’s alpha of .72. The items that were used to measure risk aversion are as follows and Appendix 9 provides an explanation of any adaptations that were made to the original items:

- RiskAv 1: I do not feel comfortable about taking chances.
- RiskAv 2: I prefer situations that have foreseeable outcomes.
- RiskAv 3: Before I make a decision, I like to be absolutely sure how things will turn out.
RiskAv4: I avoid situations that have uncertain outcomes.
RiskAv5: I do not feel comfortable improvising in new situations.
RiskAv6: I feel nervous when I have to make decisions in uncertain situations.

Social Desirability
The social desirability scale was adopted from Crowne and Marlowe (1960), who reported concurrent validity with the Edwards Social Desirability Scale (r = .32, p < .01). The measure also has an internal consistency score of .88, and test-retest correlation of .89. The items that were used to measure social desirability are as follows and Appendix 10 provides an explanation of any adaptations that were made to the original items:
SocDes1: I never hesitate to go out of my way to help someone in trouble.
SocDes2: I have never intensely disliked anyone.
SocDes3: I would never think of letting someone else be punished for my wrongdoings.
SocDes4: I am always courteous, even to people who are disagreeable.
SocDes5: When I don’t know something, I don’t mind at all admitting it.

4.4.7.2. Survey Questionnaire Design
The survey questionnaire has two parts, based on the two stages of the longitudinal design. In stage one, the survey questionnaire contains two parts, participants’ demographics and the items that measure the constructs of critical thinking, multiple perspective-taking, systems thinking, problem solving, and metacognition. In stage two, the survey questionnaire contained the measures for the constructs of job-related learning, creativity, innovative behaviour, and the measures for the control variables of social desirability and risk aversion. The section that elicits information concerning the participants’ demographics was positioned in stage one, and in the initial part of the questionnaire as this may help to increase the perceived ‘personalisation’ of the questionnaire and thus increase the commitment to fully complete the questionnaires in stages one and two.

The decision to assign the constructs in stage one (and consequently the constructs in stage two) is partly informed by the literature in terms of the direction of causality. For example, dispositions affect the behaviours related to ideation (i.e. creativity) (Plucker, Runco & Lim 2006). The constructs in stage one and stage two, and the order of occurrence of the constructs are illustrated in Figure 3.3 in the previous sub-section.
Whilst most of the rating scales and the verbal poles adopted were the same as those used by the scholars that created the inventories, it is useful to discuss the options related to each. The scale of measure determines the type of data collected, whilst rating scales concern how the scale is presented to the participant and the verbal poles are the labels that correspond to each unit in the scale of measure (Remenyi 2012).

There are four types of scale; nominal, ordinal, interval and ratio (Hair Jr et al. 2003). A nominal scale is the simplest type of measure and is used to categorise data that are discrete and mutually exclusive (Hair Jr et al. 2003). Examples of nominal data are gender such as male, female or transgender categories, and level in organisation such as non-management and management staff. Nominal scales do not indicate any order or degree of strength amongst each unit. Ordinal scales, however, do indicate the order of the units in the measure (Hair Jr et al. 2003). An example of ordinal data is order of siblings and/or placing of athletes in a race. However, ordinal scales do not indicate the difference between each unit of measure. For example, in the case of siblings, ordinal scale does not indicate how many years of difference there are between each sibling, or in the case of athletes how many points differentiate between each athlete. Interval scales addresses this issue as they specify the degree of difference between each unit of measure (Hair Jr et al. 2003). An example of an interval scale is a Likert scale that assume that the difference between ‘strongly disagree’ and ‘disagree’, is the same as the difference between ‘disagree’ and ‘neutral’. However, the interval scale does not indicate a unique origin or primacy (i.e. zero point). The ratio scale assumes the presence of a starting point and allows ratios to be computed and compared (Hair Jr et al. 2003). Financial data and time are examples of ratio scales.

Rating scales are essentially the presentation of the scale of measure that determines how the scale is rated by the participant. There are nine types of rating scale category, consensus, dichotomous, fixed sum rating, graphic rating, itemised rating, Likert, semantic differential and Stapel (Saunders et al. 2009; Cavana et al. 2001; Bryman & Bell 2011). The adoption of the type of rating scale is partly influenced by the type of scale (e.g. nominal, ordinal, interval and ratio) that is used. A category rating scale is used when only one response is required from a set of options.

A consensus rating scale is used when there is a need to obtain consensus from a panel of expert judges, who both determines the items and the measures. Dichotomous scales are simple binary decisions (e.g. ‘yes’ or ‘no’), whilst the fixed sum rating scale, also known as the ipsative and forced rating scale, requires participants to allocate a fixed number of
total points across a set of items. The graphic rating scale is graphically depicted, whilst an itemised rating scale requires participants to rate a particular item on a continuous scale that forms part of a set of attribute related to a question. A Likert scale requires participant to rate their, for example, agreement or disagreement with a particular statement. Semantic scales are bipolar attributes of a particular item, whilst a Stapel scale gauges the direction and intensity of a participants’ response to a particular item (Saunders et al. 2009; Cavana et al. 2001; Bryman & Bell 2011).

Verbal poles are the statements that accompany, for example, the numerical unit in a measure (Cavana et al. 2001). The set of ‘strongly disagree, disagree, neutral, agree and strongly agree’ options is an example of a five-point Likert scale. A variety of verbal poles can be sued to suit the nature of the scale. The rating scale and verbal pole used for each of the measures used for the constructs are provided in Table 53.
Table 53: Rating scales and verbal poles used for each measure (created by author)

<table>
<thead>
<tr>
<th>Construct</th>
<th>Original rating scale and verbal poles</th>
<th>Rating scale and verbal poles used in this study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical thinking (engagement, maturity and innovativeness)</td>
<td>Five point Likert scale, strongly disagree to strongly agree</td>
<td>As original</td>
</tr>
<tr>
<td>Systems thinking (whole and interdisciplinary knowledge)</td>
<td>Nominal scale. Choice between two statements.</td>
<td>Five point Likert scale, never, rarely, sometimes, usually, always</td>
</tr>
<tr>
<td>Multiple perspective-taking</td>
<td>Five point Likert scale, not at all, once in a while, sometimes, fairly often, frequently, if not always.</td>
<td>Five point Likert scale, strongly disagree, disagree, neutral, agree, strongly agree.</td>
</tr>
<tr>
<td>Problem solving (positive orientation and rational problem solving)</td>
<td>Seven point Likert scale, not at all true of me to extremely true of me</td>
<td>Five point Likert scale, not at all of me, slightly true of me, moderately true of me, very true of me, extremely true of me.</td>
</tr>
<tr>
<td>Problem solving (systematic)</td>
<td>Six point Likert scale. Verbal poles not reported.</td>
<td>Five point Likert scale, not at all of me, slightly true of me, moderately true of me, very true of me, extremely true of me.</td>
</tr>
<tr>
<td>Metacognition</td>
<td>Four point Likert scale, do not agree, agree slightly, agree moderately, and agree very much.</td>
<td>Five point Likert scale, strongly disagree, disagree, neutral, agree, strongly agree.</td>
</tr>
<tr>
<td>Job-related learning</td>
<td>Five point Likert scale, strongly disagree to strongly agree</td>
<td>As original</td>
</tr>
<tr>
<td>Creativity (job, team and organisation)</td>
<td>Five point Likert scale, never, rarely, sometimes, usually, very often</td>
<td>As original</td>
</tr>
<tr>
<td>Innovation behaviour</td>
<td>Five-point Likert scale ranging from ‘not at all’ to ‘to an exceptional degree’</td>
<td>As original</td>
</tr>
<tr>
<td>Social Desirability</td>
<td>Five point Likert scale, ranging from extremely well-adjusted (1) to extremely maladjusted (5)</td>
<td>Five point Likert scale, strongly disagree, disagree, neutral, agree, strongly agree.</td>
</tr>
<tr>
<td>Risk Aversion</td>
<td>Seven point Likert scale, ranging from strongly agree to strongly disagree.</td>
<td>Five point Likert scale, strongly disagree, disagree, neutral, agree, strongly agree.</td>
</tr>
</tbody>
</table>

4.4.7.3. Sampling

In an ideal world, the entire population can be studied to establish the ‘true’ state of things. The population is usually recorded in some census survey. However, all research projects are limited in terms of resources (e.g. time and money). In addition, there may be no census for some populations. However, it is argued that sampling, although inherently
less accurate in terms of reflecting the target population, is more practical in terms of being more efficient and economical (Zikmund et al. 2010). There is a trade-off between the accuracy of reflecting a population, and the cost and time involved.

Whilst it is assumed that census surveys enhance the reliability of the data, Saunders et al. (2009) argue otherwise as they state that sampling improves reliability as it negates fatigue and thus errors by the researcher. In addition, there is an argument that the more elements of a population one includes in a sample the better the sample reflects a population may actually result in diminishing returns (Cavana et al. 2001; Bryman 2012). In some cases, sampling frames may be available and are appropriate to be used. Sampling frames are considered as a proxy of a population (Cavana et al. 2001; Bryman 2012). An example is the telephone directory. However, like all tools and methods, the selection of sampling frames must be done with care to ensure that the sampling frame can indeed be considered as a proxy of the population: That is, it is ‘up-to-date’ and does not contain duplicates (Hair Jr et al. 2003).

Sampling is helpful especially when large populations are involved as it influences the overall validity of the research (e.g. did the study recruit the ‘right’ individuals in addressing the research problem and questions?) and the generalisability of the findings of the study (e.g. can the findings be applied to the entire population?) (Bryman & Bell 2011). In facilitating the selection of the most appropriate sampling method, scholars have identified a number of sampling methods (Bryman & Bell 2011).

Generally, there are two broad categories of sampling approaches: probability and non-probability. They key difference between the two approaches is the degree of generalisability that one can infer from the findings. Specifically, if a probability sampling approach is adopted, the more likely a set of findings can be generalised to the population. Bryman (2012) states that this approach in sampling “reflects the population accurately so that it is a microcosm of the population” (p. 187), as each unit has an equal chance of being selected in the sample. The non-probability sampling approach usually results in limited generalisability of the findings. Each approach contains a number of methods, summarised in Table 54. Generally, there is no right or wrong method of sampling. The choice of sampling method depends on the research problem, research question and the resources available to the research project.
Table 54: Probability and non-probability sampling designs (adapted from Cavana et al., 2001)

<table>
<thead>
<tr>
<th>Sampling Design</th>
<th>Description</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Probability sampling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple random sampling</td>
<td>All population elements are considered; each has equal chance of selection</td>
<td>High generalisability of findings.</td>
<td>Not as efficient as stratified sampling.</td>
</tr>
<tr>
<td>Systematic sampling</td>
<td>Every nth element in the population is chosen starting from a random point in the sampling frame</td>
<td>Easy to use if sampling frame is available.</td>
<td>Systematic biases are possible.</td>
</tr>
<tr>
<td>Stratified random sampling (Str.R.S.)</td>
<td>Population is first divided into meaningful segments; subjects are drawn: i in proportion to their original numbers. ii based on other criteria.</td>
<td>Most efficient among all probability designs. All groups are adequately sampled and comparisons among groups are possible.</td>
<td>Stratification must be meaningful. More time-consuming than simple random sampling or systematic sampling. Sampling frame for each stratum is essential.</td>
</tr>
<tr>
<td>Cluster sampling</td>
<td>Groups that have heterogeneous members are first identified, then some are chosen at random; all the members in each of the randomly chosen groups are studied.</td>
<td>In geographic clusters, costs of data collection are low.</td>
<td>The least reliable and efficient among the probability sampling designs since subsets of clusters are more homogeneous than heterogeneous.</td>
</tr>
<tr>
<td>Area sampling</td>
<td>Cluster sampling is done within a particular area or locality.</td>
<td>Cost-effective. Useful for decisions relating to a particular location.</td>
<td>Take time to collect data from an area.</td>
</tr>
<tr>
<td>Double sampling</td>
<td>The same sample or a subset of the sample is studied twice.</td>
<td>Offers more detailed information on the topic of study.</td>
<td>Original biases, if any, will be carried over. Individuals may not be happy responding a second time.</td>
</tr>
<tr>
<td><strong>Non-probability sampling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convenience sampling</td>
<td>The most easily accessible members are chosen as subjects.</td>
<td>Quick, convenient, inexpensive.</td>
<td>Not generalisable at all.</td>
</tr>
<tr>
<td>Judgement sampling</td>
<td>Subjects are selected on the basis of their expertise in the subject investigated</td>
<td>Sometimes the only meaningful way to investigate</td>
<td>Generalisability is questionable; not generalisable to entire population.</td>
</tr>
<tr>
<td>Snowball sampling</td>
<td>Initial sample is identified, then more subjects are selected from referrals.</td>
<td>Useful when subjects have required characteristics but are hard to find and contact.</td>
<td>Not normally generalisable.</td>
</tr>
<tr>
<td>Quota Sampling</td>
<td>Subjects are conveniently chosen from targeted groups according to some predetermined quota.</td>
<td>Very useful where minority participation in a study is critical.</td>
<td>Not easily generalisable.</td>
</tr>
</tbody>
</table>
Probability sampling involves a number of techniques such as simple random sampling, systematic sampling, stratified random sampling, cluster sampling, area sampling and double sampling. Simple random sampling essentially involves giving an equal opportunity to all elements to be considered as part of the sample. The findings using this method can be considered highly generalisable, although it is not considered to be efficient.

Systematic sampling is considered more efficient as it usually involves employing a sampling frame that is representative of the population, and selecting an ‘nth’ element as the starting point in further selecting samples (e.g. every fifth person from names in alphabetical order). Stratified random sampling involves classifying the population into meaningful groups (e.g. geographic areas) and selecting a sample from each stratum in an unbiased manner (e.g. 3 elements from each group).

Cluster sampling involves first identifying heterogeneous members of a group, who are then selected at random including those in homogenous groups. This method is considered the least efficient amongst all the probability sampling methods (Cavana et al. 2001; Bryman 2012) as the basis of clustering may be flawed and may have a significant impact on the generalisability of the findings (Cavana et al. 2001; Bryman 2012). Area sampling is a geographic/location version of cluster sampling, whilst double sampling is sampling a sample twice. This latter method whilst rigorous, may cause fatigue (and dissatisfaction) in participants.

Non probability sampling involves techniques such as convenience sampling, judgement sampling, snowball sampling and quota sampling (Cavana et al. 2001; Bryman 2012). Convenience sampling involves recruiting members who are most accessible and the findings from the use of this method are least generalisable. Judgement sampling involves selecting samples based on the expert judgement of the researcher in terms of the fit of the elements with the purpose of the study (e.g., key informants). However, this method may reflect the researcher’s biases. Snowball sampling occurs when an initial sample is asked to introduce/recommend other participants. This method is useful when the samples are unknown (difficult to be identified) and only those of the ‘same’ group have access to one another. Quota sampling involves selecting samples from a group with a predetermined quota (e.g. ratio of ethnic groups in a country) (Cavana et al. 2001; Bryman 2012).
Although there are a number of sampling methods that enhance the generalisability of the findings, each of the methods however, requires considerable resources (e.g. time), and not all research studies are afforded the same level of resources. In addition, due to the complication in the data collection process the sampling method adopted in this study is convenience sampling. A longitudinal research design tends to be an additional hindrance in recruiting participants, thus the most effective way in overcoming this and to recruit a relatively large number of participants in a rather short time frame is to use convenience sampling method and although it is comparatively less rigorous it is no less valid.

4.4.7.4. Data Collection Method and Administrative Procedures

Hair Jr et al. (2003) state that there a number of methods in data collection such as hardcopy questionnaires through postal mail, administering the survey questionnaire in-person, calling and asking participants the questions (items) by phone, and via electronic form (either in an email or a link in an email that hyperlinks to a website) (Hair Jr et al. 2003). However, there is no ‘one best’ method as each method has its advantages and disadvantages, as shown in Table 55.

Distributing the survey questionnaire in hardcopy via the post enables the researcher to ‘cast the net wide’, which is crucial as a large number of participants is crucial as warranted by some of the statistical techniques that will be used in the data analysis. Anonymity can be guaranteed, the participant can complete the questionnaire at his/her own pace and the cost is relatively low. However, this method usually results in low response rates. In addition, the survey questionnaire must be simple and easy to understand as there is no opportunity for clarification.
Table 55: Advantages and disadvantages of various methods of administering survey questions (adapted from Hair et al., 2003)

<table>
<thead>
<tr>
<th>Methods of Administration</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mail (hard copy)</td>
<td>Wider access and better coverage</td>
<td>Questionnaire must be simple</td>
</tr>
<tr>
<td>Involves mailing hard copy to predetermined respondents with cover letter</td>
<td>Provides anonymity</td>
<td>Low response rate</td>
</tr>
<tr>
<td></td>
<td>Relatively low cost</td>
<td>Points of clarification are not possible</td>
</tr>
<tr>
<td></td>
<td>Large sample size</td>
<td>Follow-up of non-response is difficult</td>
</tr>
<tr>
<td></td>
<td>Respondents complete questionnaire at own pace</td>
<td></td>
</tr>
<tr>
<td>In Person</td>
<td>Establish empathy and interest in study</td>
<td>Expensive in time and cost</td>
</tr>
<tr>
<td>Requires face-to-face contact with respondents</td>
<td>Can probe complex issues</td>
<td>May lead to interviewer bias</td>
</tr>
<tr>
<td></td>
<td>Can clarify respondents queries</td>
<td>Difficult to obtain wide access</td>
</tr>
<tr>
<td></td>
<td>High response rate</td>
<td>Relatively small sample size</td>
</tr>
<tr>
<td>By phone</td>
<td>Provides personal contact</td>
<td>Short interview time</td>
</tr>
<tr>
<td>This is a form of personal interview</td>
<td>Wide geographical coverage</td>
<td>Can be expensive</td>
</tr>
<tr>
<td></td>
<td>Easy and quick access</td>
<td>Limited to telephone owner</td>
</tr>
<tr>
<td></td>
<td>Can be done with the aid of a computer</td>
<td>Loss of anonymity</td>
</tr>
<tr>
<td>Electronic</td>
<td>Easy to administer</td>
<td>Can be complex to design and program</td>
</tr>
<tr>
<td>Administered via the internet through e-mail</td>
<td>Provides anonymity</td>
<td>Limited to computer users</td>
</tr>
<tr>
<td></td>
<td>Low cost</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Global reach</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fast capturing of data and analysis</td>
<td></td>
</tr>
</tbody>
</table>

Although the face-to-face method in surveys is not typical, it is an option if it is crucial to obtain high response rates (e.g. when the participants are unique and there are not many of them). In addition, this method may be useful when the survey is complex and there is a need to probe the participants’ responses, and it is important in the study to establish empathy with the participant. However, as this method requires significant time to conduct one survey, it is not an ideal method for collecting a large amount of data in a relatively short time. In addition, the personal approach afforded by this method can be quite expensive especially when one considers the time required to survey each participant and the cost to travel to the location of the participants, and it can be influenced by the researcher’s bias. In addition, the participant will lose their anonymity with the researcher if this method is adopted.
Conducting the survey by phone provides the best of both worlds in terms of the postal and in-person approach. This method enables a wider geographic coverage to be surveyed as well, and can be relatively efficient as well as affording the researcher to probe and clarify responses. However, the limitation of this method is that it still takes time to complete and may be costly (e.g. researcher’s time and cost of phone calls) and like the in-person method, the participant will lose their anonymity.

