Engineers as entrepreneurs: entrepreneurial orientation of engineers in South Africa

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ABSTRACT

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A positive relationship between economic growth and entrepreneurship has been established as derived from the body of knowledge in the domain of entrepreneurship. In acknowledgement of this relationship, governments have embarked on schemes and policies that encourage entrepreneurship in their economic development policies. The individual entrepreneur is a key player in new entrepreneurial venture process. The entire society is responsible for shaping an environment within which a behaviour pattern that promotes or hinders entrepreneurship is developed.

The study mainly focused on understanding the behavioural phenomenon which is termed entrepreneurial orientation (EO) of engineers within the South African context. The assumed EO of entrepreneurial engineers was expected to be higher than that of non-entrepreneurial engineers. Cronbach Alpha's tests found the pre-structured EO scale to be reliable. T-test results for mean difference confirmed that entrepreneurs have a higher EO on the overal EO construct as well as on the autonomy, proactiveness and risk taking dimemensions.

Factor analysis results supported the view that the EO construct is uni-dimensional. Situational factors that shaped the social environment alluded to above were studied as a secondary objective. Chi-square tests did not confirm the expectation that entrepreneurial engineers would be exposed to situational factors

that promote entrepreneurship than their non-entrepreneurial counter parts. Lack of entrepreneurial education and finance have been identified as the key factors that hamper entrepreneurship. Recommendations are included in this report.

"Most of what you hear about entrepreneurship is all wrong.

It's not magic; it's not mysterious; and it has nothing to do with genes.

It's a discipline and, like any discipline, it can be learned."

Peter F. Drucker

Keywords

Engineer - refers to an individual who has completed an engineering programme that has been accredited by the Engineering Council of South Africa (ECSA) and is recognised as meeting the initial academic requirements for registration as a Professional Engineer in South Africa (ECSA, 2010)

Entrepreneur - is an person who has started a new business where there was none before (Duygulu, 2008)

Entrepreneurial engineers – for the purpose of this research an entrepreneurial engineer is an engineer who is currently self-employed, own or has started an entrepreneurial venture

Non-entrepreneurial engineers - for the purpose of this research a non-entrepreneurial engineer is an engineer who is in currently employed and has not started or do not own an entrepreneurial venture

Entrepreneurial orientation (EO) – is defined as processes, practices and decision making activities that lead to new entry into entrepreneurship

Entrepreneurial Intent – intention of individuals to become entrepreneurs

Situational factors – elements of culture, work experience, education, environment created by institutions and government agencies that contribute towards the promotion and hindrance of entrepreneurship within a national economy.

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Masters of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other university. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

Name:

Signature:

Date:

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CHAPTER 1: INTRODUCTION TO RESEARCH PROBLEM

1.1 Research Title

Engineers as Entrepreneurs: Entrepreneurial Orientation of Engineers in South Africa.

1.2 Introduction

Success or failure of transition economies such as South Africa has been attributed by a large proportion to the performance of entrepreneurs (McMillan & Woodruff, 2002 cited in Minniti & Levesque, 2008). An entrepreneur is defined as one who organises, manages and assumes the risks and reaps the benefits of starting a new entrepreneurial venture (Wood, Gadd, & Falkenburg, 2004). New entrepreneurial ventures have been found to be instruments of change and growth for economies (Aloulou and Fayolle, 2005).

The individual entrepreneur is an essential part of the process through which these new ventures are created (Baron, 2007) and on the same note it should be stated that some aspects of their behaviour and cognition plays a role in their entrepreneurial abilities. The social environment which individuals are part of shapes behaviours and cognition that either promote or hinder entrepreneurial activity (Domke-Damonte, Faulstich & Woodsen III, 2008).

In appreciation of the role that entrepreneurs play in growing an economy, the idea to conduct research in entrepreneurship was born. The main focus of the study isto understand the behavioural phenomenon which is termed **entrepreneurial orientation (EO) of engineers**, as it is understood from literature that it is a personal trait that differentiates entrepreneurs from non-entrepreneurs (Baron & Ward, 2004) cited in (Pownall & Lawson, 2005). In recognition that a social environment shapes the behaviour of individuals towards an interest in entrepreneurship or lack thereof, the secondary focus of this study is on understanding the South African social environment and how it has contributed to the level of entrepreneurship. The study population is engineers. Esbach (2009) in the study about relevance of engineering entrepreneurship highlighted the importance of engineers in advancing entrepreneurship. Esbach (2009) stated that engineers with their innovation-channelling skills create entrepreneurial products.