The final method is to conduct the survey electronically. This method is easy to administer, low cost, provides a global reach and is very efficient (i.e. data can be sorted into a table in real time as the participants complete the survey). However, similar to survey by post, it is crucial that the items are pre-tested for clarity as there is no opportunity for participants to ask the researcher to clarify any of the items.

The first attempt at data collection in this study adopted both postal and electronic methods. Participants were sent hardcopy survey questionnaires via their organisations, who had agreed to allow their staff to participate in the study. A self-addressed envelope with a postal stamp was included in every survey questionnaire. This was to make returning the questionnaire to the researcher as easy as possible for the participants. The postal, hardcopy method was adopted for the first questionnaire as this initial attempt required the participants’ name and email address, and their supervisors’ name and email address. By virtue of completing the hardcopy, the participants would be providing consent to the researcher in identifying them and their supervisors, and to contact them and their supervisors. In each questionnaire, participants were asked if they would like to complete the questionnaire in stage two in hardcopy or electronically.

As the first attempt at data collection was unsuccessful as there were low participation and data for each case was incomplete, the research design was revised. The second attempt to collect data resulted in the identity of the participants being anonymous to the researcher and did not require the individuals’ supervisors to participate (see section on ethics for more details concerning the second data collection attempt). Each survey questionnaire was distributed electronically in the second attempt.

4.5. DATA ANALYSIS

This section discusses how the data will be analysed. Using SPSS version 22, and Smart PLS. The first subsection discusses the descriptive statistics that will be reported and how the data will be prepared prior to the analyses using inferential statistics. The second
subsection is a discussion on the primary method of analysis used to test the hypotheses: partial least squares analysis based on structural equation modelling (PLS-SEM).

4.5.1. Descriptive Statistics and Data Preparation
The data analysis will first involve obtaining descriptive statistics in presenting the demographics of participants. Whilst there are number of statistical techniques available to test the hypotheses, this study will be using PLS-SEM, which is considered to an extension of general linear modelling procedures such as multiple regression analysis and analysis of variance (ANOVA).

4.5.2. Structural Equation Modelling
Structural equation modelling (SEM) is a multivariate technique that enables the analysis of complex relationships of multiple latent variables (e.g. unobservable constructs such as dispositions) simultaneously (Hair et al. 2006; Hoyle 1995). The essence of SEM involves the organising the ‘causal’ relationship amongst variables in the form of a model that is underpinned by theory (Stein, Morris & Nock 2012; Byrne 2006). Whilst there are other multivariate techniques, SEM is considered more advantageous as it is considered to be more flexible in terms of accommodating for different research designs and in terms of the approach in data analysis (Kline 2011). For example, SEM enables the researcher to analyse the data a priori or a posteriori in adopting either a confirmatory or exploratory approach in the factor analysis (Byrne 2006; Sroufe 2003). In addition to being flexible, SEM is more rigorous as it is able to take estimates of error variance into consideration in the examination of relationships amongst the constructs (Tomarken & Waller 2005).

The advantages of SEM also lie in its capability in the evaluation of models in particular, the measurement model and structural model (Lei & Wu 2007). The measurement model originates from the field of psychometrics and enables researchers to measure constructs that cannot be measured directly. Confirmatory factor analysis (CFA) as the measurement model in SEM requires the researcher to specify the factor structures a priori from theory. In accommodating the assumption of measurement errors, the measurement model corrects coefficients in the model and improves reliability by separating common variances from error variances in the observed variables (Blunch 2008). Once the latent constructs have been specified, the structural (or path) model, an extension of the multiple regression technique, enables the estimation of the causal relations and directional influence between the latent constructs. SEM can thus simultaneously include and
analyse both observed and unobserved latent constructs in the examination of hypothesised relationships (Shook et al. 2004).

4.5.2.1. Covariance-based, Partial Least Squares SEM

There are two complementary traditions in SEM, component-based SEM (CB-SEM) and covariance-based SEM (PLS-SEM). The primary aim of CB-SEM is to assess the consistency between the predetermined theoretical model and the eventual data obtained (Blunch 2008). The key aim of CB-SEM is to examine the fit between the data and the model as Borsboom, Mellenbergh and Van Heerden (2003) state that “The idea is that although the fit of a latent variable model to the data may not prove the existence of causally operating latent variables, the model does formulate this as a hypothesis; consequently, the fit of such models can be adduced as evidence supporting this hypothesis” (p. 203). Thus the theorised model must have sound underpinning as it is required to perform three types of test; confirmatory, alternative models and model generation in meeting the pre-specified multivariate normal distribution (Henseler, Ringle & Sarstedt 2012; Reinartz, Haenlein & Henseler 2009).

The alternative to CB-SEM is PLS-SEM (or just PLS), which unlike CB-SEM, does not require a priori specification of a model as this technique enables the researcher to undertake an exploratory analysis (Götz, Liehr-Gobbers & Krafft 2010). The purpose of PLS is also in contrast to CB-SEM as it involves prediction (rather than fit) (Chin 1998; Wold 1966). The key differences between CB-SEM and PLS-SEM are outlined in Table 56.

PLS is regarded as more appropriate for this study for a number of reasons. PLS is firstly more suited for this study as it is prediction-orientated, which fits the aims of the study in examining the constructs that predict innovation behaviour. The second reason relates to the flexibility that PLS affords the study, specifically as PLS does not a priori relationships to be hypothesised unlike covariance-based SEM. This is not to infer that the hypothesised relationship are not based on strong arguments derived from the literature, however, the exploratory nature of the factor analysis in PLS enables the analysis to be more amenable to other models that are a better fit as Sellin (1995) argues that “The analysis, then, can be characterized as a series of model analyses guided by theoretical considerations and empirical evidence” (p. 257). The third reason is due to PLS having more consistent inner structure coefficients (Cassel et al. 1999). The fourth reason is the appropriateness of PLS for analysing small samples and the fifth reason is due to its non-restrictive nature as it does not require normative assumptions of the data to
hold true (Wold 1985), in addition to not needing to adhere to the restrictive assumptions of multivariate normality (Wold 1982). Sixthly, it is appropriate when multicollinearity is present (Chin 1998).

### Table 56: Comparison of PLS-SEM and CB-SEM (Chin & Newsted 1999)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Component-based SEM (PLS-SEM)</th>
<th>Covariance-based SEM (CB-SEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Objective</strong></td>
<td>Prediction oriented</td>
<td>Parameter oriented</td>
</tr>
<tr>
<td><strong>Approach</strong></td>
<td>Variance based</td>
<td>Covariance based</td>
</tr>
<tr>
<td><strong>Assumptions</strong></td>
<td>Predictor specification (nonparametric)</td>
<td>Typically multivariate normal distribution and independent observations (parametric)</td>
</tr>
<tr>
<td><strong>Parameter estimates</strong></td>
<td>Consistent as indicators and sample size increase (i.e., consistency at large)</td>
<td>Consistent</td>
</tr>
<tr>
<td><strong>Latent Variable Scores</strong></td>
<td>Explicitly estimated</td>
<td>Indeterminate</td>
</tr>
<tr>
<td><strong>Epistemic relationship between a latent variable and its measures</strong></td>
<td>Can be modelled in either formative or reflective mode</td>
<td>Typically only with reflective indicators</td>
</tr>
<tr>
<td><strong>Minimum sample size</strong></td>
<td>Recommended minimum number of observations range from 6-100</td>
<td>Recommended minimum number of observations range from 200-800</td>
</tr>
<tr>
<td><strong>Implications</strong></td>
<td>Optimal for prediction accuracy</td>
<td>Optimal for parameter accuracy</td>
</tr>
<tr>
<td><strong>Model complexity</strong></td>
<td>Large complexity (e.g., 100 constructs and 1000 indicators)</td>
<td>Small to moderate complexity (e.g., less than 100 indicators)</td>
</tr>
</tbody>
</table>

Sellin (1995) extols the advantages of PLS as he states that “Partial least squares is a flexible and extremely powerful technique for the examination of path models with latent constructs measured by multiple indicators. It is distribution-free except for predictor specification and, thus, requires much less stringent assumptions than other approaches to latent variable path analysis....These unique features of PLS facilitate the analysis of complex models even under circumstances that would cause other methods to fail to produce reasonable results” (p. 266). In addition, the PLS analysis will be undertaken in a two-step approach, firstly assessing the measurement or inner model, followed by examining the structural or outer model (Anderson & Gerbing 1988). As discussed earlier, the measurement model involves assessing the reliability and validity of the
measures. The second phase involves testing the hypotheses by examining the direct and indirect relationship between the constructs (Chiou et al. 2011).

4.5.2.2. Reflective Measurement Models
This section further discusses the two major classifications of the measurement model that exist in PLS; formative and reflective measures. In formative measurement models the path of causality is from the measure to the construct, and the model includes items that are not necessarily correlated to one another, and each item has a significant contribution to the ‘meaning’ behind the construct. Thus if any of the items is removed, the meaning of the construct would inevitably change (Podsakoff et al. 2003). Thus the nature of formative measures inherently precludes the test of internal consistency and reliability (Diamantopoulos & Winklhofer 2001). In contrast, the path of causality in reflective measurement models are from construct to the measures, and the items in the measure are expected to be highly correlated with each other and thus the removal of one item from the measure should not alter the meaning of the construct (Jarvis, MacKenzie & Podsakoff 2003). The reflective measures will be used in this study due to the theoretical and empirical implications discussed. The differences between reflective and formative constructs are provided in Table 57.

In assessing the reflective measurement model, reliability (specifically in regards to internal consistency) and validity (in particular both convergent and discriminant validity are examined) are crucial considerations (Hair, Ringle & Sarstedt 2011). Although Cronbach’s alpha (α) is the most popular measure of internal reliability, composite reliability (CR) is more appropriate for reflective measures (Werts, Linn & Jöreskog 1974). This is supported by Chin (2010) who states that “In comparison to Cronbach’s alpha, this measure does not assume tau equivalency among the measures with its assumption that all indicators are equally weighted. Therefore, while alpha tends to be a lower bound estimate of reliability, CR is a closer approximation under the assumption that the parameter estimates are accurate” (p. 671). In addition, CR is less stringent than Cronbach’s alpha as the assumption that indicators are equally reliable is not assumed nor required. A CR ranging between .70 and .90 is considered satisfactory (Nunnally & Bernstein 1994).
Table 57: Framework of reflective and formative model (Coltman et al. 2008)

<table>
<thead>
<tr>
<th>Theoretical considerations</th>
<th>Reflective model</th>
<th>Formative model</th>
<th>Relevant literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of construct</td>
<td>Latent construct exists independent of the measures used.</td>
<td>Latent construct is determined as a combination of its indicators.</td>
<td>Borsboom et al. (2003)</td>
</tr>
<tr>
<td>Direction of causality between items and latent construct</td>
<td>Variation in the construct causes variation in the item measures. Variation in item measures does not cause variation in the construct Items share a common theme Items are interchangeable Adding or dropping an item does not change the conceptual domain of the construct</td>
<td>Variation in the construct does not cause variation in the item measures. Variation in item measures causes variation in the construct Items need not share a common theme Items are not interchangeable Adding or dropping an item may change the conceptual domain of construct</td>
<td>Bollen and Lennox (1991) Edwards and Bagozzi (2000) Rossiter (2002) Jarvis et al. (2003)</td>
</tr>
<tr>
<td>Characteristics of items used to measure the construct</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Empirical Considerations</td>
<td>Reflective model</td>
<td>Formative model</td>
<td>Relevant literature</td>
</tr>
<tr>
<td>Item inter-correlation</td>
<td>Items should have high positive inter-correlation</td>
<td>Items can have any pattern of inter-correlation but should possess the same directional relationship</td>
<td>Cronbach (1951) Nunnally and Bernstein (1994) Churchill Jr (1979)</td>
</tr>
<tr>
<td>Item relationships with construct antecedents and consequences</td>
<td>Items have similar sign and significance of relationships with antecedents/consequences as the construct Error term in items can be identified.</td>
<td>Items may not have similar significance of relationships with the antecedents/consequences as the construct Error term cannot be identified if the formative measurement model is estimated in isolation.</td>
<td>Bollen and Lennox (1991) Diamantopoulos and Winklhofer (2001) Diamantopoulos and Siguaw (2006) Bollen and Ting (2000)</td>
</tr>
<tr>
<td>Measurement error and collinearity</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A different set of criteria is used to examine convergent and discriminant validity in the reflective measurement model. Chin (2010) states that convergent validity is “the extent to which blocks of items strongly agree (i.e., converge) in their representation of the underlying construct they were created to measure” (p.674). Convergent validity is measured according to the suggestion of Fornell and Larcker (1981) using the average variance extracted (AVE), which is the average communality of items or the average variance of the indicator.
squared factor loading. The AVE is the indicator variance as explained by the construct and scholars such as Fornell and Larcker (1981) and Chin (2010) argue that as an adequate threshold, the AVE should be .50 or higher.

Discriminant validity is essentially the distinction or un-relatedness between two constructs. Thus, for a latent construct to demonstrate discriminant validity, it must explain more variance in its own indicators than it does the variance in other latent constructs. Two measures are used in assessing discriminant validity; criterion (Fornell & Larcker 1981) and cross loadings (Hair et al. 2011). Hair et al. (2011) state that in using the criterion measure “the AVE of each latent construct should be greater than the latent construct’s highest squared correlation with any other latent construct” (p.146), whilst, in terms of cross loadings, the target indicator’s loading must be higher than the loadings of all other constructs in the model (Sosik, Kahai & Piovoso 2009). Table 58 summarises the criteria and minimum threshold for internal consistency, indicator reliability, convergent validity and discriminant validity in a reflective measurement model.

**Table 58: Summary of criteria to assess the reflective measurement model (Hair et al. 2011)**

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal consistency</td>
<td>Composite reliability should be higher than .70.</td>
</tr>
<tr>
<td>Convergent validity</td>
<td>The AVE should be .50 or higher.</td>
</tr>
<tr>
<td>Discriminant validity</td>
<td>The AVE of each latent construct should be greater than the construct’s highest squared correlation with any other latent construct i.e. Fornell and Larcker (1981) criterion. An indicator’s loading with its respective latent construct should be greater than its cross loadings.</td>
</tr>
</tbody>
</table>

**4.5.2.3. Structural Model**

Hair et al. (2006) argue that the structural model “represents the theory with a set of structural equations and is usually depicted with a visual diagram” (p. 845) and is also known as a theoretical or causal model. In terms of PLS, the structural model is evaluated against the level of variance that is explained and the significance levels of the path coefficients. The R-square of the endogenous variable (i.e., the variable being predicted) is used to indicate the amount of variance in the endogenous variables that is explained by the theoretical model (Chin 2010).
In determining the significance of the path coefficients, researchers have an option from three resampling methods; bootstrapping, jack-knifing and blindfolding. The bootstrapping method is a non-parametric approach for estimating the precision and distribution of path coefficients (Hesterberg et al. 2005). Chin (2010) explains the bootstrap approach as he states that “N samples sets are created in order to obtain N estimates for each parameter in the PLS model. Each sample is obtained by sampling with replacement from the original data set (typically until the numbers of cases are identical to the original sample set)” (p. 674). Nonetheless, this method has limitations in particular this method has a precondition that evenly distributed data points are present, and thus this method is not appropriate for small sample sizes (e.g. less than 100) (Nevitt & Hancock 2001).

The jack-knife method addresses some of the limitations of bootstrapping as it caters for small sample sizes and outliers, and is considered more stable than bootstrapping (Chiquoine & Hjalmarsson 2009). Kock (2012) states that jack-knife “creates a number of resamples that equals the original sample size, and each resample has one case removed. That is, the sample size of each resample is the original sample size minus 1” (p. 12).

The final resampling method is the blindfolding method. Hair et al. (2011) state that blindfolding is a “procedure, where a sample re-use technique that omits every dth data point part and uses the resulting estimates to predict the omitted part” (p.147) and as Kock (2011) states, blindfolding allows the researcher to set the number of resamples to be created in the algorithm. This method also facilitates the examination of a model’s predictive utility by estimating the endogenous variables’ Q2 values (Stone 1974). In terms of this study, bootstrapping will be adopted. Table 59 illustrates the criteria used to interpret a structural model.
Table 59: Summary of criteria used to interpret a structural model (Hair et al. 2011)

<table>
<thead>
<tr>
<th>Criterion/ Basis</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>R² values</td>
<td>R² values of .75, .50, or .25 for endogenous latent variables in the structural model can be described as substantial, moderate, or weak respectively.</td>
</tr>
<tr>
<td>Bootstrapping path coefficients</td>
<td>Bootstrapping can be used to assess the path coefficients’ significance. The Critical Z-value for a one–tailed test is 1.645 (significance level= 5 per cent). However, t approaches Z as samples size increases.</td>
</tr>
</tbody>
</table>

In sum, PLS is an appropriate technique to be used in the higher-order thinking dispositions-creativity-innovation model as it is i) prediction orientated, ii) accommodates exploratory factor analysis, iii) consistent inner structure coefficients, iv) suitable for small samples, v) free of assumptions concerning residuals and parameters, and vi) appropriate when multicollinearity is present.