The following sections present the research motivation, relevance of studying EO, relevance of study population group, potential beneficiaries of study outcome, research scope and research problem.

1.3 Research Motivation

1.3.1 Relevance of Study: Entrepreneurship in South Africa

Emerging economies such as South Africa face daunting economic development challenges (West III, Bamford and Marsden, 2008). Birch (1979) and Reynolds *et*

al (2000) cited in West III *et al* (2008) have well documented the positive relationship between entrepreneurship and economic growth particularly in developed economies. Ireland, Hill, Camp & Sexton (2001) cited in Wang (2008) indicated that the heart of entrepreneurship is wealth creation.

Additionally, Aloulou and Fayolle (2005) have also supported that entrepreneurial venture is an engine of change and growth for any economy and that the entrepreneurial attitude fuels it. As a result of the understanding of the correlation between entrepreneurship and economic growth, West III *et al* (2008) citing Acs (1996), Birch (1979), Kirchhoff and Phillips (1991) and Romer (1990) argues that entrepreneurial development is seen by many governments as a gateway to economic vitality leading to, amongst many factors, enhancing prospects for self-generating innovation and future growth and yielding qualitative improvements to an areas' social and economic fabric.

As part of economic development and as a solution to social issues such as high unemployment rates estimated at **26%,** South Africa has identified enterprise development as becoming an increasingly important avenue for job creation and economic growth (Sasix, 2009). Currently, entrepreneurial activity in SA is low compared to other developing nations, for example, South African entrepreneurs contribute only 35% of Gross Domestic Product (GDP), compared with **60%** in developing economies like India and Brazil (Mass & Harrington, 2008).

In view of the above and the South African economic context, this study is focused on entrepreneurship within South Africa.

1.3.2 Relevance of Entrepreneurship Research Construct: Entrepreneurial Orientation

Lumpkin and Dess (1996) cited in Wang (2008) define entrepreneurial orientation (EO) as the processes, practices and decision making activities that lead to new entry. This is supported by Rauch, Wiklund, Lumpkin, and Frese (2009) as they advocate that EO represents the policies and practices that provide a basis for entrepreneurship. Rauch *et al* (2009) have concluded in their study that EO represents a promising area for building a cumulative body of relevant knowledge about entrepreneurship.

1.3.3 Relevance of Unit of Analysis: Engineer within South African Context

This research is focused on EO of engineers within South Africa as it is understood that in addition to the above theories. In this context, an **engineer** refers to an individual who has completed an engineering programme that has been accredited by the Engineering Council of South Africa (ECSA) and is recognised as meeting the initial academic requirements for registration as a Professional Engineer in South Africa (ECSA, 2010). Population is by this definition however the engineers need not to be members of ECSA or any professional engineers association. A list of the accredited programme is available at ECSA website.

Lacquet (2004) cited in Esbach (2009) claims that engineering has over time underpinned and continues to underpin economies around the world. Esbach (2009) further asserts that although technological advances have introduced rapid change that meet the demands of modern day society, this change continues to be integrative and iterative presenting engineering as a static element of economic structure. Coetzer (2006) cited in Esbach (2009), suggests that engineering entrepreneurship could help in creating the engine that drives the economy of South Africa. Magnanti (2005) cited in Esbach (2009) concludes that together the combination of management and engineering provide an ideal underpinning for technology innovation and entrepreneurship.

Reflecting on specifics of the SA economy, Global Entrepreneurship Monitor (GEM) has identified SA as being in the *efficiency-driven* phase of economic development thus requiring the development of efficient production processes and improvements in the quality of products (Maas & Harrington, 2008). Additionally, Baron and Ward (2004) have concluded that some individuals are better able to recognise opportunities than others because they have better access to pertinent information or they are better able to utilise the information they have.

In view of the above, engineers can make a valuable contribution in economies through entrepreneurship. This informed the decision to focus this study on the EO on engineers.