4.5.2.4. Mediation Testing Technique

A mediation effect is said to have occurred when an independent variable (y) correlates with the dependent variable (x) via an intervening variable (z) (Baron & Kenny 1986). Baron and Kenny (1986, p. 1176) state that mediation can be claimed if three conditions are met “i) the independent variable significantly predicts the dependent variable, ii) the independent variable significantly predicts the mediator variable, and iii) when the dependent variable is regressed on both the independent variable and mediator variable, the mediator variable significantly predicts the dependent variable, while at the same time the predictive utility of the independent variable is diminished”. However, Baron and Kenny (1986), and Judd and Kenny (1981) argue that mediation is nonetheless a matter of degree. They outline three decision criteria a) there is no mediation effect if Condition 2 is not met, b) there is partial mediation if the mediator and the independent variable both significantly predict the dependent variable when they are used simultaneously, and c) there is full mediation if only the mediator is significant when it and the independent variable are used simultaneously to predict the dependent variable.
4.6. Ethics

The initial research methodology also involved a longitudinal and dual-source design (i.e. employees and their corresponding supervisors). Both ‘employee’ and ‘supervisor’ participants were required to complete two sets of questionnaires each at two points in time approximately of 30 days apart. As the design required ‘matching’ the participants (i.e. both ‘employee’ and ‘supervisor’) to the questionnaires (i.e. first and second questionnaire) they had completed, the identities and contact details of the participants were required. The University of Newcastle’s Human Research Ethics Committee approved this research and the Protocol Reference Number is: H-2012-0237.

However, as time progressed it became clear that this approach will not succeed. After a year of collecting data, only 62 participants were recruited and there was 100 per cent attrition: That is, none of the participants had completed all of their surveys as a complete case consists of two questionnaires completed by the ‘employee’ participant plus two questionnaires completed by his/her ‘supervisor’.

After a number of attempts by the researcher to identify and recruit participants, he was contacted by Qualtrics, the vendor that provides the facilities for the electronic survey. Qualtrics offered the researcher additional service in leveraging upon their existing survey panels. The survey panels are individuals who have indicated to Qualtrics their willingness to participate in surveys. Given the time constraints and the impending deadline to submit the thesis, the researcher enlisted Qualtrics survey panel service. The criteria for the selection of participants (see section on sampling) were provided to Qualtrics and a project manager from Qualtrics was allocated to the project to ensure that the data collected were bona fide (i.e. genuine people completing the questionnaire honestly).

As per the original ethics application all the required information was included in the survey, with the researcher and his supervisor’s contact details made available. Qualtrics agreed to adhere by the ethical considerations required by the University of Newcastle, Australia. Although Qualtrics provided a small incentive to each individual, the incentive is transparent at a pre-determined rate (by Qualtrics) and fair to all individuals. In addition, participation by the individuals is completely voluntary and the anonymity of the individuals from the researcher is guaranteed. Qualtrics only keeps track of the individuals to ensure that the questionnaire is completed in its entirety for payment purposes. Confidentiality is also guaranteed as Qualtrics do not keep any copies of the
data once it has been provided to the researcher. The handling and storage of the data by the researcher is as per the ethics guidelines provided by the University of Newcastle, Australia.

4.7. LIMITATIONS

Whilst efforts have been made to ensure that the research methodology and design are both robust and rigorous, as with all studies, there are some limitations. Firstly, all the data collected are from the same source (i.e., individual employees completed questionnaires in the two stages). Mono-source data may become an issue as significant bias may be prevalent in the data. To examine if this is indeed an issue, Harman’s test (Podsakoff & Organ 1986; Avolio, Yammarino & Bass 1991) will be undertaken. In addition, control variables will be used to ensure the effects of related variables that are not in the conceptual model are statistically removed.

A second limitation of the study relates to the source of the data. In addition to the single source of the data, the data collected in this study are considered ‘soft’ data. Nonetheless, soft data are inherently justifiable in many cases. For example, self-reports on cognitive dispositions are considered the ‘best’ approach in terms of efficiency and effectiveness, as alternatives such as Functional Magnetic Resonance, (fMRI) are too expensive whilst not being able to guarantee validity. However, there are instances where ‘hard’ data may be appropriate such as innovation behaviour that may be disclosed in individuals’ annual appraisal reports.

The third and final limitation relates to the sampling approach. The convenience sampling method adopted inherently limits the generalisability of the findings. A more ‘systematic’ approach in sampling (e.g. probabilistic sampling family of methods) may have enabled the researcher to build into the study a comparative exercise (e.g. innovative industries/professions versus non-innovative industries/professions). Nonetheless, these limitations do not detract from the robustness and rigor of the research methodology and design. For example, a number of statistical tests will be undertaken to examine the degree of mono-source bias to identify if such biases are an issue.
4.8. **Summary**

This chapter has provided a rationale for the research paradigm, strategy and design options adopted. The positivist paradigm is adopted due to the philosophical underpinnings in terms of epistemological, ontological and axiology perspectives. The research paradigm informs the research strategy in particular the adoption of the survey strategy. The survey research strategy involves recruiting a large number of participants to complete a set of self-report scales. There are number of important elements that are required to be addressed, specifically in the context of the research design.

A key principle of the research design is that all the elements selected must be methodologically coherent with the research strategy. The purpose of the study is one of hypothesis-testing that essentially concerns *explaining* the relationship between the dependent variable and independent variables, thus it follows that the type of investigation is either causal or correlational. The study is correlational as the statistical techniques applied (as well as the research design employed) cannot ensure causality. The unit of analysis is the individual, which is consistent with the overall purpose of the study in investigating the innovative behaviour of individuals and its antecedents in relation to cognitive dispositions, job-related learning and creativity. The time horizon is longitudinal. Data are collected at two points in time with a minimum of 60 days between the two stages. The constructs measured at each point are based upon the hypothesised direction of occurrence. The thinking dispositions were measured in the first stage and the other variables (e.g., job-related learning, creativity and innovation behaviour) including the two control variables were measured in the second stage. The purpose and nature of the study suggests that the extent of the researcher’s interference is minimal as no manipulation is required. This is because the data required from the participants are reflexive. The survey only contains some explanation in regards to the problem solving measure as to ensure that all participants have the same understanding of the context in which problem solving occurs. Consistent with the rest of the research design, the study setting is non-contrived as no manipulation is necessary and this helps to enhance ecological validity.

As Section 4.4.7.1 shows, the reliability of measures is maintained by adopting established measures. This study has also undertaken reliability analysis with both composite analysis (Cronbach Alpha) and the average variance extracted (AVE) approaches showing acceptable convergent validity and internal consistency. Face
validity is also ensured by using established measures. The findings have external validity for similar samples of individuals with comparable demographics.

The data collected are considered as ‘quantitative’ data that involves questionnaires as the main instrument in gathering data through the surveys. The items used in the scales were adapted from existing measures. The scholars that established these measures all reported acceptable/satisfactory validity and reliability levels. A non-probability sampling design was adopted; in particular, convenience sampling was used.

In terms of data analyses, the data will first be analysed using descriptive statistics concerning the participants’ demographics (e.g. frequencies, mean and standard deviation). PLS analysis will then be used to test the hypotheses and an overall conceptual model that will be created by aggregating the hypotheses.

This chapter ends with a discussion concerning the ethical considerations as outlined the University of Newcastle, Australia involving humans. The protocol involving human ethics was strictly adhered to, with clear steps undertaken to guarantee the anonymity of the participants identity and the confidentiality of their responses. As with all studies, this study also has some limitations. The key limitations of the study were acknowledged, nonetheless, these limitations do not detract from the robustness and rigour of the research methodology and design.
5.0. CHAPTER FIVE– DATA ANALYSIS

5.1 INTRODUCTION

This chapter contains the results of the analyses that were conducted. Section 5.2 contains details of the sample and provides an overall profile of the participants. Section 5.3 contains the findings that were obtained for the measurement model, which was assessed prior to testing the hypotheses. Section 5.4 contains the results of the hypothesis testing whilst Section 5.5 contains the findings of an analysis that was used to test an overall conceptual model that was primarily based on the hypotheses. Section 5.6 contains some concluding remarks for the chapter.

5.2 SAMPLE CHARACTERISTICS

The sample consists of 202 participants who voluntarily accepted an invitation to participate in the study. Participants are from a wide range of industries including education, finance, healthcare, IT, manufacturing and real estate. All of the participants worked in white-collar occupations including administration, customer service, operations, IT support, and management.

Table 60 provides demographic details of the participants. Participants are on average approximately 45 years old and have been in their current jobs on average for approximately 8 years and have worked in their current industry on average for approximately 15 years. Approximately half of the sample is male and about three quarters of participants hold a Bachelor’s Degree or higher.
Table 60: Demographic Profile of the Sample

<table>
<thead>
<tr>
<th>Age</th>
<th>Years in Current Job</th>
<th>Years in Current Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>44.7 (10.6)</td>
<td>8.4 (7.5)</td>
<td>14.9 (9.9)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>97 (48%)</td>
<td>105 (52%)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highest Level of Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>High School</td>
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<td>16 (8%)</td>
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</table>

<table>
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<th>Level in Organisation</th>
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<td>Frontline</td>
</tr>
<tr>
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</tr>
<tr>
<td>19 (9%)</td>
</tr>
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</table>

5.3 Measurement Model

Partial Least Squares (PLS) analysis involves testing the measurement model (i.e., outer model) and the structural model (i.e., the inner or hypothesised model). The inner model is first assessed to ensure the discriminant validity, convergent validity and internal reliability of the measures that are used to measure the constructs in the structural or hypothesised model. After the measurement model has been assessed and found to be satisfactory, the structural model can then be tested.

Critical thinking was modelled as a second-order reflective construct consisting of three first-order reflective constructs: That is, engagement, maturity, and innovation. Problem solving was modelled as a second-order reflective construct consisting of three first-order reflective constructs: That is, positive problem orientation, rational, and systematic. Systems thinking was modelled as a second-order reflective construct consisting of two first-order reflective constructs: That is, systems thinking the whole and systems thinking interdisciplinary knowledge. Creativity was modelled as a second-order reflective construct consisting of three first-order reflective constructs: That is, creativity job, creativity team, and creativity organisation. Metacognition, multiple perspective-taking, job-related learning, and innovation were modelled as first-order reflective constructs.
All of the variables (i.e., systems thinking, metacognition, multiple perspective-taking, problem solving, critical thinking, job-related learning, creativity, and innovation) in the hypotheses are latent constructs and each was measured using a multiple-item scale. The PLS analysis revealed that several items from the original scales needed to be omitted in order to obtain a satisfactory measurement, or inner, model. All of the items that were used to measure the various constructs are reflective in nature and thus the loadings are simply the correlations between the items and their respective latent construct.

Table 61 provides the loadings, t-values of the loadings, means and standard deviations of those items from the various multiple-item scales that were used. As shown in Table 61, all of the items that were retained loaded significantly on their respective latent constructs.

Control variables were used in this study. Job-related learning was controlled for the effects of years in current job and social desirability. Creativity was controlled for the effects of years in current job, risk aversion and social desirability. Innovation was controlled for the effects of years in current job, risk aversion and social desirability. Risk aversion and social desirability were modelled as first-order reflective constructs.
Table 61: Loadings, t-values and Means (SD) for Latent Constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>Indicator</th>
<th>Loading</th>
<th>t-value</th>
<th>Mean (SD)</th>
</tr>
</thead>
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<tr>
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<td></td>
</tr>
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<td>Engagement</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>CTE1</td>
<td>.696</td>
<td>15.1</td>
<td>4.09 (0.71)</td>
</tr>
<tr>
<td></td>
<td>CTE3</td>
<td>.732</td>
<td>18.7</td>
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<tr>
<td></td>
<td>CTE4</td>
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<td>25.7</td>
<td>4.12 (0.78)</td>
</tr>
<tr>
<td></td>
<td>CTE7</td>
<td>.773</td>
<td>19.2</td>
<td>4.16 (0.73)</td>
</tr>
<tr>
<td></td>
<td>CTE9</td>
<td>.691</td>
<td>14.2</td>
<td>4.17 (0.70)</td>
</tr>
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<td></td>
</tr>
<tr>
<td></td>
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<tr>
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<td>Maturity</td>
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<td>4.16 (0.73)</td>
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<td>CTE9</td>
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<td>Problem Solving</td>
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<td>PSPPO3</td>
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<td>PSPPO5</td>
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<td>Systematic</td>
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</tr>
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</tr>
<tr>
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<td>.779</td>
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<td>3.71 (0.97)</td>
</tr>
<tr>
<td></td>
<td>PSS6</td>
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<td>3.85 (0.93)</td>
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<td></td>
<td>PSS7</td>
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<td>3.57 (.1.01)</td>
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<tr>
<td></td>
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<tr>
<td></td>
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<td>.760</td>
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</tr>
<tr>
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Table 61 (cont’d): Loadings, t-values and Means (SD) for Latent Constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>Indicator</th>
<th>Loading</th>
<th>t-value</th>
<th>Mean (SD)</th>
</tr>
</thead>
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<td>MPT3</td>
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<td>3.92 (0.78)</td>
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<td></td>
<td>MPT4</td>
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<td>4.00 (0.75)</td>
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<td>57.9</td>
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<td>3.44 (0.82)</td>
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<td>25.4</td>
<td>3.53 (0.85)</td>
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<td></td>
<td>CreateJob3</td>
<td>.828</td>
<td>29.8</td>
<td>3.35 (0.90)</td>
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<tr>
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<td>CreateJob4</td>
<td>.842</td>
<td>28.3</td>
<td>3.37 (0.90)</td>
</tr>
<tr>
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<td>CreateJob5</td>
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<td>28.7</td>
<td>3.50 (0.87)</td>
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<tr>
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<td>3.38 (0.89)</td>
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<tr>
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<td>CreateTeam2</td>
<td>.856</td>
<td>33.9</td>
<td>3.31 (0.86)</td>
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<td>CreateTeam3</td>
<td>.865</td>
<td>40.1</td>
<td>3.27 (0.94)</td>
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<tr>
<td></td>
<td>CreateTeam4</td>
<td>.856</td>
<td>35.9</td>
<td>3.35 (0.89)</td>
</tr>
<tr>
<td></td>
<td>CreateTeam5</td>
<td>.842</td>
<td>31.8</td>
<td>3.36 (0.86)</td>
</tr>
<tr>
<td>Organisation</td>
<td>CreateOrg1</td>
<td>.851</td>
<td>34.7</td>
<td>3.29 (0.95)</td>
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<tr>
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<td>CreateOrg2</td>
<td>.878</td>
<td>51.5</td>
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<td>CreateOrg3</td>
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<td>47.7</td>
<td>3.20 (0.95)</td>
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<td></td>
<td>CreateOrg4</td>
<td>.846</td>
<td>36.0</td>
<td>3.22 (0.92)</td>
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<td></td>
<td>CreateOrg5</td>
<td>.869</td>
<td>40.6</td>
<td>3.23 (0.90)</td>
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<td>Innovation1</td>
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<td>2.93 (1.03)</td>
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<td>Innovation2</td>
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<td>Innovation3</td>
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<td>2.96 (1.04)</td>
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<tr>
<td>Risk Aversion</td>
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<td>2.5</td>
<td>3.79 (0.82)</td>
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<td>RiskAv3</td>
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<tr>
<td></td>
<td>RiskAv4</td>
<td>.678</td>
<td>3.2</td>
<td>3.28 (0.96)</td>
</tr>
<tr>
<td>Social Desirability</td>
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<td>16.9</td>
<td>3.86 (0.86)</td>
</tr>
<tr>
<td></td>
<td>SocDes2</td>
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<td>2.90 (1.22)</td>
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<td>SocDes4</td>
<td>.672</td>
<td>8.6</td>
<td>3.65 (0.94)</td>
</tr>
</tbody>
</table>

5.3.1 Convergent Validity, Discriminant Validity and Internal Consistency

Items from a scale that are used to measure a reflective construct need to be highly correlated because they are, in principle, reflecting the same underlying construct. When this occurs, the items that are used to measure a reflective construct are highly correlated, the scale can be considered as demonstrating convergent validity.
The Average Variance Explained (AVE) is the average squared loading between the items used to measure a reflective construct and the construct itself. The AVE represents the proportion of variance in the items that are used to measure a particular reflective construct that is explained by the construct itself (Fornell & Larcker 1981). The AVE should be greater than .50 for acceptable convergent validity as it indicates that the latent construct explains more than half of the variance in the items that are used to measure it (Chin 1998).

The internal consistency of a set of reflective items can be measured using the composite reliability. Composite reliability is calculated as follows:

\[ CR = \frac{\sum \text{loadings}^2}{\left(\sum \text{loadings}^2 + \sum \text{indicator measurement error}\right)} \]

Composite reliability is similar to Cronbach’s Alpha except that it does not assume that all items are equally weighted (Chin 1998). The composite reliability coefficient should be greater than 0.7 for acceptable internal consistency (Hair et al. 1998).

Table 62 provides the average variance extracted and composite reliability for all of the latent constructs. As shown in Table 62, all of the AVEs are greater than .50 and all of the composite reliabilities are greater than .70. It can be assumed therefore that all of the measures have acceptable convergent validity and internal consistency.

### Table 62: Average Variance Extracted (AVE) and Composite Reliabilities

<table>
<thead>
<tr>
<th>Latent Construct</th>
<th>AVE</th>
<th>Composite Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Thinking</td>
<td>.52</td>
<td>.93</td>
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<tr>
<td>Problem Solving</td>
<td>.52</td>
<td>.93</td>
</tr>
<tr>
<td>Metacognition</td>
<td>.65</td>
<td>.90</td>
</tr>
<tr>
<td>Systems Thinking</td>
<td>.51</td>
<td>.93</td>
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<td>Multiple Perspective-Taking</td>
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<td>.89</td>
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<td>Job-related Learning</td>
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<td>Creativity</td>
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<td>Innovation</td>
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<td>.93</td>
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<td>.80</td>
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<tr>
<td>Social Desirability</td>
<td>.56</td>
<td>.79</td>
</tr>
</tbody>
</table>

Items that are used to measure a particular reflective construct should be more strongly correlated to the reflective latent construct that they are measuring than to other constructs. When this occurs, the items that are used to measure a particular reflective construct are demonstrating discriminant validity. Discriminant validity can be claimed if the square root of the AVE for a particular construct is greater than the correlations between the construct and other constructs in the model (Chin & Gopal 1995).
Table 63 provides the correlations between the latent constructs and the squared AVE for each construct. As shown in Table 63, the squared AVE of each construct is greater than all of its correlations with the other constructs. It can therefore be claimed that the constructs have satisfactory discriminant validity.

Table 63: Correlations and Squared AVE \( ^a \) for Constructs

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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>.72</td>
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<td>5. MPT</td>
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<td>.86</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. JobYrs</td>
<td>.04</td>
<td>.06</td>
<td>-.17</td>
<td>.02</td>
<td>.03</td>
<td>-.18</td>
<td>-.01</td>
<td>-.04</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. RiskAv</td>
<td>.07</td>
<td>.27</td>
<td>.19</td>
<td>.08</td>
<td>.16</td>
<td>.19</td>
<td>.19</td>
<td>.16</td>
<td>.02</td>
<td>.76</td>
<td></td>
</tr>
<tr>
<td>11. SocDes</td>
<td>.23</td>
<td>.31</td>
<td>.22</td>
<td>.27</td>
<td>.38</td>
<td>.30</td>
<td>.43</td>
<td>.37</td>
<td>.06</td>
<td>.12</td>
<td>.75</td>
</tr>
</tbody>
</table>

\( ^a \) = Squared AVEs are presented in bold on the diagonal. NA = not applicable.

Another way to check discriminant validity is to examine the cross loadings between each latent construct in the model and items that are used to measure the other latent constructs. The items that are used to measure a particular latent construct should have loadings with the latent construct that are larger than their correlations with the other latent constructs in the model (Chin 1998).

Appendix 11 provides the cross-loadings between each latent construct in the model and items that are used to measure the other latent constructs. As shown in Appendix 11, the items for each construct have loadings that are greater with it than with any other construct. Based on these findings, it can be claimed that the measures for all of the constructs have satisfactory discriminant validity.
A single component test was conducted using SPSS to determine if common method variance was a major issue. All of the items that are presented in Table 2 that were used to measure the five thinking dispositions, job-related learning, creativity and innovation were subjected to a principal components analysis to see if they all loaded strongly on one component. The findings from a principal components analysis reveal that the first component explains 34.7 per cent of the total variance in these items thereby indicating that common method variance is not a major concern. Furthermore, that several of the predictors of creativity and innovation were found to be significant provides further evidence that common method variance is not problematic in this study.

The issue as to whether or not the five thinking dispositions can be regarded as a single disposition was addressed by subjecting all of the items shown in Table 63 that were used to measure the five thinking dispositions to a single component test. The findings from a principal components analysis reveal that the first component explains 37.6 per cent of the total variance in these items thereby indicating that the five dispositions cannot be regarded as a single overarching disposition even though strong correlations were found between the five dispositions. Furthermore, the finding that multiple perspective-taking and systems thinking have unique effects on creativity further supports the argument that the five dispositions are not aspects of a single overarching disposition.

5.4 HYPOTHESIS TESTING

According to Baron and Kenny (1986), three conditions need to be met in order to claim a mediation effect: 1) the independent variable significantly predicts the dependent variable; 2) the mediator significantly predicts the dependent variable; and 3) when the dependent variable is regressed on both the independent variable and the mediator, the mediator significantly predicts the dependent variable and the predictive power of the independent variable is less than it is in Condition 1. Furthermore, partial mediation occurs if the independent variable significantly predicts the dependent variable in Condition 3.

The six hypotheses were tested using partial least squares analysis rather than SPSS because PLS takes measurement error into account and does not assume the data are normally distributed. The findings from these analyses are presented next.
5.4.1 Hypothesis One

According to Hypothesis 1, job-related learning mediates the relationship between critical thinking and creativity. A PLS analysis was conducted to test Hypothesis 1 and the results of this analysis are provided in Figure 36. As shown in Figure 36, Baron and Kenny’s (1986) three conditions are met. Job-related learning partially mediates the relationship between critical thinking and creativity. Hypothesis 1 is therefore supported.

Figure 36: Critical Thinking → Job-Related Learning → Creativity

CT = Critical Thinking, JRL = Job-Related Learning, JobYrs = Years in Current Job, RiskAv = Risk Aversion, SocDes = Social Desirability.

* = standardised regression coefficient when regressing creativity on CT (Condition 1)
ns = non-significant, ** p < .01, *** p < .001.

Total effect = 0.320. Direct effect = 0.266. Indirect effect = 0.054. A Sobel test revealed that the indirect effect of critical thinking on creativity via job-related learning is significant (Z = 2.18, p < .05).
5.4.2 Hypothesis Two

According to Hypothesis 2, job-related learning mediates the relationship between problem solving and creativity. A PLS analysis was conducted to test Hypothesis 2 and the results of this analysis are provided in Figure 37. As shown in Figure 37, Baron and Kenny’s (1986) three conditions are met. Job-related learning partially mediates the relationship between problem solving and creativity. Hypothesis 2 is therefore supported.

**Figure 37: Problem Solving → Job-Related Learning → Creativity**

<table>
<thead>
<tr>
<th>PS</th>
<th>Creativity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Solving</td>
<td>Creativity</td>
</tr>
<tr>
<td>.27*** (.32*)</td>
<td>R² = .378</td>
</tr>
<tr>
<td>JobYrs: -.21***</td>
<td>R² = .164</td>
</tr>
<tr>
<td>JRL</td>
<td>SocDes: .25***</td>
</tr>
<tr>
<td>.20**</td>
<td>RiskAv: .03ns</td>
</tr>
<tr>
<td>.31***</td>
<td>JobYrs: .02ns</td>
</tr>
<tr>
<td>R² = .164</td>
<td></td>
</tr>
</tbody>
</table>


* = standardised regression coefficient when regressing creativity on PS (Condition 1)
ns = non-significant, ** p < .01, *** p < .001.

Total effect = 0.333. Direct effect = 0.271. Indirect effect = 0.061. A Sobel test revealed that the indirect effect of problem solving on creativity via job-related learning is significant (Z = 2.15, p < .05).
5.4.3 Hypothesis Three

According to Hypothesis 3, job-related learning mediates the relationship between metacognition and creativity. A PLS analysis was conducted to test Hypothesis 3 and the results of this analysis are provided in Figure 38. As shown in Figure 38, Baron and Kenny’s (1986) three conditions are met. Job-related learning partially mediates the relationship between metacognition and creativity. Hypothesis 3 is therefore supported.

Figure 38: Metacognition → Job-Related Learning → Creativity


*a = standardised regression coefficient when regressing creativity on MC (Condition 1)
ns = non-significant, * p < .01, ** p < .01, *** p < .001.

Total effect = 0.305. Direct effect = .245. Indirect effect = 0.060. A Sobel test revealed that the indirect effect of metacognition on creativity via job-related learning is significant (Z = 2.22, p < .05).
5.4.4 **Hypothesis Four**

According to Hypothesis 4, job-related learning mediates the relationship between systems thinking and creativity. A PLS analysis was conducted to test Hypothesis 4 and the results of this analysis are provided in Figure 39. As shown in Figure 39, Baron and Kenny’s (1986) three conditions are met. Job-related learning partially mediates the relationship between systems thinking and creativity. Hypothesis 4 is therefore supported.

![Figure 39: Systems Thinking → Job-Related Learning → Creativity](image)


* = standardised regression coefficient when regressing creativity on ST (Condition 1)
ns = non-significant, * p < .05, ** p < .01, *** p < .001.

Total effect = 0.363. Direct effect = 0.317. Indirect effect = 0.046. A Sobel test revealed that the indirect effect of systems thinking on creativity via job-related learning is significant (Z = 1.78, p < .05).
5.4.5 Hypothesis Five

According to Hypothesis 5, job-related learning mediates the relationship between multiple perspective-taking and creativity. A PLS analysis was conducted to test Hypothesis 5 and the results of this analysis are provided in Figure 40. As shown in Figure 40, Baron and Kenny’s (1986) three conditions are met. Job-related learning partially mediates the relationship between multiple perspective-taking and creativity. Hypothesis 5 is therefore supported.

![Diagram](image)

**Figure 40: Multiple Perspective-Taking → Job-Related Learning → Creativity**


* = standardised regression coefficient when regressing creativity on MPT (Condition 1)

** Total effect = 0.411. Direct effect = .342. Indirect effect = 0.070. A Sobel test revealed that the indirect effect of multiple perspective-taking on creativity via job-related learning is significant (Z = 2.53, p < .01).
5.4.6 **Hypothesis Six**

According to Hypothesis 6, creativity mediates the relationship between job-related learning and innovation. A PLS analysis was conducted to test Hypothesis 6 and the results of this analysis are provided in Figure 41. As shown in Figure 41, Baron and Kenny’s (1986) three conditions are met. Creativity partially mediates the relationship between job-related learning and innovation. Hypothesis 6 is therefore supported.

![Figure 41: Job-Related Learning → Creativity → Innovation](image)

**JRL** = Job-Related Learning, **JobYrs** = Years in Current Job, **RiskAv** = Risk Aversion, **SocDes** = Social Desirability.

---

**a** = standardised regression coefficient when regressing innovation on JRL (Condition 1)

\[^\text{ns}^\text{= non-significant, \text{***} \ p < .001}^\]

Total effect = 0.528. Direct effect = 0.334. Indirect effect = 0.195. A Sobel test revealed that the indirect effect of job-related learning on innovation via creativity is significant (Z = 4.52, p < .001).

5.5 **Overall Model**

As an exploratory analysis, the six hypotheses were combined to create an overall model, which also contains direct paths from the five thinking dispositions to innovation as well as the first-order constructs and the three control variables. This model was tested using PLS analysis. Five hundred bootstrap samples were used. Table 64 contains the findings from this analysis.
### Table 64: Findings for the Overall Model

<table>
<thead>
<tr>
<th>Source</th>
<th>Sample</th>
<th>Bootstrap Mean</th>
<th>SE</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT → JRL</td>
<td>-0.038</td>
<td>-0.035</td>
<td>0.114</td>
<td>0.34*</td>
</tr>
<tr>
<td>PS → JRL</td>
<td>0.062</td>
<td>0.083</td>
<td>0.130</td>
<td>0.47**</td>
</tr>
<tr>
<td>MC → JRL</td>
<td>0.090</td>
<td>0.098</td>
<td>0.083</td>
<td>1.07ss</td>
</tr>
<tr>
<td>ST → JRL</td>
<td>-0.002</td>
<td>-0.022</td>
<td>0.107</td>
<td>0.02**</td>
</tr>
<tr>
<td>MPT → JRL</td>
<td>0.205</td>
<td>0.198</td>
<td>0.123</td>
<td>1.67*</td>
</tr>
<tr>
<td>JRL → Creativity</td>
<td>0.263</td>
<td>0.250</td>
<td>0.067</td>
<td>3.96***</td>
</tr>
<tr>
<td>CT → Creativity</td>
<td>-0.056</td>
<td>-0.062</td>
<td>0.106</td>
<td>0.53**</td>
</tr>
<tr>
<td>PS → Creativity</td>
<td>0.033</td>
<td>0.047</td>
<td>0.106</td>
<td>0.31**</td>
</tr>
<tr>
<td>MC → Creativity</td>
<td>0.095</td>
<td>0.096</td>
<td>0.065</td>
<td>1.46**</td>
</tr>
<tr>
<td>ST → Creativity</td>
<td>0.195</td>
<td>0.188</td>
<td>0.089</td>
<td>2.20*</td>
</tr>
<tr>
<td>MPT → Creativity</td>
<td>0.212</td>
<td>0.204</td>
<td>0.087</td>
<td>2.42**</td>
</tr>
<tr>
<td>Creativity → Innovation</td>
<td>0.529</td>
<td>0.528</td>
<td>0.060</td>
<td>8.83***</td>
</tr>
<tr>
<td>JRL → Innovation</td>
<td>0.326</td>
<td>0.325</td>
<td>0.058</td>
<td>5.63***</td>
</tr>
<tr>
<td>CT → Innovation</td>
<td>-0.123</td>
<td>-0.128</td>
<td>0.093</td>
<td>1.32**</td>
</tr>
<tr>
<td>PS → Innovation</td>
<td>-0.105</td>
<td>-0.103</td>
<td>0.075</td>
<td>1.39**</td>
</tr>
<tr>
<td>MC → Innovation</td>
<td>-0.066</td>
<td>-0.063</td>
<td>0.056</td>
<td>1.18**</td>
</tr>
<tr>
<td>ST → Innovation</td>
<td>0.018</td>
<td>0.025</td>
<td>0.080</td>
<td>0.23**</td>
</tr>
<tr>
<td>MPT → Innovation</td>
<td>0.269</td>
<td>0.268</td>
<td>0.079</td>
<td>3.40***</td>
</tr>
<tr>
<td>JobYrs → JRL</td>
<td>-0.187</td>
<td>-0.183</td>
<td>0.065</td>
<td>2.89**</td>
</tr>
<tr>
<td>SocDes → JRL</td>
<td>0.202</td>
<td>0.210</td>
<td>0.093</td>
<td>2.17*</td>
</tr>
<tr>
<td>JobYrs → Creativity</td>
<td>0.036</td>
<td>0.035</td>
<td>0.057</td>
<td>0.63**</td>
</tr>
<tr>
<td>RiskAv → Creativity</td>
<td>0.043</td>
<td>0.058</td>
<td>0.056</td>
<td>0.78**</td>
</tr>
<tr>
<td>SocDes → Creativity</td>
<td>0.194</td>
<td>0.208</td>
<td>0.069</td>
<td>2.80**</td>
</tr>
<tr>
<td>JobYrs → Innovation</td>
<td>0.012</td>
<td>0.013</td>
<td>0.049</td>
<td>0.24**</td>
</tr>
<tr>
<td>RiskAv → Innovation</td>
<td>0.002</td>
<td>0.005</td>
<td>0.050</td>
<td>0.04**</td>
</tr>
<tr>
<td>SocDes → Innovation</td>
<td>0.017</td>
<td>0.014</td>
<td>0.058</td>
<td>0.29**</td>
</tr>
<tr>
<td>CT → CTE</td>
<td>0.930</td>
<td>0.931</td>
<td>0.012</td>
<td>77.82***</td>
</tr>
<tr>
<td>CT → CTI</td>
<td>0.908</td>
<td>0.908</td>
<td>0.013</td>
<td>68.29***</td>
</tr>
<tr>
<td>CT → CTM</td>
<td>0.846</td>
<td>0.846</td>
<td>0.024</td>
<td>34.95***</td>
</tr>
<tr>
<td>PS → PSPPO</td>
<td>0.825</td>
<td>0.825</td>
<td>0.028</td>
<td>29.30***</td>
</tr>
<tr>
<td>PS → PSR</td>
<td>0.912</td>
<td>0.912</td>
<td>0.017</td>
<td>54.15***</td>
</tr>
<tr>
<td>PS → PSS</td>
<td>0.937</td>
<td>0.937</td>
<td>0.011</td>
<td>86.83***</td>
</tr>
<tr>
<td>ST → STIDK</td>
<td>0.911</td>
<td>0.910</td>
<td>0.016</td>
<td>58.92***</td>
</tr>
<tr>
<td>ST → STTW</td>
<td>0.948</td>
<td>0.948</td>
<td>0.009</td>
<td>110.03***</td>
</tr>
<tr>
<td>Creativity → Job Creativity</td>
<td>0.947</td>
<td>0.947</td>
<td>0.010</td>
<td>94.53***</td>
</tr>
<tr>
<td>Creativity → Team Creativity</td>
<td>0.967</td>
<td>0.967</td>
<td>0.006</td>
<td>165.42***</td>
</tr>
<tr>
<td>Creativity → Org. Creativity</td>
<td>0.957</td>
<td>0.957</td>
<td>0.007</td>
<td>136.52***</td>
</tr>
</tbody>
</table>


ns = non-significant, * p < .05, ** p < .01, *** p < .001.

$R^2$ (JRL) = .194, $R^2$ (Creativity) = .443, $R^2$ (Innovation) = .623.
The findings from Table 64 are summarised as follows:

i) Multiple perspective-taking is the only thinking disposition to have a significant effect on job-related learning;

ii) Job-related learning is the strongest predictor of creativity whilst systems thinking and multiple perspective-taking also have significant unique effects on creativity;

iii) Creativity is the strongest predictor of innovation whilst job-related learning and multiple perspective-taking also have significant unique effects on innovation;

iv) Years in current job has a significant negative unique effect on job-related learning;

v) Social desirability has a significant unique effect on both job-related learning and creativity;

vi) All of the first-order latent constructs for critical thinking, problem solving, systems thinking, and creativity are significantly related to their second-order latent constructs; and

vii) The ‘average variance accounted for’ (AVA or average $R^2$) is an indicator of the predictive power of a model and basically refers to how well the endogenous variables are predicted by their independent variables (Fornell & Bookstein 1982). The minimum cut-off value for acceptable predictive power is an AVA of .10 (Falk & Miller 1992). $R^2$ for job-related learning is .194, $R^2$ for creativity is .443 and $R^2$ for innovation is .623. The AVA for the overall model is therefore .420, which is well above the minimum acceptable value.

The findings for the relationships between the constructs involved in the hypotheses that are provided in Table 4.6 are depicted in simplified form in Figure 42.
Figure 42: Overview of main findings for the overall model

= non-significant, = significant
5.6 **Summary**

PLS analyses were used to test the hypotheses and an overall exploratory conceptual model that was developed by combining the hypotheses and adding direct effects from the five thinking dispositions to innovation. The results of the PLS analyses provided support for a satisfactory measurement model. Satisfactory convergent validity was found based on AVEs and composite reliabilities. Satisfactory discriminant validity was found based on cross-loadings of the items and the latent constructs as well as on a comparison of the squared AVEs and the correlations between the latent constructs. All six of the hypotheses were supported and the findings from the overall model revealed that multiple perspective-taking has significant unique effects on job-related learning, creativity and innovation, systems thinking has a significant unique effect on creativity, the best predictor of creativity is job-related learning and the best predictor of innovation is creativity. Chapter 6 provides a discussion of these findings in relation to previous research as well as a discussion of the practical and theoretical implications of the findings.
6.0. CHAPTER SIX – DISCUSSION AND CONCLUSION

6.1 INTRODUCTION
This chapter is the final chapter of this thesis and is organized as follows. The findings in relation to the hypotheses are discussed in Section 6.2. In Section 6.3, the findings in relation to the overall model are discussed. The implications of the findings for both theory and practice are also discussed in Section 6.3. The limitations of the study and areas for future research are discussed in Section 6.4. Section 6.5 provides a conclusion to the thesis.

6.2 RESULTS OF HYPOTHESIS TESTING
Table 65 provides an overview of the results of the hypothesis testing. In essence, the major findings are (i) job-related learning partially mediates the relationship between each of the five thinking dispositions and creativity, and (ii) creativity partially mediates the relationship between job-related learning and innovation.