1.3.4 Potential beneficiaries of the study

Norman and Nieuwenhuizen (2009) model of entrepreneurship development discussed in latter chapters has highlighted that for entrepreneurship to thrive within a national economy it would take the entire society comprising of government, academic institutions, finance instutions and communities in general to carve an overall social environment that is conducive to entrepreneurship.

In view of the above, *potential benefits* to stakeholders stated above are highlighted:

- The outcome of this research will provide the government with information that can be used as inputs for policy development which are focused on entrepreneurship.
- Academic institutions, particularly schools of engineering, would find knowledge about factors that can be incorporated into the engineering curriculum in order to align themselves with government's imperative of increasing entrepreneurship. Additionally the improved curriculum would better prepare engineering graduates for career in entrepreneurship should they aspire to be entrepreneurs.
- As entrepreneurship is context specific, this study will also add to a wealth of knowledge about entrepreneurship in a developing country amongst engineers which will be of interest to entrepreneurship scholars who have a special interest in entrepreneurship within developing economies.

- Engineers would stand to benefit from understanding the factors that promote entrepreneurial behaviour and perhaps they can identify them and learn to become successful entrepreneurs.

1.4 Research Scope

Pownall and Lawson (2005) argue that EO should consider spatial and geographical cultural factors as they are understood to underpin sustainable competitiveness for entrepreneurs. Additionally Knight (1997), Thomas and Mueller (2000) cited in Rauch *et al* (2009) have indicated that EO or certain dimensions thereof may differ across countries. Rauch *et al* (2009) attribute the difference in EO within geographical locations to cultural norms and to illustrate this point it is said that for example an aggressive stance as advocated by EO may be rewarded in some culture but punished in orders.

Additionally Tang, Tang, Marino, Zhang and Li (2008) have stated that EO has been widely studied in the US context and other developed countries whilst less has been done in emerging economies. Furthermore, Rauch *et al* (2009) stated that the formulation of EO model and the original empirical tests were mainly done in the Northern American context and hence they advocated that clarifying the extent to which these results replicate or not across a wide set of countries may not only contribute to future EO research but more generally to theorizing about entrepreneurship because it would help in establishing boundary conditions of theories.

In justifying conducting an EO study in China, Tang *et al* (2008) argued that Western practices are not universal and hence the EO results obtained from studies within those practices may not be representative of emerging economies. The author supports Tang *et al* (2008)'s view that western and even emerging economies practices are not universal, hence it is relevant to study EO in the South African context.

Furthermore, Domke-Damonte *et al* (2008) have highlighted that although it is understood that EO provides an indicator of the requisite behavioural initiative that are conducive to new venture development, limited attention has been given to the evaluation of an individual's EO given that these individuals differ in terms of social and economic background of the country in which they were socialised.

In acknowledgement of the above findings, the scope of this study is limited *to understanding the EO of engineers both in employment* (non-entrepreneurial engineers) and *self-employment* (entrepreneurial engineers) environments within the South African context.

1.5 Research Problem

Baron and Ward (2004) cited in Pownall and Lawson (2005) advocate that discussion of the relevance of cognitive science to study entrepreneurship has suggested that entrepreneurs, when compared with non-entrepreneurs, may possess differences in terms of their knowledge structures (*the sum of what they*

know), how they interact with the environment (what *is recognised as a valid information source and which may constitute a previously unidentified opportunity*) and their likely greater use of heuristics as satisfying decision making mechanism. An **entrepreneu**r is defined as one who organises, manages and assumes the risks and reaps the benefits of a new entrepreneurial venture (Wood *et al*, 2004).

In view of the above stated theory, the aim of this study is to achieve the following:

- To study the EO of entrepreneurial and non-entrepreneurial engineers in South Africa. A comparison between the two groups will be made to assess if the orientation of these groups are the same or different.

The **first secondary aim** of this research would be to understand the extent to which:

- **Non-entrepreneurs have intentions of becoming entrepreneurs**

Pownall & Lawson (2005) citing Baron and Ward (2004) presented the idea that **Entrepreneurial Intention (EI)** is developed from cognitive viewpoints. Additionally these authors citing Kruger *et al* (2000) indicated that EI develops due to a combination of both situational and individual factors. In view of the above, in addition to understanding the EO of this population group, the **second secondary aim** of this research will be to find out what the:

- **Situational and individual factors** are that have contributed to business entry or lack thereof into entrepreneurship. This will be solicited on an exploratory basis as additional questions to the EO questions.

1.6 Conclusion

The literature cited in this section has provided support for conducting this study in the South African context. This is important as studies such as this one increases the understanding about the context specific factors that drive or hinder entrepreneurship. The literature references are discussed in much more detail in the next section of this report.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The purpose of literature survey is to present an overview of research that has been conducted on entrepreneurial orientation and factors that create a necessary environment for entrepreneurship to thrive. Literature that highlights the importance of the contribution that the study population being engineers can make to entrepreneurship in an economy is also presented.

2.2 Components of literature review

The literature review is divided into **five** main components namely, *definition of entrepreneurship, entrepreneurship as a behavioural phenomenon, entrepreneurial Intention, knowledge workers, engineers as entrepreneurs*.

2.2.1 Entrepreneurship Defined

Schumpeter (1934) cited in Aloulou and Fayolle (2005) highlighted that **entrepreneurship** is about *combining resources in new ways* (such as the introduction of new products with higher quality, with new methods of production, breakthroughs in new market, conquests of new sources of supply of raw materials and reorganisation of a new sector) *that disrupts the market equilibrium in economic systems.*

Entrepreneurship has been defined as the *ability to channel creative innovations into ventures that have value as well as ability to create and sell new idea and building new businesses* (Wood *et al*, 2004). Complementary to the above definition, Madsen (2007) citing Churchill (1992) and Shane and Venkataraman (2001) presents that entrepreneurship is about *searching for opportunities and/or processes that uncover and develop opportunities.*

Drucker (1999) cited in Esbach (2009) claims that despite the huge interest in the subject of entrepreneurship since its inception, a definition of entrepreneurship is hard to pin down because of the different descriptions used by a multitude of authors. Whatever the definition of entrepreneurship is adopted by various authors, the current author agrees with the essence that entrepreneurship is about wealth creation as advocated by Ireland, Hill, Camp & Sexton (2001) cited in Wang (2008).

The following section presents research findings that support a view that entrepreneurship is a behavioural phenomenon which thrives under specific environmental conditions.

2.2.2 Entrepreneurship as a Behavioural Phenomenon

Baron (2007) suggests that entrepreneurs engage in generating ideas for new ideas and products, recognising business opportunities related to the new ideas and products and obtaining the resources needed for developing these ideas through to the launch of the products. The author also identifies entrepreneurs as

an essential part of the process through which new ventures are created and states that it is reasonable to suggest that at least some aspects of their behaviour and cognition play an important role in the entrepreneurial process.

Fulford and Rizzo (2009) suggest that entrepreneurship is a behavioural phenomenon. The above supports Baron and Ward (2004)'s findings cited in Pownall and Lawson (2005) that entrepreneurs, when compared with non-entrepreneurs, have behavioural difference as a result of cognitive differences resulting from factors they interact with the in environment.

Baron (2007) additionally clarifies that entrepreneurship researchers should only focus on entrepreneurs' behaviour and cognitive variables and/or processes that are closely related to the conception, launch, development and operation of new ventures. Baron (2007) advocates EO represents how the entrepreneur behaves and thinks towards entrepreneurship.

On the same note Domke-Damonte *et al* (2008), claims that entrepreneurial activity of one's own society shapes the future pursuit of the activity by individuals within that society. The above is supported by Begley and Tan (2001) cited in Pownall and Lawson (2005) who have identified that the perception of a cultural level connection between innovation and successful entrepreneurship, may actually dampen an individual's desire to start a business, when it is not supported or evidenced by those who are in a position to question the desirability of becoming an entrepreneur.

Additionally, Pownall and Lawson (2005) advocated that the availability of successful entrepreneurial role models within the environment of a region in which

the individuals are part of will contribute positively towards successful entrepreneurial decision making.