Table 65: Results of Hypothesis Testing

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1  Job-related learning mediates the relationship between critical thinking and creativity.</td>
<td>Yes</td>
</tr>
<tr>
<td>H2  Job-related learning mediates the relationship between problem solving and creativity.</td>
<td>Yes</td>
</tr>
<tr>
<td>H3  Job-related learning mediates the relationship between metacognition and creativity.</td>
<td>Yes</td>
</tr>
<tr>
<td>H4  Job-related learning mediates the relationship between systems thinking and creativity.</td>
<td>Yes</td>
</tr>
<tr>
<td>H5  Job-related learning mediates the relationship between multiple perspective-taking and creativity.</td>
<td>Yes</td>
</tr>
<tr>
<td>H6  Creativity mediates the relationship between job-related learning and innovation.</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The major findings will be discussed as follows. The relationships between the five thinking dispositions and job-related learning will be discussed in Section 6.2.1. The relationship between job-related learning and creativity will be discussed in Section
6.2.2. The relationships between the five thinking dispositions and creativity will be discussed in Section 6.2.3. The relationship between creativity and innovation will be discussed in Section 6.2.4. Finally, the relationship between job-related learning and innovation will be discussed in Section 6.2.5.

6.2.1 Higher-Order Thinking Dispositions and Job-Related Learning

Five higher-order thinking dispositions were examined in this thesis. The discussion on the relationship between each of the five dispositions and job-related learning is sequenced as follows: critical thinking, problem solving, metacognition, systems thinking and multiple perspective-taking.

6.2.1.1 Critical Thinking and Job-Related Learning

Critical thinking was operationalised as a second-order reflective construct comprising three first-order reflective constructs: engagement, innovativeness and maturity. This conceptualisation of critical thinking was based on the work of Facione et al. (2000). The engagement aspect of critical thinking involves looking for opportunities to solve problems and relating to a wide range of issues. The innovativeness aspect of critical thinking involves enjoying the problem-solving process and learning in general. The maturity aspect of critical thinking involves asking many questions about an issue and being objective when considering facts rather than being overly affected by one’s biases about an issue.

Critical thinking was found to be positively related to job-related learning. To the best of the author’s knowledge, this is the first study to examine the relationship between critical thinking and job-related learning so there are no previous studies to which the findings from the present study can be compared.

Critical thinking is an antecedent of job-related learning for several reasons. Having a strong sense of inquisitiveness is an aspect of critical thinking and this results in undertaking knowledge-acquisition activities, such as research and reading, which lead to learning. Critical thinking also involves being engaged in a topic/problem and enjoying finding solutions to challenging problems. Critical thinkers are inclined to be analytical and break down a topic/problem into its constituents thereby resulting in a better understanding of the topic/problem. Critical thinkers also tend to be mature in the sense that they carefully consider the opinions of others even of those who disagree with them, are open to reflecting on their own biases and are willing to change their opinions when confronted with information that contradicts their opinions.
This willingness to change and accept new ideas is central to learning. Critical thinkers are neither dogmatic nor gullible, tend to be pragmatic, and enjoy learning about new topics. All of these attributes make critical thinkers effective learners.

6.2.1.2 Problem Solving and Job-Related Learning

Problem solving was operationalised as a second-order reflective construct comprising three first-order reflective constructs: positive orientation, rational and systematic. This conceptualisation of problem solving was based on the measures developed by Sadowski et al. (1994) and Heppner and Peterson (1982). The positive orientation dimension of problem solving involves having a confident attitude towards problems in that they are seen as solvable. The rational dimension involves evaluating the advantages and disadvantages of each solution before making a decision. The systematic dimension involves obtaining and understanding information about a complex problem before attempting to solve the problem.

Problem solving was found to be positively related to job-related learning. No previous study was found that has examined the relationship between the problem solving disposition and job-related learning. Starling (1992) argues that problem solving and learning are tightly integrated as problem solving is highly iterative and the better a person is at learning, the better the person will be at solving problems.

A problem-solving disposition is an antecedent of job-related learning as it compels individuals to learn effectively in their jobs and in their personal lives, and renders them likely not to be fazed when confronted with a problem. When individuals who have a problem-solving disposition encounter a problem/challenge, they are likely to approach the problem/challenge in a confident manner: That is, they are likely to have a positive orientation. Emotions play an important role in the thinking process and remaining self-assured when facing a problem is likely to improve the likelihood of solving the problem as unsettling emotions can impairs one’s ability to focus (Furnham 2006) and optimism facilitates perseverance. Individuals who have a problem-solving disposition are likely to be self-reliant when dealing with problems and will attempt to learn as much as possible to overcome the problems before attempting to develop solutions: That is, they will be systematic. Finally, when faced with a problem, individuals who have a problem-solving disposition are likely to be methodical and evaluate the advantages and disadvantages of each solution before making a decision: That is, they will be rational.
6.2.1.3 Metacognition and Job-Related Learning

Metacognition was operationalised as a first-order reflective construct based on the work of Cartwright-Hatton et al. (2004). Metacognition is essentially the monitoring of one’s thoughts so that one is aware of how one thinks about various issues.

Metacognition was found to be positively related to job-related learning. No previous study was found that has examined the relationship between metacognition and job-related learning.

As discussed in Chapter 2, the clearest relationship between metacognition and learning is through the notion of self-regulated learning: Efklides et al. (2006) argue that the two go hand-in-hand. Metacognition and learning are intrinsically linked as metacognition may trigger processes that activate and sustain efforts to undertake learning (Zimmerman 1986). In addition to its direct contribution to learning, metacognition influences the affective state of an individual by enhancing positive affective states and emotional stability thereby helping the individual to learn more effectively (Thomas et al. 2008). Veenman et al. (2006) explain that metacognition’s enabling of heightened awareness (of self and environment) allows individuals better opportunities to self-regulate, which in turn also helps them to better develop and influence learning strategies (Baird 1990). Metacognition helps individuals to know and recognise/understand their zone of proximal development and how to progress to the next level (Wenden 1998). Metacognition involves personal reflection and evaluation, both of which are important processes in Kolb’s (1984) model of learning.

6.2.1.4 Systems Thinking and Job-Related Learning

Systems thinking was operationalised as a second-order reflective construct comprising two first-order reflective constructs: the whole; and interdisciplinary knowledge. This conceptualisation was based on the measure developed by Frank et al. (2007). Systems thinking the whole involves having a need to know or an interest in the “big picture” when undertaking a task such that one considers what one is doing in relation to what others are doing as opposed to focusing solely on task completion. The interdisciplinary knowledge aspect of systems thinking involves having an attitude wherein it is considered important to have knowledge or awareness of other related fields rather than focusing solely on one’s area of expertise.
Systems thinking was found to be positively related to job-related learning. No previous study was found that has examined the relationship between systems thinking and job-related learning.

Systems thinking disposition fosters job-related learning as one’s job exists within the context of the organisation’s overall processes and is linked to the jobs of other organisational members and often to the jobs of others who work in supply-chain organisations (e.g., supplier and customer organisations). In other words, one’s job is a part of an overall system. Being able to understand how one’s job is related to the jobs of one’s colleagues or others not only enables one to appreciate the impact of one’s job but also enables one to better learn about one’s job and its requirements. In addition, an individual’s understanding of a system is arguably never complete because systems tend to be dynamic and thus continually changing. Consequently, being predisposed to engage in systems thinking is likely to result in ongoing learning.

Systems thinking compels individuals to update their knowledge about a particular system and to learn new skills as new elements and sub-systems are identified and learned thereby facilitating the acquisition of inter-disciplinary knowledge and ultimately job-related knowledge and skills. In addition, system thinking negates ‘tunnel vision’ as it promotes a cross-disciplinary approach to addressing problems rather than a uni-dimensional (or monodisciplinary) approach. As put forth by Rosenthal (2003), systems thinking involves understanding the value of feedback loops and results in a willingness to seek feedback and learn from feedback.

6.2.1.5 Multiple Perspective-Taking and Job-Related Learning

Multiple perspective-taking was operationalised as a first-order reflective construct. Although there is a substantial amount of literature on the topic of multiple perspective-taking and related topics such as empathy, a search of the literature failed to find an established measure of multiple perspective-taking. Consequently, a modified version of ‘intellectual stimulation’, which is a component of Bass’ model of transformation leadership and involves encouraging followers to look at problems from different perspectives, was used. Multiple perspective-taking is essentially the tendency to recognize that a single situation can be seen from different points of view and involves the willingness to evaluate a situation from different perspectives even if it means re-examining existing methods/approaches.
Multiple perspective-taking was found to be positively related to job-related learning. No previous study was found that has examined the relationship between multiple perspective-taking and job-related learning.

One reason why the tendency to adopt multiple perspectives might facilitate job-related learning is that multiple perspective-taking helps to mitigate our natural tendency to rely on cognitive processes, such as stereotyping and other information-simplification heuristics (e.g., availability heuristic), that are inherently biased (Litchfield and Gentry 2010). Individuals who are predisposed to adopt multiple perspectives are thus likely to acquire not only more knowledge about an issue because they get to consider different facets of the issue but also more accurate (or less biased) knowledge and thereby broaden their horizons and enhance their effectiveness.

Another reason why the disposition to adopt multiple perspectives enhances job-related learning is that adopting and appreciating different perspectives constitutes as knowledge accumulation. Whilst this form of intellectual knowing is important, affective perspective-taking also facilitates job-related learning (Underwood & Moore 1982). The capacity to empathise with others provides the basis for individuals to appreciate the complexities and nuances that may be involved in a particular field or area (Selman 1980; Hyun & Marshall 1997) and overcomes the limitations caused by biases such as egocentrism. For example, multiple perspective-taking helps individuals to appreciate the complexity of a system. Without multiple perspective-taking, individuals may only view a particular system as unidimensional (i.e., restricted to their spheres of influence) thereby limiting opportunities to learn about other aspects of the system.

6.2.2 Job-Related Learning and Creativity

Job-related learning was operationalised as a first-order reflective latent construct based on the work of Loon and Casimir (2008). Job-related learning refers to the acquisition of new job-related knowledge and skills.

Creativity was operationalised as a second-order reflective construct consisting of three first-order reflective constructs: job-related creativity, team-related creativity, and organisation-related creativity. This conceptualisation was based on the measure developed by Runco et al. (2001). It was decided to measure creativity at three levels to provide a more comprehensive coverage of workplace creativity as not all workplace-related creativity is specifically associated with one’s job. Creativity
essentially refers to coming up with new ideas on how to improve the way in which one perform one’s job as well as the ways in which one’s team and organisation operate.

Job-related learning was found to be positively related to creativity. No previous study was found that has examined the relationship between job-related learning and creativity.

Job-related learning facilitates creativity because knowledge of a particular issue and its related fields enables the discovery of new connections between concepts and processes and provides a foundation for the generation of new ideas and insights. An individual who is not knowledgeable or who is not learning new things about a topic is unlikely to discover creative ideas about the topic. As explained by Finke, Ward and Smith (1992) Geneplor model, job-related learning potentially helps to provide some structure (e.g. categorisation) for creativity to take place in a more efficient and effective manner. In addition, job-related learning helps to improve an individual’s ability to think originally and elaborate on their creative ideas fluently (Wallach & Kogan 1965).

6.2.3 Higher-Order Thinking Dispositions and Creativity

The following sub-sections provide a discussion on the relationship between each of the five higher-order thinking dispositions and creativity. The order in which the five dispositions are discussed is as follows: critical thinking, problem solving, metacognition, systems thinking and multiple perspective-taking.

6.2.3.1 Critical Thinking and Creativity

As mentioned earlier, critical thinking was operationalised as comprising three components: engagement (i.e., looking for opportunities to solve problems and relating to a wide range of issues), innovativeness (i.e., enjoying the problem-solving process and learning in general), and maturity (i.e., asking many questions about an issue and being objective when considering facts rather than being overly affected by one’s biases about an issue).

The relationship between critical thinking and creativity was found to be mediated partially by job-related learning. This finding indicates that critical thinking influences creativity both indirectly and directly via job-related learning.
The disposition to think critically facilitates creativity indirectly because critical thinking improves job-related learning, which then facilitates creativity, as mentioned in Section 6.2.1.1. Critical thinking disposition refers to the tendency to proactively look for opportunities to solve complex problems and new knowledge because of intellectual curiosity (Irani et al. 2007). This tendency together with the willingness to consider facts in an objective manner leads to an individual accumulating knowledge and ideas about a particular domain or subject (e.g., job-related learning). Being well informed about a subject facilitates creativity.

Job-related learning and critical thinking were used simultaneously to predict creativity and both were significant predictors (i.e., one of the conditions of partial mediation). This finding indicates that critical thinking influences creativity directly or in ways other than via improving job-related knowledge and skills. One explanation for how this may occur is the multi-faceted nature of the critical thinking disposition. As Halx and Reybold (2006) suggest, critical thinking involves entertaining ideas without necessarily accepting them, which helps to spur creativity. Fisher (2001) maintains that critical thinking and creativity go hand-in-hand, in the form of ‘critico-creative’. He reasons that there is a degree of creativity involved in the structuring of arguments. Also, Renaud and Murray (2008) argue that both critical thinking and creativity are synergistic in producing ‘productive thinking’ and thereby may be complementary to one another. In addition to positive engagement and inquisitiveness, critical thinkers also tend to be mature in their thinking and this helps them to recognize their own biases and limitations. Such a disposition fosters an attitude to seek new ideas and to abandon ideas that are not supported by existing evidence, which may facilitate creativity. As Irani et al. (2007) postulated, critical thinking involves intellectual curiosity and results in individuals seeking new challenges and experiences that are not directly related to their specific work roles. This intellectual curiosity predisposes them to be creative.
6.2.3.2. Problem Solving and Creativity

As mentioned earlier, problem solving was operationalised as comprising three dimensions: positive orientation (i.e., having a confident attitude towards problems), rational (i.e., evaluating the advantages and disadvantages of alternative solutions) and systematic (i.e., acquiring and understanding information about a complex problem before attempting to solve the problem).

The relationship between problem solving and creativity was found to be mediated partially by job-related learning. This finding indicates that problem solving influences creativity both indirectly and directly via job-related learning.

The problem solving disposition facilitates creativity indirectly because problem solving improves job-related learning, which then enhances creativity, as mentioned in Section 6.2.1.2. Problem solving facilitates creativity partly because problem solving involves accumulating and understanding information about a complex problem. Accumulating and understanding information about a problem is essentially learning about the problem. In this way, problem solving indirectly facilitates creativity via job-related learning.

Job-related learning and problem solving were used simultaneously to predict creativity and both were significant predictors (i.e., one of the conditions of partial mediation). This finding indicates that problem solving influences creativity directly or in ways other than via improving job-related knowledge and skills. There are a few possible ways in which the problem solving disposition can facilitate creativity other than via job-related learning and these are discussed next.

Problems can be classified as either well-defined or ill-defined. Well-defined problems generally involve some clear choices for the individual to choose from. In contrast, with ill-defined problems, the potential solutions are nebulous or unformulated and thus ill-defined problems require a degree of creativity to be solved. As a result, ill-defined problems are generally considered to be more critical than well-defined problems not only because there are no established solutions but also because finding creative solutions to these problems can give a firm competitive advantages over its rivals.

The tendency to adopt a positive orientation towards problems (i.e., having a confident attitude towards problems) is likely to increase the chances of findings creative
solutions to ill-defined problems because solving complex problems involves not only cognitive components but also affective components (Tallman and Gray (1990)). Seeing a problem in a positive light such as a challenge, or as an opportunity to benefit in some positive way from having the problem, is likely to increase ‘problem finding’, which requires the ability to imagine a desirable situation (Jay & Perkins 1997). Furthermore, a positive problem-solving disposition enhances creativity as a degree of imagination and self-confidence is required in the problem-solving process specifically in the problem-finding stage (Lee & Cho 2007). Problem finding or identifying the root cause of a problem leads to creativity.

6.2.3.3 Metacognition and Creativity

The metacognition disposition refers to the tendency to monitor one’s thoughts so that one is aware of how one’s mind works. The relationship between metacognition and creativity was found to be mediated partially by job-related learning. This finding indicates that metacognition influences creativity both directly and indirectly via job-related learning.

The metacognition disposition or the tendency to pay close attention to one’s thoughts facilitates creativity indirectly because metacognition improves job-related learning, which then enhances creativity, as mentioned in Section 6.2.1.3. Metacognition can trigger processes that activate and sustain efforts to undertake learning (Zimmerman 1986) and enhances positive emotional states and emotional stability thereby helping the individual to learn more effectively (Thomas et al. 2008).

Job-related learning and metacognition were used simultaneously to predict creativity and both were significant predictors (i.e., one of the conditions of partial mediation). This finding indicates that metacognition influences creativity directly or in ways other than via improving job-related knowledge and skills. There are a few possible ways in which the metacognition disposition can facilitate creativity other than via job-related learning and these are discussed next.

The metacognition disposition predicts creativity not only by improving job-related learning but also by helping an individual to withhold criticality and suspend judgment thereby leading the individual to pursue and explore an idea that may have something to offer, although it may at first appear trivial or inapplicable (Swanson 1992). Metacognition enables individual to be aware of their biases and preferences, and thereby potentially help individuals to regulate these proclivities that may result in
them prematurely precluding ideas that are worthwhile. Another reason why metacognition predicts creativity over and above the effects of job-related learning is that metacognition allows the simultaneous monitoring of both job-related learning and creativity. Swanson (1992) argues that individuals with the metacognition disposition tend to be reflective in their choice of cognitive strategies in selecting the most appropriate and fitting for a given situation. This potentially renders individuals confident with respect to being flexible and adopting the ‘right’ type of thinking, such as divergent or convergent thinking, for a particular situation.

Metacognition underpins ability of individuals to monitor, control and adapt to their environment (Pretz & Sternberg 2005) and this may enhance creativity regardless of job-related learning. Individuals with high metacognitive ability are cognitively flexible in coming up with ideas and are not fixated on conventional ways of doing things. As Pretz and Sternberg (2005) state “we can conclude that intelligence is related to (1) efficiency of basic cognitive processes (speed of perception and focused brain activity) and (2) metacognitive control and flexibility of cognitive processes (attention, cognitive control, strategy flexibility)” (p. 314). Intelligent individuals have better-orchestrated brain functioning that results in higher processing speed as they suggest “…intelligence seems to be a metacognitive ability, the ability to selectively attend, to focus one’s cognitive processes, and to switch processing as conditions change. Intelligence is more than just good cognition; it is the ability to use that cognitive ability adaptively. This characteristic of intelligence is most apparent in studies of higher-order cognition, perhaps because those studies include problems complex enough to require this kind of flexibility of processing” (p. 315). Thus metacognition results in adaptiveness and flexibility and these may lead to creativity even in the absence of job-related learning.

6.2.3.4 Systems Thinking and Creativity

The systems thinking disposition was operationalized as comprising two facets: the whole (i.e., being interested in the ‘big picture’) and interdisciplinary knowledge (i.e., regarding it important to have knowledge or awareness of other fields related to one’s area of expertise or concern). The systems thinking disposition refers to the tendency to think systemically, specifically in terms of how a set of elements are connected together (Checkland 1999).
The relationship between systems thinking and creativity was found to be mediated partially by job-related learning. This finding indicates that systems thinking influences creativity both directly and indirectly via job-related learning.

The disposition to engage in systems thinking facilitates creativity indirectly because systems thinking improves job-related learning, which then enhances creativity, as mentioned in Section 6.2.1.4. The attitude that employees should gain interdisciplinary knowledge and general knowledge in fields other than that of their specialisation is one of the reasons why the systems thinking disposition can improve job-related learning. Additionally, an interest in knowing how one’s job fits into the big picture should also lead to a better understanding of the impact of one’s job on the overall organisation and thus facilitate job-related learning. Systems thinking helps to provide insights as previously undetected patterns and relationships amongst elements in a system (i.e., the organisation) start to ‘emerge’ thereby fostering job-related learning.

Job-related learning and systems thinking were used simultaneously to predict creativity and both were significant predictors (i.e., one of the conditions of partial mediation). This finding indicates that systems thinking influences creativity directly or in ways other than via improving job-related knowledge and skills.

The system thinking disposition augments the prediction of creativity over and above that achieved by job-related learning for a few possible reasons. An understanding of aspects of the organisation other than one’s job (i.e., interdisciplinary knowledge) facilitates the recognition of the interdependence of and relationships between elements in a system, the nature of the interaction and interplay between these elements and/or sub-systems, potential synergies that exist between these elements and/or sub-systems, and overall, a better appreciation of the complexity of the ‘whole’ (i.e., the entire organisation). The system thinking disposition facilitates the discovery of relationships between/amongst elements in a system and subsequently results in the generation of new ideas that are not dependent on job-related learning.

The tendency to engage in systems thinking, specifically in ‘seeing the whole’, is an underlying capacity that cannot be entirely learned. Hence, whilst systems thinking dispositions results in accumulating knowledge across disciplines, and through more intense job-related learning, not all systems can be learned. As argued by Cabrera et al. (2008), systems are relative. For example, what is regarded as a system to one
person, may be regarded as a sub-system by another person. In addition, the tendency to engage in systems thinking enhances creativity beyond the effects of job-related learning because relationships between elements are boundless, and the form and intensity of synergy amongst elements in systems are almost endless and the discovery of these relationships and synergies are not entirely dependent on the knowledge and skills required to perform a particular job. As Frank (2006) argued, synergy is one of the most crucial aspects of systems, although it can be difficult to identify and learn about. However, recognising synergy provides a catalyst for creative ideas to be generated.

6.2.3.5 Multiple Perspective-Taking and Creativity

The multiple perspective-taking disposition is essentially the tendency to evaluate situations from different angles/perspectives and re-examine existing methods/approaches by considering them from different perspectives. The relationship between multiple perspective-taking and creativity was found to be mediated partially by job-related learning. This finding indicates that multiple perspective-taking influences creativity both directly and indirectly via job-related learning.

The disposition to engage in multiple perspective-taking facilitates creativity indirectly because multiple perspective-taking improves job-related learning, which then enhances creativity, as mentioned in Section 6.2.1.5. Looking at a problem from various perspectives or different angles can facilitate job-related learning as it helps an individual to learn new things about the specific tasks that constitute his/her particular job. Learning new things about a particular job can result in the need to acquire specific information or skills in order to effectively perform one’s job. In this way, the tendency to engage in multiple perspective-taking can enhance job-related learning.

Job-related learning and multiple perspective-taking were used simultaneously to predict creativity and both were significant predictors (i.e., one of the conditions of partial mediation). This finding indicates that multiple perspective-taking influences creativity directly or in ways other than via improving job-related knowledge and skills. The multiple perspective-taking disposition augments the prediction of creativity over and above that achieved by job-related learning for a few possible reasons.
The multiple perspective-taking disposition predicts creativity beyond the effects of job-related learning because an individual who has a tendency to adopt the perspective of others will be in a better position to generate novel ideas (Litchfield & Gentry 2010). The propensity to adopt different perspectives enables individuals to make new connection amongst these different perspectives. Whilst depth in one perspective may be helpful to develop expertise (i.e., job-related knowledge and skills), it is the disposition to adopt different viewpoints that sheds new light in an area, and sparks new ideas. Multiple perspective-taking disposition enables individuals to recognise, and identify opportunities and problems that others may not be aware of and thereby stimulates the generation of new ideas (Parker & Axtell 2001).

Multiple perspective-taking predicts creativity directly as multiple perspective-taking is process-orientated and helps with the continuous generation of ideas that may not be consciously ‘learned’. Multiple perspective-taking is crucial to creativity as it facilitates both divergent and convergent thinking (Guilford et al. 1978). Divergent thinking arises as multiple perspective-taking enables for the creativity as a ‘spark’ (or eureka moment) to occur by being able to adopt many different view sets. In addition, convergent thinking occurs when different perspectives reveal commonalities that were not previously recognised or realised.

6.2.4 Creativity and Innovation
Creativity was operationalised as a second-order reflective construct consisting of three first-order reflective constructs: job-related creativity, team-related creativity, and organisation-related creativity. This conceptualisation was based on the measure developed by Runco et al. (2001). It was decided to measure creativity at three levels to provide a more comprehensive coverage of workplace creativity as not all workplace-related creativity is specifically associated with one’s job. Creativity essentially refers to coming up with new ideas on how to improve the way in which one perform one’s job as well as the ways in which one’s team and organisation operate.

Innovation behaviour was operationalised as a first-order reflective construct based on the work of Scott and Bruce (1994). Innovation behaviour includes searching out new technologies, championing ideas to others and obtaining funds required for the implementation of new ideas.
Creativity is essentially the development of original ideas that are useful. The notion of usefulness refers to ideas being potentially feasible, and not inane, and having practical value to an organisation in the short- or medium-term (Simon 2001). Once an idea has been developed or discovered, and is deemed to be useful, the next stage is to bring the idea to fruition. Bringing an idea to fruition involves many steps including convincing those who control organisational resources to invest in the idea, developing a plan to transform the idea into a profitable product/service, and implementing the plan. As a result, creativity is positively associated with innovation behaviour because creativity is arguably the final antecedent to innovation.

The positive correlation between creativity and innovation that was found in this study is consistent with the findings of numerous other studies. Černe, Jaklič and Kerlavaj (2013) reported a positive correlation between team creativity and team innovation. Hollanders and van Cruysen (2009) reported a positive correlation between individuals self-expression of creativity and an index of innovations including outputs (e.g. products), Çökeşkin and Knudsen (2012) reported a positive correlation between time spent on creative activities and product innovation.
6.2.5 Job-Related Learning and Innovation

As mentioned earlier, job-related learning was operationalised as a first-order reflective latent construct comprising the acquisition of new job-related knowledge and skills. Furthermore, innovation was operationalised as a first-order reflective construct comprising innovation behaviour such as developing adequate plans and schedules for the implementation of new ideas.

The relationship between job-related learning and innovation was found to be mediated partially by creativity. This finding indicates that job-related learning influences innovation both directly and indirectly via creativity.

Job-related learning facilitates innovation indirectly because job-related learning improves creativity, which then enhances innovation, as mentioned in Section 6.2.4. Creativity involves the generation of novel and useful ideas and in order to bring these ideas to fruition, it is necessary to enact innovation behaviours such as convincing those who control organisational resources (e.g., senior management) to provide funds so that the ideas can be tested or implemented. As a result, creativity leads to innovation behaviour.

Creativity and job-related learning were used simultaneously to predict innovation and both were significant predictors (i.e., one of the conditions of partial mediation). This finding indicates that job-related learning influences innovation directly or in ways other than via improving creativity. Job-related learning augments the prediction of innovation over and above that achieved by creativity for a few possible reasons.

Job-related learning directly enhances innovation because innovation behaviour is at times defined as an extra role behaviour (Welbourne et al. 1998) that individuals have to adopt to be successful in their job or careers. This innovation role is in addition to the other facets of organisational citizenship such as helping colleagues by sharing one’s knowledge.

Job-related learning encourages innovation behaviour in ways that are unrelated to the generation of new ideas (i.e., creativity) because job-related learning involves more than simply acquiring knowledge and skills that are necessary for performing job-specific tasks. Job-related learning also involves learning about the expectations and requirements of the roles (e.g., required to streamline procedures or meet budgets) involved in successfully performing a particular job as well as learning about how
one’s job is connected to other organisational processes (e.g., cross-functional or inter-organisational aspects of one’s job). This type of job-related learning can help individuals to become savvy about the organisation’s socio-political landscape and this can facilitate innovation behaviours such as promoting and championing ideas to others as well as investigating and securing the funds needed to implement new ideas.

Learning remains crucial for innovation primarily due to the implementation aspect of innovation (von Stamm 2008) because learning about a job helps to address the challenges of implementing new ideas efficiently. In addition, job-related learning facilitates innovation behaviour in ways other than by enhancing creativity because individuals have to learn quickly and effectively how to translate something that is novel into something that is tangible.

6.3 **THEORETICAL AND PRACTICAL IMPLICATIONS OF THE FINDINGS**

This section provide a discussion of the implications of the findings on both theory and practice. The theoretical implications of the findings are discussed in Section 6.3.1 whilst the practical implications of the findings are discussed in Section 6.3.2.

6.3.1 **Theoretical Implications**

Innovation behaviour is caused by many factors, and has been studied in various fields such as organisational psychology, sociology, economics and management (Patterson et al. 2009a). The causes of innovation behaviour can be found at different levels. For instance, at the individual level there are intra-personal factors such as personality and abilities. At the group level there are factors such as team cohesion and leadership whilst at the organisational level innovative behaviour can be caused by factors such as organisational culture.

This study’s contribution to theory is premised upon the final overall model, which is essentially the six hypothesised mediation effects combined. Hair Jr et al. (2013) state that “Theory is a set of systematically related hypotheses developed following the scientific method that can be used to explain and predict outcomes. Thus, hypotheses are individual conjectures, whereas theories are multiple hypotheses that are logically linked together and can be tested empirically” (p. 12). In addition, the most effectual theories are those that are parsimonious (Pfeffer 1982).
This study contributes to our knowledge on the causes of innovation behaviour by addressing the paucity in research on how intrapersonal factors (i.e., higher-order thinking dispositions) influence innovation behaviour at the individual level. Five higher-order thinking dispositions that are relevant to innovation behaviour were identified; critical thinking, problem solving, metacognition, systems thinking, and multiple perspective-taking. A three-step causal chain between these higher-order thinking dispositions and innovation behaviour was proposed. It was conjectured that these thinking dispositions indirectly influence innovation behaviour by facilitating job-related learning, which then stimulates creativity and subsequently results in innovation behaviour. The findings are consistent with the hypotheses and the findings from the overall model provides further insights into the relative importance of the various thinking dispositions with regard to job-related learning, creativity and innovation behaviour.

This is the only study (to the best of the author’s knowledge) that provides a comprehensive investigation of the relationships between several higher-order thinking dispositions and innovation behaviour. The findings demonstrate that higher-order thinking dispositions, job-related learning and creativity are important antecedents of innovation behaviour. The findings are consistent with the notion that higher-order thinking dispositions influence innovation via two mediators: job-related learning and creativity. The findings also demonstrate the crucial roles that job-related learning and creativity play in innovation behaviour. Whilst the importance of creativity as an antecedent of innovation behaviour is well established, the significant role that job-related learning has been found to play introduces new trajectories of discussions.

Job-related learning, which was conceptualised as informal learning, appears to be an important outcome of the higher-order thinking dispositions and a pivotal antecedent of creativity and innovation behaviour. Acquiring job-related knowledge and skills and other information about one’s job (e.g., role expectations, relationship of one’s work with other organisational processes) helps an individual to become well-informed about one’s job not only in terms of performing the specific roles involved in the job but also with regard to how the job fits into the big picture thereby enhancing the individual’s ability to be creative not only with regards to their jobs but also their teams and organisations: innovation behaviour then ensues from creativity. Job-related learning is the strongest predictor of creativity, and this is potentially explained
by the changes in knowledge, skills and attitudes that accompany learning. The significant role that creativity plays in innovation is not surprising as novel ideas are a cornerstone of innovation (Patterson et al. 2009a; von Stamm 2008).

Analysis of the overall model revealed that, of the five higher-order thinking dispositions, multiple perspective-taking is the most influential when it comes to job-related learning, creativity and innovation. Specifically, when the five higher-order thinking dispositions are used concurrently to predict job-related learning, only multiple perspective-taking is a significant predictor. Furthermore, when the five higher-order thinking dispositions and job-related learning are used concurrently to predict creativity, job related learning is a significant predictor whilst multiple perspective-taking and systems thinking are the only thinking dispositions that are significant predictors, with multiple perspective-taking being a stronger predictor than systems thinking. Finally, when the five higher-order thinking dispositions, job-related learning and creativity are used concurrently to predict innovation, job related learning and creativity are significant predictors whilst multiple perspective-taking is the only thinking disposition that is a significant predictor.

The findings in relation to the concurrent predictive utility of the five higher-order thinking dispositions can be attributed to multicollinearity amongst the dispositions due to common method bias or to them being manifestations of an overarching thinking disposition. However, both of these explanations are ruled out by the findings of a principal components analysis (i.e., Harman’s test) that was conducted: a single component test revealed that approximately one third of the variance in the items used to measure the five dispositions is explained by a single component. Furthermore, multiple perspective-taking and systems thinking both significantly predict creativity thus providing evidence against the argument that the five dispositions are aspects of an overarching disposition.

The primacy of multiple perspective-taking in comparison to the other higher-order thinking dispositions may be due to its central role in innovation. Firstly, multiple perspective-taking enables ideas to be generated as this disposition enables individuals to interlink and combine a variety of concepts within an array of contexts to learn about specific issues and then create genuine novelty. Secondly, multiple perspective-taking helps with the implementation of these novel ideas as it equips individuals with foresight in terms of what may be required to successfully transform a creative idea into an innovation. Specifically, a multiple perspective-taking disposition will help
individuals to adopt various views such as that of business-case development, project management, risk management, contingency planning, communication and stakeholder management. Thirdly, multiple perspective-taking arguably facilitates systems thinking and vice-versa, which is crucial for innovation. Csikszentmihalyi (1988) argues that individuals who wish to innovate within a system must also reproduce how the system works in their minds. And to do this, one must be able to adopt different perspectives. Multiple perspective-taking is crucial in dealing with complex problems and helps individual to adopt radical views in light of novel, and ill-defined problems and situations. This is crucial for organisations that face challenges that are unprecedented, as von Stamm (2008) quotes Einstein, who said “A problem cannot be solved with the mindset that created it” (p. 14).

Whilst Rothwell (1994) argued that a general model of innovation is not practical due to its variedness, scholars have nonetheless studied innovation from different perspectives. This study contributes to theory by examining the effects of higher-order thinking dispositions on innovation behaviour at the individual level. In particular, this study potentially extends the Componential Model put forth by Amabile (1983). The Componential Model is an intra-individual model of innovation that postulates innovation behaviour is dependent on an individual’s intrinsic motivation in relation to specific tasks and skills that are domain specific and processes that contribute to creativity (Amabile 2012; Amabile 1996).

The findings of this study support the Componential Model in that intrapersonal factors (i.e., higher-order thinking dispositions) appear to impact on innovation, in particular as an antecedent of creativity in the form of learning, multiple perspective-taking and systems thinking dispositions. In addition, the findings elaborate the Componential Model specifically from the integrated view of cognition and disposition in the form of two higher-order thinking dispositions: multiple perspective-taking and systems thinking. This study may also be viewed as extending the Componential Model in that innovation behaviour has been included.

The five higher-order thinking dispositions and their effects have tended to be discussed/examined separately in the literature and this is the first study to examine the joint effects of several higher-order thinking dispositions. The predominance of multiple perspective-taking has arguably resulted in the creation of questions more so than the provision of answers as to how the five thinking dispositions affect innovation.
A reasonable inference that can be made from the findings is that there exists a complex interplay between the various thinking dispositions such that when confronted with a complex problem, an individual might keep switching from one type of higher-order thinking to and from other types of higher-order thinking. An example of how the five thinking dispositions might be used in a sequential manner is useful for demonstrating the complexity of the interplay that might exist between the five higher-order thinking dispositions. For instance, an initial reaction to a complex problem might be a positive attitude towards the problem due to the engagement aspect of the critical thinking, the individual might then adopt a linear form of higher-order thinking such as systematic problem solving, then switch to a non-linear form such as metacognition to reflect on why the problem remains unresolved and this may lead to multiple perspective-taking, systems thinking and critical thinking when developing and evaluating possible solutions. Further research is necessary to delve deeper into these issues and to assess the veracity of this inference.

This study’s key contribution to knowledge is the model (as shown in Figure 42) that brings together disparate perspectives and elements of higher-order thinking into a single model in explaining innovation behaviour from a higher-order thinking dispositional perspective. This contribution is consistent with the theories espoused by Chamorro, Premuzic and Furnham in their model in understanding the interface between personality and intelligence, as well as Ackerman’s model that links personality, interest and intelligence. The contribution of this study does not only extend our understanding of the relationship between intelligence and personality but also expands this theoretical field in explaining innovation behaviour.

In terms of further synthesis with the extant literature primarily involving innovation behaviour, the findings have been discussed within the context of how intra-individual constructs in this study contribute to typical performance of individuals that are more sustainable and predictable than maximal approaches to performance. This study has contributed to the field of innovation by locating our findings within Amabile’s Componential model: For example, in expanding this model using an integrated view that is higher-order thinking dispositions.

6.3.2 Practical Implications

Innovation is important to businesses and organisations because it is the single most important factor that can transform a crisis (e.g. economic recession) into an
opportunity (Patterson et al. 2009a). Based on the findings of this study, several suggestions are provided that may help to foster innovation behaviour in organisations.

As Dewey (1933) states, if one were forced to choose between an ability and a disposition to predict future behaviour, we should select the disposition because dispositions tend to be more stable than abilities. Hence, organisations should not only focus on recruiting people who have specific abilities but should also include higher-order thinking dispositions as a criterion in their recruitment processes, especially for positions that require innovativeness and innovation behaviour. Organisations should develop selection processes that examine the ability of candidates to adopt multiple perspectives and to think systemically.