Amongst many other additional factors, Domke-Damonte *et al* (2008) state that the social setting as a whole, such as community, government agencies, financial resources, and family issues form part of the integral national culture which is a contributing factor towards individuals EO. The above theory built the foundation of understanding Litan and Song (2008) who concluded that it is important for entrepreneurs in different parts of the world to shape their entrepreneurial activities to adapt to amongst many factors laws, cultures and forces that drive entrepreneurial success in their context.

Krauss, Frese, Friedrich and Unger (2005) suggest that the EO behaviour pattern is expected to be found to be common in entrepreneurs. Additionally Pownall and Lawson (2005) confirm that the EO of an individual can be understood to result from a mix of personal and situational factors. Furthermore, Fulford and Rizzo (2009) citing Aloulou and Fayolle (2005) state that EO is a form of strategic orientation in which entrepreneurship becomes the dominant logic.

Grant and Bush (1995) cited in Domke-Damonte, Faulstich, and Woodsen III (2008), have argued that although EO has been studied on the organisational level, it should be viewed as a psychological disposition of individuals to act within an organisational level and just viewed as a strategic orientation of managers. This view is supported by Aloulou and Fayolle (2005) cited in Fulford and Rizzo (2009) who acknowledge that firms take on the individual entrepreneurs' perspective and

enact its entrepreneurial behaviour according to how the owner/manager reasons and acts.

Domke-Damonte *et al* (2008) additionally advocate that individuals enter organisations possessing a specific EO and they suggest citing Baumeister and Muraven (1996) that generational effects would have conditioned the individuals to perceive the social environment around them in ways that either encourage or discourage innovation and risk taking behaviour. The implication of the above is that EO research done on organisational level may be used to understand EO on an individual level.

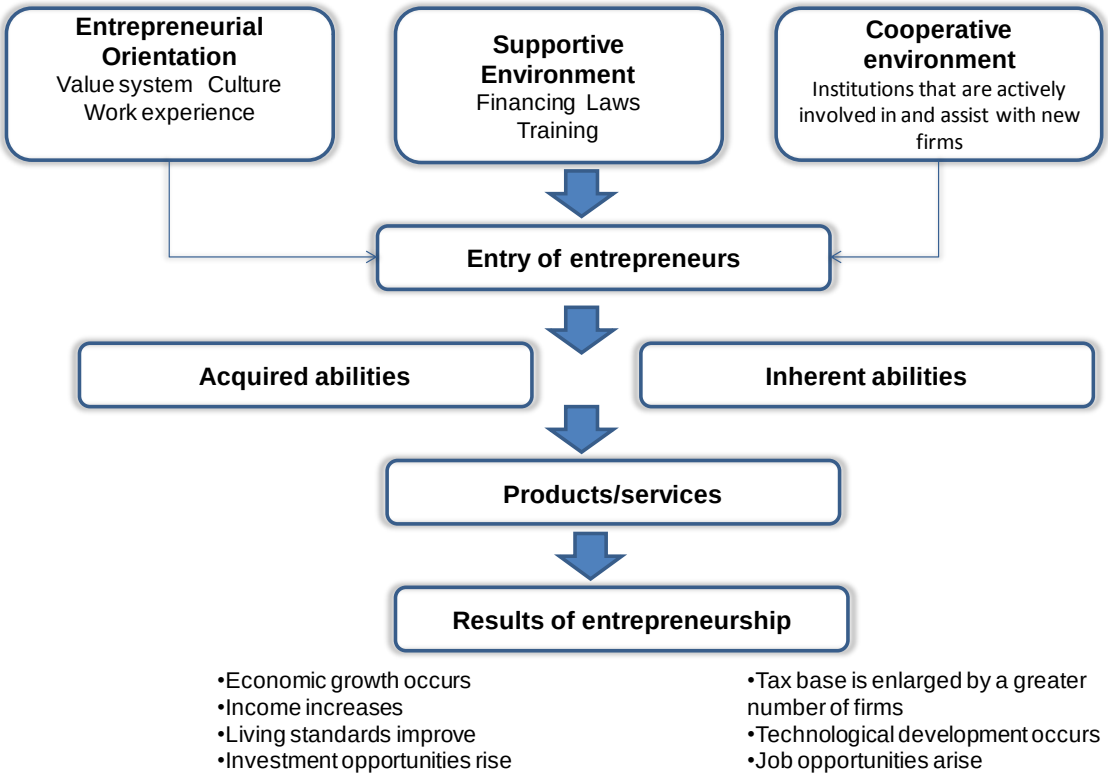
The strong flavour of entrepreneurship as a behaviour influenced and shaped by environmental factors further support the idea of conducting the research within this specific environment called South Africa. Additionally, it has become apparent that EO represents the behavioural traits that are necessary to understand entrepreneurial activity amongst individuals and the lack thereof on another group. It is in this light that this research is mainly *focused on comparing the EO of engineers who are entrepreneurs and those who are non-entrepreneurs within the South African context.*