Another suggestion from the findings is that organisations need to help their members to develop higher-order thinking dispositions. However, the question arises as to whether or not dispositions can be ‘developed’? The nature-nurture debate has been applied to dispositions. Generally, dispositions are conceptualised as a gift from nature, in other words it is something that individuals are born with although it is acknowledged that dispositions do change slowly over time. So whether one can ‘train’ or ‘develop’ higher-order thinking dispositions is highly contentious. Ackerman (1997) argues that as proclivities, dispositions such as curiosity, can be nurtured, which is crucial for creativity and innovation (von Stamm 2008; Csikszentmihalyi 1990). Chamorro-Premuzic and Furnham (2004) reason that the personality/intellect interface is unique and is neither a personality trait nor a pure intellectual construct. They state that the personality/intellect interface can be represented as an ability, and such ‘ability’ can be conceptualised as an output or performance. In adopting this conceptualisation of higher-order thinking dispositions as an ability, it therefore indicates that higher-order thinking dispositions can be developed to a certain extent.

Litchfield and Gentry (2010) state that as a motivated cognition, it is quite likely that multiple perspective-taking can be developed. Parker and Axtell (2001) argue that multiple perspective-taking ability and disposition can be developed by increasing the number of quality interactions with others that an individual may have on their job. By interacting closely with a wider variety of people (e.g. colleagues) in meaningful ways, these individuals will start to learn about the work of others thereby providing them with opportunities to develop an understanding of what others do and consequently develop the ability to adopt multiple perspectives. In addition, they also
suggest that employees should be given the opportunity to participate in the decision-making processes involved in change initiatives so that they are exposed to the views, interests and issues of the different stakeholders who are involved in the change initiatives.

The learning and development functions in organisations can play a crucial role in developing their workforces to think in a non-linear manner. This is a challenge as most primary, secondary and even tertiary education systems are generally grounded on linear approaches that are characteristic of critical thinking and problem solving. Hence learning and development practitioners must ‘re-train’ the organisation’s workforce: job rotation may be useful in this regard. Job rotation can provide employees with opportunities to develop new insights into what other employees in their organisations do and the challenges that they face. As a result, job rotation can foster multiple perspective-taking and systems thinking. In addition, organisations should develop their workforce to be effective learners and not only provide training but also incentives for learning because learning is a strong predictor of creativity and ultimately innovation.

Organisations should also find ways to foster job-related learning. One way is to facilitate and encourage social networking and ultimately the sharing of knowledge, which in turn helps job-related learning. Knowledge sharing is especially important when tacit knowledge is involved and tacit knowledge (e.g., tricks of the trade, personal insights) is especially important for creativity. The production of knowledge is also dependent on people's individual differences such as prior knowledge, which in turn is explained by the individual’s memory, cognition load, personality and interests (Ackerman & Beier 2003). Hence, it is important for organisations to cultivate a culture that provides the impetus for people to share knowledge and be innovative.

6.4 LIMITATIONS AND FUTURE RESEARCH

There are several limitations to the research that has been conducted in this thesis and these are acknowledged in this section. Additionally, some potential ideas for future research are provided in this section.

6.4.1 Limitations

The aim of this study was to investigate the relationships between intrapersonal factors specifically higher-order thinking dispositions and innovation behaviour. This focus inevitably rules out other factors that are arguably equally important to innovation
behaviour such as motivation, self-efficacy, actual reasoning skills, group factors such as team cohesiveness and leadership, and organisational factors such as organisational culture and reward systems.

Although steps were taken to design the research in a rigorous manner, unexpected outcomes in the project has resulted in some compromises being made (e.g., excluding the use of data on innovation behaviour of participants from their supervisors’ perspective), as discussed in Chapter 3. An obvious limitation of the study is the small sample size. Although the use of PLS-SEM has helped to overcome some of the shortcomings of a small sample, a larger sample would have nonetheless been beneficial.

Another limitation is the sampling strategy adopted. Although innovation is pervasive in all organisations, in all jobs and comes in many forms as discussed in Chapter 2, the sampling strategy could have been more focused or even adopted a comparative perspective in examining the strength of innovation in different industries or professions. Additionally, that the sample was obtained via a third party brings into question the generalisability of the findings.

All of the data that were used to test the hypotheses were obtained via self-report measures and this brings into question the veracity of the data especially as the constructs in the hypotheses are arguably socially desirable traits/outcomes. However, in order to address this limitation, the data were controlled statistically for the effects of social desirability. The data could have also been obtained from multiple sources for the purpose of triangulation. However there are issues that must be considered as MacKinnon (1961) found that people who tend to be less innovative tend to perceive and rate others as more intelligent. Hence, third-party ratings are also subjective. In addition, where dispositions are concerned, individuals are usually the best (of a bad bunch of alternatives) source (Furnham 1992; James & Mazerolle 2001).

The cross-lagged, panel data mitigates some of the issues involved with the use of cross-sectional data. However, similar to the issues inherent in cross-sectional data, the design of the study and the use of correlation-based statistical analyses rules out making any causal statements based on the findings. Selig and Little (2012) argue that intra-individual changes have an effect on the parameters of the panel model, which suggest that the use of two stages of data collection involving participants’ higher-
order thinking dispositions in Stage 1 and job-related learning, creativity and innovation behaviour in Stage 2 is appropriate.

Although not a limitation per se, the study could have also attempted to measure actual thinking ability. Dispositions may not provide an accurate ‘picture’ of an individual’s underlying mental processes/aptitudes. For example, an individual might have a tendency to engage in critical thinking but the level of critical-thinking ability is an important factors when it comes to evaluating the effects of the tendency to engage in critical thinking. Williams and Stockdale (2003) argue that some dispositions (e.g. rational problem solving and critical thinking dispositions) may be a form of compensation for a lack of (or absence) talent. Hence, measuring or testing for actual higher-order thinking skills should help to better inform the linkages between higher-order thinking dispositions and innovation behaviour.

Finally, whilst one could argue that the construct of metacognition should be multidimensional, and go beyond self-consciousness, there are arguments that the other dimensions of metacognition of knowledge and regulation, as proposed by scholars such as Flavell (1979), are mere beliefs rather than actual knowledge and hence contribute little to the construct of metacognition. Even Flavell (2004) acknowledged that metacognitive knowledge is a form of folk psychology.

6.4.2 Future Research

As mentioned in the discussion on the theoretical implications of the findings, the different higher-order thinking dispositions might have complex interaction effects on outcomes such as job-related learning and these effects might also be due to sequencing effects. Future areas of research include not only validating the findings obtained in this study but exploring interaction and sequencing effects. Another direction for future research is to examine the effects of higher-order thinking on different outcomes such as typical and maximal job performance. Additionally, it would be interesting and worthwhile to examine if different leadership styles are related to different higher-order thinking dispositions.

Innovation and innovation behaviour are areas that have received considerable attention from scholars. In addition to the higher-order thinking dispositions that were examined in this study, other scholars have also investigated other intra-individual factors such as cognitive/intellectual skills (Runco 2004b), personality (e.g. openness to experience) (Furnham et al. 2008), self-efficacy and intrinsic motivation (Amabile
1983), emotions/affect states (including emotional intelligence) (Shalley, Zhou & Oldham 2004), and knowledge (tacit knowledge, domain specific knowledge) (Simonton 1984; Patterson et al. 2009a). In addition, interpersonal factors and their impact on innovation have also been investigated. Examples include communications and interpersonal skills (Rank, Pace & Frese 2004), and networking and social skills (Good et al. 2007). The literature indicates, however, that leadership and organisational culture are areas that are crucial for innovation behaviour and warrant further research.

Although the direct relationship between organisational culture and innovation behaviour has been investigated, there are opportunities for studies on whether dispositions moderate or mediate the effects of organisational culture on innovation behaviour. The rationale for this suggestion is that certain higher-order thinking dispositions might be fostered by or synergise with some organisational cultures but not by or with others. For example, a bureaucratic organisational culture might foster or synergise with linear thinking dispositions such as problem solving but not with multiple perspective-taking or systems thinking because of the narrow spans of control that typify bureaucratic cultures. From a methodological perspective, future research may adopt an experimental design to examine the causal effects of higher-order thinking and personal dispositions on innovation behaviour.

A detailed examination of the effects of different types of leadership on innovation behaviour is warranted given the widespread of effects of leadership on organisational members. As mentioned with regards to organisational culture, certain higher-order thinking dispositions might be fostered by or synergise with some leadership styles but not by or with other leadership styles. For example, transformational leadership might be more likely than transactional leadership to foster systems thinking and thus innovation because transformational leadership emphasises a vision for the organisation and collective goals that involves change whereas transactional leadership focuses essentially on performing one’s job-related tasks.

Another area for future research lies in examining the effects of interpersonal factors on innovation behaviour. Although an individual might have viable creative ideas, it is often (if not always) the case that the individual will need to co-operate with others if the potential of the creative ideas is to be realised. The likelihood that an individual with creative ideas would take the next step and engage in innovation behaviours (e.g., championing the ideas to colleagues or to seek funding or other types of support from
senior management) is arguably greater when the individual trusts the other parties that need to be involved to transform an idea into an innovation. Innovation is often a complex endeavour and trust amongst organisational actors helps to facilitate the coordination of action in complex systems (Seabright, Levinthal & Fichman 1992).

Dispositions help to predict typical performance, which may be more prized in a turbulent environment that requires consistency rather than a maximal performance orientation that is untenable over long periods of time. Higher-order thinking dispositions are important when sustained effort is required especially for innovation-based processes that may take time and inherently involves unique challenges and impediments. One possible area for future research would be to examine the effects of higher-order thinking dispositions on typical and maximal performance.

6.5 CONCLUSION

As stated in Chapter 1, innovation is of prime concern to many organisations due to the need to compete with rivals from around the globe. Although it was recognised in Chapter 1 that innovation can stem from different sources, the focus of this research was innovation from individual employees. There is considerable evidence that higher-order thinking dispositions are related to innovation and the objective of this research was to address a gap in the literature by developing a model of the mechanism via which various higher-order thinking dispositions (i.e., critical thinking, problem solving, metacognition, systems thinking and multiple perspective-taking) influence innovative behaviour in the workplace and then testing the model. Two research questions were developed and data were obtained from a convenience sample of 202 participants via a two-stage longitudinal design.

The first research question focused on how higher-order thinking dispositions influence innovative behaviour. According to the model that was developed in response to this research question, higher-order thinking dispositions influence innovation behaviour via two mediators; job-related learning and creativity. However, it is acknowledged that the model is limited as there are arguably a multitude of other factors that are involved in the linkage between higher-order thinking dispositions and innovation behaviour. These factors are diverse in the sense that they are from different levels of analysis: That is, intrapersonal (e.g., motivation), interpersonal (e.g., trust), group (e.g., cohesion), organisational (e.g., organisational culture) and societal (e.g., uncertainty avoidance).
The second research question focused on the relative importance of the different higher-order thinking dispositions with regards to innovation behaviour. The findings revealed that multiple perspective-taking appears to be the pre-eminent higher-order thinking disposition. Specifically, when the five thinking dispositions are used concurrently as predictors, multiple perspective-thinking is the only disposition that significantly predicts job-related learning, creativity and innovation behaviour. None of the other dispositions significantly predict job-relating learning nor innovation behaviour whilst systems thinking significantly predict creativity. Despite the primacy of multiple perspective-taking, the findings showed that each of the five higher-order thinking dispositions indirectly influences creativity via job-related learning and also has a direct influence on job-related learning.
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## APPENDICES

### APPENDIX 1: CRITICAL THINKING ITEMS

<table>
<thead>
<tr>
<th>ENGAGEMENT</th>
<th>Original Items (Irani et al. 2007)</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I look for opportunities to solve problems.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I am interested in many issues.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I am able to relate to a wide variety of issues.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I enjoy finding answers to challenging questions.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I am a good problem solver.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I am confident that I can reach a reasonable conclusion.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I am likely to apply my knowledge to a wide variety of issues.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I am able to explain things clearly.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I ask good questions when trying to clarify a solution.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I present issues in a clear and precise manner.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I keep on working on things until I get them right.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COGNITIVE MATURITY</th>
<th>Original Items (Irani et al. 2007)</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I listen carefully to the opinions of others even when they disagree with me.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I am likely to change my opinion when I am given new information that conflicts with my current opinion.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I try to consider the facts without letting my biases affect my decisions.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I can get along with people who do not share my opinions.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I consider how my own biases affect my opinions.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I try to find multiple solutions to problems.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I ask many questions when making a decision.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I believe that most problems have more than one solution.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INNOVATIVENESS</th>
<th>Original Items (Irani et al. 2007)</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>I enjoy learning about many topics.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I ask lots of questions in a learning environment.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>It is important to be well informed.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td><strong>Engagement</strong> Original Items (Irani et al. 2007)</td>
<td>Adaptation</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>I enjoy solving problems.</td>
<td>-No adaptation-</td>
<td></td>
</tr>
<tr>
<td>I enjoy learning even when I am not in school.</td>
<td>-No adaptation-</td>
<td></td>
</tr>
<tr>
<td>I search for the truth even when it makes me uncomfortable.</td>
<td>-No adaptation-</td>
<td></td>
</tr>
<tr>
<td>I will go out of my way to find the right answers to a problem.</td>
<td>-No adaptation-</td>
<td></td>
</tr>
</tbody>
</table>
**APPENDIX 2: PROBLEM SOLVING ITEMS**

**Positive Problem Orientation**

<table>
<thead>
<tr>
<th>Original Items (D’Zurilla et al. 2002)</th>
<th>Adaptation <em>(in italics)</em></th>
<th>Rationale for adaption in Subordinate Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>When my first efforts to solve a problem fail, I know if I persist and do not give up too easily, I will be able to eventually find a good solution.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>When I have a problem, I try to see it as a challenge, or opportunity to benefit in some positive way from having the problem.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>Whenever I have a problem, I believe that it can be solved.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>When problems occur in my life, I like to deal with them as soon as possible.</td>
<td><em>When problems occur, I like to deal with them as soon as possible.</em></td>
<td>The phrase “in my life” was removed as this term is not consistent with the rest of items i.e. non-specific to the source of the problem</td>
</tr>
<tr>
<td>When I am faced with a difficult problem, I believe that I will be able to solve it on my own if I try hard enough.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
</tbody>
</table>
### Rational

<table>
<thead>
<tr>
<th>Original Items (D’Zurilla et al. 2002)</th>
<th>Adaptation <em>(in italics)</em></th>
<th>Rationale for adaptation in Subordinate Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whenever I have a decision to make, I try to predict the positive and negative consequences of each option.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
</tbody>
</table>
## Systematic

<table>
<thead>
<tr>
<th>Original Items (Heppner &amp; Peterson 1982)</th>
<th>Adaptation (<em>in italics</em>)</th>
<th>Rationale for adaption in Subordinate Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>After I have tried to solve a problem with a certain course of action, I take time and compare the actual outcome to what I thought should have happened.</td>
<td>-No adaptation-&lt;br&gt;* Similar to Rational Problem Solving item four: “After carrying out a solution to a problem, I try to evaluate as carefully as possible how much the situation has changed for the better”.</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>When confronted with a problem, I stop and think about it before deciding on the next step.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I try to predict the overall result of carrying out a particular course of action.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I have a systematic method for comparing alternatives and making decisions.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>When I am confused by a problem, one of the first things I do is survey the situation and consider all the relevant pieces of information.</td>
<td>* Similar to Rational Problem Solving item two: “When I have a problem to solve, one of the first things I do is get as many facts about the problem as possible”. Simplified by removing the phrase “pieces of”.</td>
<td></td>
</tr>
<tr>
<td>When I have a problem, I think up as many possible ways to handle it as I can until I can't come up with any more ideas.</td>
<td>* Similar to Rational Problem Solving item five: “When I am trying to solve a problem, I think of as many options as possible until I</td>
<td>Simplified.</td>
</tr>
<tr>
<td>Original Items (Heppner &amp; Peterson 1982)</td>
<td>Adaptation (in italics)</td>
<td>Rationale for adaption in Subordinate Questionnaire</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>When confronted with a problem, I consistently examine my feelings to find out what is going on in a problem situation.</td>
<td><em>When confronted with a problem, I rely on my emotions to find the causes of the problem.</em></td>
<td>Simplified. Removed superfluous words.</td>
</tr>
</tbody>
</table>

**Items not used:**


- I feel threatened and afraid when I have an important problem to solve.
- When making decisions, I do not evaluate all of my options carefully enough.
- I feel nervous and unsure of myself when I have an important decision to make.
- I wait to see if a problem will resolve itself first, before trying to solve it myself.
- When my first efforts to solve a problem fail, I get very frustrated.
- When I am faced with a difficult problem, I doubt that I will be able to solve it on my own, no matter how hard I try.
- I go out of my way to avoid having to deal with problems in my life.
- Difficult problems make me very upset.
- When I am trying to solve a problem, I go with the first idea that comes to mind.
- When a problem occurs in my life, I put off trying to solve it for as long as possible.

**Heppner and Petersen’s (1982) Personal Problem Solving measure**

- I am usually able to think up creative and effective alternatives to solve a problem.
- I have the ability to solve most problems even though initially no solution is immediately apparent.
- Many problems I face are too complex for me to solve.
- I make decisions and am happy with them later.
- When I make plans to solve a problem, I am almost certain that I can make them work.
- Given enough time and effort, I believe I can solve most problems that confront me.
- When faced with a novel situation I have confidence that I can handle problems that may arise.
- I trust my ability to solve new and difficult problems.
- After making a decision, the outcome I expected usually matches the actual outcome.
- When confronted with a problem, I am unsure of whether I can handle

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<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• I spend more time avoiding my problems than solving them.</td>
<td>• When I become aware of a problem, one of the first things I do is to try to find out exactly what the problem is.</td>
</tr>
<tr>
<td>• When I have a decision to make, I do not take the time to consider the pros and cons of each option.</td>
<td>• When a solution to a problem was unsuccessful, I do not examine why it didn't work.</td>
</tr>
<tr>
<td>• I put off solving problems until it is too late to do anything about them.</td>
<td>• When I am confronted with a complex problem, I do not bother to develop a strategy to collect information so I can define exactly what the problem is.</td>
</tr>
<tr>
<td>• When making decisions, I go with my “gut feeling” without thinking too much about the consequences of each option.</td>
<td>• After I have solved a problem, I do not analyze what went right or what went wrong.</td>
</tr>
<tr>
<td>• I am too impulsive when it comes to making decisions.</td>
<td>• When confronted with a problem, I tend to do the first thing that I can think of to solve it.</td>
</tr>
<tr>
<td></td>
<td>• When deciding on an idea or possible solution to a problem, I do not take time to consider the chances of each alternative being successful.</td>
</tr>
<tr>
<td></td>
<td>• I generally go with the first good idea that comes to my mind.</td>
</tr>
<tr>
<td></td>
<td>• When I try to think up possible solutions to a problem, I do not come up with very many alternatives.</td>
</tr>
<tr>
<td></td>
<td>• When confronted with a problem, I do not usually examine what sort of external things my environment may be contributing to my problem.</td>
</tr>
<tr>
<td></td>
<td>• When my first efforts to solve a problem fail, I become uneasy about my situation.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>ability to handle the situation.</td>
<td></td>
</tr>
<tr>
<td>• Sometimes I do not stop and take time to deal with my problems, but just kind of muddle ahead.</td>
<td></td>
</tr>
<tr>
<td>• Even though I work on a problem, sometimes I feel like I am groping or wandering, and am not getting down to the real issue.</td>
<td></td>
</tr>
<tr>
<td>• I make snap judgments and later regret them.</td>
<td></td>
</tr>
<tr>
<td>• Sometimes I get so charged up emotionally that I am unable to consider many ways of dealing with my problems.</td>
<td></td>
</tr>
</tbody>
</table>
## APPENDIX 3: METACOGNITION ITEMS

<table>
<thead>
<tr>
<th>Original Items (Cartwright-Hatton et al. 2004)</th>
<th>Adaptation (&lt;em&gt;in italics&lt;/em&gt;)</th>
<th>Rationale for adaption</th>
</tr>
</thead>
<tbody>
<tr>
<td>I think a lot about my thoughts</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I am aware of the way my mind works when I am thinking through a problem</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I monitor my thoughts</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I rarely question my thoughts</td>
<td>&lt;em&gt;I often question my thoughts.&lt;/em&gt;</td>
<td>Positively phrased to facilitate analysis.</td>
</tr>
<tr>
<td>I am constantly aware of my thinking</td>
<td>I am constantly aware of my thinking.</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I pay close attention to the way my mind works</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I constantly examine my thoughts</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
</tbody>
</table>
**APPENDIX 4: SYSTEMS THINKING ITEMS**

**Understanding the Whole**

<table>
<thead>
<tr>
<th>Original Items (Frank 2010)</th>
<th>Adaptation (in italics)</th>
<th>Rationale for adaption</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. When I'm involved in an engineering work, it is important for me to understand the big picture.</td>
<td>A. When I'm doing my job, I need know the big picture.</td>
<td>Generally (for all proceeding items where relevant), the relevant items that referred to engineering were rephrased not to reflect any specific professions/occupations.</td>
</tr>
<tr>
<td>B. When I'm involved in an engineering task, it is important for me to understand all the details.</td>
<td>Not used. Only positively phrased items were used ('A' option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>A. When I take care of a product, it is important for me to see how it functions as a part of the system.</td>
<td>A. When I undertake a task, I need to know how it fits in with the overall organisational system.</td>
<td>Product” was substituted with “task” to make the item more relevant to other participants. “Fits in” was used as “function” may not be a frequently used and understood term by respondent who use English as a second language (ESL).</td>
</tr>
<tr>
<td>B. When I take care of a product, it is important for me to concentrate on this product, assuming that other engineers will take care of the other parts of the system.</td>
<td>Not used. Only positively phrased items were used ('A' option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>A. I don't like to be involved with details; I prefer to deal with the system's aspects.</td>
<td>A. I don't like to be involved with details; I prefer to deal with the organisation’s systems</td>
<td>Item rephrased to specify the organisational system.</td>
</tr>
<tr>
<td>B. In areas in which I'm involved, I like to understand all the details</td>
<td>Not used. Only positively phrased items were used ('A' option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>A. It is important for me to identify the benefits derived from embedding several products/sub-systems/systems.</td>
<td>A. It is important for me to improve the overall work system</td>
<td>“Product” was substituted with “task” to make the item more relevant to other participants.</td>
</tr>
<tr>
<td>Original Items (Frank 2010)</td>
<td>Adaptation (in italics)</td>
<td>Rationale for adaption</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>B. I prefer not to deal with combinations of products/sub-systems/ systems but rather to concentrate on the product for which I am responsible.</td>
<td>Not used. Only positively phrased items were used (‘A’ option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>A. When I deal with a product, I always look at the interconnections and mutual influences between the main product and the peripheral products.</td>
<td>A. When I undertake a task, I look at the how it is related to what other people are doing.</td>
<td>“Product” was substituted with “task” to make the item more relevant to other participants. “Always” was removed as this is an “absolute” qualifier. Similar to the term “never”.</td>
</tr>
<tr>
<td>B. I prefer to thoroughly take care of the part for which I am responsible and leave the issue of interconnections between a system's parts to the integration engineers.</td>
<td>Not used. Only positively phrased items were used (‘A’ option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>A. It is important for me to know what other employees in my department/ project do.</td>
<td>A. It is important for me to know what other employees in my department do.</td>
<td>The term “project” was removed as it may not be relevant to all participants. The term “department” includes all situations.</td>
</tr>
<tr>
<td>B. It is important for me to do my best and not interfere to the work of other employees in my department/ project.</td>
<td>Not used. Only positively phrased items were used (‘A’ option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>A. I make due with a general description when being presented with a new product which needed to my job.</td>
<td>A. I am happy to start working on a new task even if I am only given a general description of what I need to do.</td>
<td>“Product” was substituted with “task” to make the item more relevant to other participants. There was a grammatical error in the original “A” statement, “make due” as it should have been “make do”. However, this the term “make do” was not adopted as it is a metaphor/ idiom that respondents who use English as second language may not understand.</td>
</tr>
<tr>
<td>Original Items (Frank 2010)</td>
<td>Adaptation (in italics)</td>
<td>Rationale for adaption</td>
</tr>
<tr>
<td>---------------------------</td>
<td>------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>B. I am a perfectionist and I request to receive a detailed explanation when a new product needed to my job is first presented to me.</td>
<td>Not used. Only positively phrased items were used (‘A’ option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>A. When I encounter a problem, I first try to find a quick resolution without getting involved in the details.</td>
<td>A. When I encounter a problem, I think of how my proposed solution affect others departments/employees</td>
<td>The statements were simplified and the word “solution” and “solving” was used in place of “resolution” as a resolution can imply a decision or better sight. These different connotations may be a problem for respondents who use English as a second language.</td>
</tr>
<tr>
<td>B. When I encounter a problem, I first try to break it into its components and resolve it in stages</td>
<td>Not used. Only positively phrased items were used (‘A’ option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>A. I take interest in the activities of engineers from other disciplines who are involved in the project.</td>
<td>A. I take interest in the activities of colleagues from other disciplines that are part of my team.</td>
<td>The term “project” was removed as it may not be relevant to all participants. The term “team” includes all situations.</td>
</tr>
<tr>
<td>B. I do not involve myself in the work of engineers from other disciplines, I generally rely upon them.</td>
<td>Not used. Only positively phrased items were used (‘A’ option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
</tbody>
</table>

**Interdisciplinary Knowledge**

<table>
<thead>
<tr>
<th>Original Items (Frank 2010)</th>
<th>Adaptation (in italics)</th>
<th>Rationale for adaption</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. I think that every employee should gain interdisciplinary knowledge and general knowledge in several fields.</td>
<td>A. I think that every employee should gain interdisciplinary knowledge and general knowledge in several fields.</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>B. I think that every employee should become an</td>
<td>Not used. Only positively phrased items were</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>Original Items (Frank 2010)</td>
<td>Adaptation (in italics)</td>
<td>Rationale for adaption</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>expert in his/her field. Learning more fields may lead to sciolism (to know a little about many subjects).</td>
<td>used (‘A’ option) as a Likert scale.</td>
<td>Generally (for all proceeding items where relevant), the relevant items that referred to engineering were rephrased not to reflect any specific professions/occupations.</td>
</tr>
<tr>
<td>A. It is important for me to acquire knowledge in other engineering fields.</td>
<td>A. It is important for me to acquire knowledge in fields other than my specialisation.</td>
<td></td>
</tr>
<tr>
<td>B. I prefer to be a professional in my major field and to learn all its aspects in depth.</td>
<td>Not used. Only positively phrased items were used (‘A’ option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>A. A good engineer needs to also understand other areas relevant to the project.</td>
<td>A. A good professional needs to be both an expert his/her area and also understand other areas relevant to their work.</td>
<td>The term “project” was removed as it may not be relevant to all participants. The term “work” includes all situations.</td>
</tr>
<tr>
<td>B. A good engineer needs to be a technical expert in his field (a professional guru).</td>
<td>Not used. Only positively phrased items were used (‘A’ option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>A. An engineer should be aware on non-engineering related considerations such as business and financial considerations.</td>
<td>A. Any professional should be aware of all other aspects their work (e.g. technical, financial, marketing, human resources).</td>
<td>The relevant items that referred to engineering were rephrased not to reflect any specific professions/occupations.</td>
</tr>
<tr>
<td>B. An engineer should focus on engineering and leave the business considerations to the CFO office.</td>
<td>Not used. Only positively phrased items were used (‘A’ option) as a Likert scale.</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>A. It is important to me to attain knowledge also in areas that are not my main area of expertise (please specify one area: ).</td>
<td>A. It is important to me to attain knowledge in areas that are not my main area of expertise.</td>
<td>Statement “A” was simplified.</td>
</tr>
<tr>
<td>B. I prefer to specialize in depth in the area of my</td>
<td>Not used. Only positively phrased items were</td>
<td>-not applicable-</td>
</tr>
<tr>
<td>Original Items (Frank 2010)</td>
<td>Adaptation (in italics)</td>
<td>Rationale for adaption</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------</td>
<td>------------------------</td>
</tr>
</tbody>
</table>
| expertise.                  | used (‘A’ option) as a Likert scale. | }
# Appendix 5: Multiple Perspective-taking Items

<table>
<thead>
<tr>
<th>Original Items (Bass 1990)</th>
<th>Adaptation (in italics)</th>
<th>Rationale for adaption in Subordinate Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-examine ways of doing things to see if they are up to standard.</td>
<td><em>I re-examine ways of doing things to see if they are up to standard.</em></td>
<td>Items rephrased (with the inclusion of the word “I”) to guide participants to respond to the items from their own perspective rather than the leader.</td>
</tr>
<tr>
<td>Look at problems from many different angles.</td>
<td><em>I look at problems from many different angles.</em></td>
<td>-As above-</td>
</tr>
<tr>
<td>Try new ways of looking at how to complete assignments.</td>
<td><em>I try new ways of looking at how to complete assignments.</em></td>
<td>As above-</td>
</tr>
<tr>
<td>Seek differing perspectives when solving problems.</td>
<td><em>I seek differing perspectives when solving problems.</em></td>
<td>As above-</td>
</tr>
</tbody>
</table>
## APPENDIX 6: JOB-RELATED LEARNING ITEMS

<table>
<thead>
<tr>
<th>Original Items (Loon &amp; Casimir 2008)</th>
<th>Adaptation (in italics)</th>
<th>Rationale for adaption</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the last six months, I have learnt a lot of things that have helped me to perform my job better.</td>
<td>Time frame changed from six months to two months</td>
<td>- Time frame changed to suit lag between stages</td>
</tr>
<tr>
<td>In the last six months, I have acquired a lot of new job-related knowledge.</td>
<td>Time frame changed from six months to two months</td>
<td>- Time frame changed to suit lag between stages</td>
</tr>
<tr>
<td>In the last six months, I have acquired a lot of new job-related skills.</td>
<td>Time frame changed from six months to two months</td>
<td>- Time frame changed to suit lag between stages</td>
</tr>
</tbody>
</table>
**APPENDIX 7: CREATIVITY (JOB, TEAM, AND ORGANISATION) ITEMS**

* Runco, Plucker and Lim’s (2000) found two factors in their study. However, Factor 2 was removed as the authors suggest, “theoretical distinction between the factors is difficult to determine. The lack of theory suggesting two factors and the high correlation between them suggests that the one-factor structure should guide interpretation of Runco Ideation Behavior Scale results” (p. 397). Only five of the 17 items from Factor 1 were used.

<table>
<thead>
<tr>
<th>Original Items (Runco 2000-2001)</th>
<th>Adaptation (in italics)</th>
<th>Rationale for adaption</th>
</tr>
</thead>
</table>
| I have many wild ideas.          | *I have many ideas on how to improve the way I do my job*  
*I have many ideas to improve how my team works*  
*I have many ideas to improve how my organisation works* | Rephrased to focus on work.  
Three similar items were created; one directed at the participant’s “job”, “team” and “organisation”.  
This was applied to all proceeding items. |
| I think about ideas more often than most people. | -Not included- | -As above- |
| I come up with a lot of ideas or solutions to problems. | *I come up with a lot of ideas or solutions to problems related to my job.*  
*I come up with a lot of ideas or solutions to problems related to how my team works.*  
*I come up with a lot of ideas or solutions to problems related to how my organisation works.* | -As above- |
| I come up with an idea or solution other people have never thought of. | *I come up with ideas or solutions my colleagues have never thought in relation to our jobs.*  
*I come up with ideas or solutions my colleagues have never thought in relation to how our team works.*  
*I come up with ideas or solutions my colleagues have never thought in relation to how our organisation work.* | -As above- |
<p>| I like to play around with ideas for the fun of it. | -Not included- | -As above- |</p>
<table>
<thead>
<tr>
<th><strong>Original Items (Runco 2000-2001)</strong></th>
<th><strong>Adaptation (in italics)</strong></th>
<th><strong>Rationale for adaption</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>I would rate myself highly in being able to come up with ideas.</td>
<td>-Not included-</td>
<td>-As above-</td>
</tr>
<tr>
<td>I have always been an active thinker—I have lots of ideas.</td>
<td>-Not included-</td>
<td>-As above-</td>
</tr>
<tr>
<td>I am able to think up answers to problems that haven’t already been figured out.</td>
<td>-Not included-</td>
<td>-As above-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simplified and “figured out” was removed as it colloquial.</td>
</tr>
</tbody>
</table>
| I am good at combining ideas in ways that others have not tried.  | *I am good at combining ideas in ways that others have not tried to improve the way we our jobs.*  
*I am good at combining ideas in ways that others have not tried to improve the way our teams work.*  
*I am good at combining ideas in ways that others have not tried to improve the way our organisation works.* | -As above-                  |
| Friends ask me to help them think of ideas and solutions.         | -Not included-                                                                             | -As above-                |
|                                                                 |                                                                                           | Included proposition “to” and replaced “friends” with “colleagues” to direct the items at the work place and to be work-related. |
| I have ideas about new inventions or about how to improve things. | *I have ideas about how to improve things related to my job.*  
*I have ideas about how to improve things related to how my team works.*  
*I have ideas about how to improve things related to how our organisation works.* | -As above-                  |
<p>|                                                                 |                                                                                           | Original item was double barreled. Removed “new inventions” as “improve things” is a general and may involve new inventions |</p>
<table>
<thead>
<tr>
<th>Original Items (Runco 2000-2001)</th>
<th>Adaptation (in italics)</th>
<th>Rationale for adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>my organisation works</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I often get excited by my own new ideas.</td>
<td>-Not included-</td>
<td>The face validity of the item is questionable. Removed to improve parsimony of questionnaire.</td>
</tr>
<tr>
<td>It is important to be able to think of bizarre and wild possibilities.</td>
<td>-Not included-</td>
<td>The face validity of the item is questionable. Removed to improve parsimony of questionnaire.</td>
</tr>
<tr>
<td>I enjoy having leeway in the things I do and room to make up my own mind.</td>
<td>-Not included-</td>
<td>The face validity of the item is questionable. Removed to improve parsimony of questionnaire.</td>
</tr>
<tr>
<td>I would take a college course which was based on original ideas.</td>
<td>-Not included-</td>
<td>The face validity of the item is questionable. Removed to improve parsimony of questionnaire.</td>
</tr>
<tr>
<td>I am able to think about things intensely for many hours.</td>
<td>-Not included-</td>
<td>The face validity of the item is questionable. Removed to improve parsimony of questionnaire.</td>
</tr>
<tr>
<td>I try to exercise my mind by thinking things through.</td>
<td>-Not included-</td>
<td>The face validity of the item is questionable. Removed to improve parsimony of questionnaire.</td>
</tr>
</tbody>
</table>
## APPENDIX 8: INNOVATION BEHAVIOUR ITEMS

<table>
<thead>
<tr>
<th>Original Item (Scott &amp; Bruce 1994)</th>
<th>Adaptation (in italics)</th>
<th>Rationale for adaption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Searches out new technologies, processes, techniques and/or product ideas.</td>
<td>In the last 2months, I have searched out new technologies, processes, techniques and/or product ideas.</td>
<td>Items direct participants to themselves. The phrase “I” is included in all proceeding items. Refers to the last two months, which is the interval between the two stages of the questionnaire.</td>
</tr>
<tr>
<td>Generates creative ideas.</td>
<td>In the last 2months, I have generated creative ideas.</td>
<td>-As above-</td>
</tr>
<tr>
<td>Promotes and champion ideas to others.</td>
<td>In the last 2months, I have promoted and champion ideas to others.</td>
<td>-As above-</td>
</tr>
<tr>
<td>Investigates and secures funds needed to implement new ideas.</td>
<td>In the last 2months, I have investigated and secured funds needed to implement new ideas.</td>
<td>-As above-</td>
</tr>
<tr>
<td>Develops adequate plans and schedules for the implementation of new ideas.</td>
<td>In the last 2months, I have developed adequate plans and schedules for the implementation of new ideas.</td>
<td>-As above-</td>
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<tr>
<td>Is innovative.</td>
<td>I am innovative.</td>
<td>-As above-</td>
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## Appendix 9: Risk Aversion Items

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<th>Original Item (Mandrik &amp; Bao 2005)</th>
<th>Adaptation (<em>italics</em>)</th>
<th>Rationale for adaptation</th>
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<tbody>
<tr>
<td>I do not feel comfortable about taking chances.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I prefer situations that have foreseeable outcomes.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>Before I make a decision, I like to be absolutely sure how things will turn out.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I avoid situation that have uncertain outcomes.</td>
<td>-No adaptation-</td>
<td>-No adaptation-</td>
</tr>
<tr>
<td>I feel comfortable improvising in new situations.</td>
<td><em>I do not feel comfortable improvising in new situations</em></td>
<td>Positively keyed to facilitate ease of analysis.</td>
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<tr>
<td>I feel nervous when I have to make decision in uncertain situations.</td>
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<td>-No adaptation-</td>
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<tr>
<td>I do not feel comfortable about taking chances.</td>
<td>-No adaptation-</td>
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## APPENDIX 10: SOCIAL DESIRABILITY ITEMS

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<th>Rationale for adaption</th>
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<tr>
<td>I never hesitate to go out of my way to help someone in trouble.</td>
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## Appendix 11: Cross Loadings

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<th>MPT</th>
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<th>Create</th>
<th>Innov.</th>
<th>RiskAv</th>
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