The following section applies a model to highlight external or country's environment variables that either contributes to the promotion or hindrance of entrepreneurship within a country. The model captures the essence of what was discussed in this section and links it to objectives of this research.

2.2.3 Behavioural Entrepreneurship Context

Norman and Nieuwenhuizen (2009) in their model of entrepreneurship development, as shown on *Figure 1* below, have captured the essence of the research findings presented in the previous section and have highlighted that for entrepreneurship (which is a behavioural phenomenon) to occur and thrive with a national economy various external variables (situational factors) that contribute to a conducive entrepreneurial orientation, supportive and cooperative environment are to be present.

Figure 1: A model for entrepreneurship development (Nieman & Nieuwenhuizen, 2009)



Supportive environment refers to, amongst many factors, such as business development, mentoring, funding and mentoring which are offered by government agencies (Norman & Nieuwenhuizen, 2009). The**cooperative environment** refers to institutions actively involved in promoting entrepreneurship such as financial and academic institutions (Norman & Nieuwenhuizen, 2009). Entrepreneurial orientation is shaped by social factors such as culture, work experience, education, role models and personal orientation amongst many other factors (Norman & Nieuwenhuizen, 2009).

Personal orientation includes factors such as innovativeness, autonomy, risk taking, proactiveness and competitiveness aggressiveness. According to Norman and Nieuwenhuizen (2009) an EO includes elements of personal orientations stated above whereas in academic research cited in this document **EO** is what Nieman and Nieuwenhuizen (2009) termed **personal orientations**.

Although Nieman and Nieuwnehuizen's (2009) model of entrepreneurship development is used to guide this research in terms of understanding the key *situational factors (external variables)* that explain the entrepreneurial behaviour of engineers in South Africa, it should be noted that the academic research definition of *entrepreneurial orientation* is adopted which is a synonym of *personal orientation* as advocated by Nieman and Nieuwnehuizen (2009).

In line with the objectives of this research the *main* focus of this research will be the EO of engineers which is only limited to personal orientation in terms of the model discussed above. The *secondary* objective of this research includes understanding the situational factors that contribute toward an entrepreneurial

environment that is either conducive or hinders entrepreneurship. The remainder of the key elements included in the model of entrepreneurship development were studied to enable the achievement of the secondary objectives of this research which is to understand situational factors that promote or hinder entrepreneurship in South Africa amongst the chosen population group.

The following section discusses EO as a construct.

2.2.4 Entrepreneurial Orientation (EO)

Lumpkin and Dess (1996) cited in Wang (2008) define **Entrepreneurial Orientation** (EO) as the processes, practices and decision making activities that lead to new entry. Lumpkin and Dess (1996) cited in Domke-Damonte *et al* (2008) suggest that EO involves the intentions and actions of key players functioning in a dynamic process with the aim of creating new ventures. This is supported by Rauch *et al* (2009) as they advocate that EO represents the policies and practices that provide a basis for entrepreneurship.

Rauch *et al* (2009) have stated that EO has its roots in the strategy-making process literature. It is viewed by these authors as the entrepreneurial strategy-making processes that key decision makes use to enact their firm's organisational purpose, sustain its vision and create a competitive advantage.

Domke-Damonte *et al* (2008) cited Grant & Bush (1995) and West by saying that EO provides an insight into the predispositions that an individual may carry with

him or her into a business setting. Additionally, these authors citing Lumpkin and Dess (1996) stated that EO provides an indicator of the requisite behavioural initiatives that are conducive to new venture development.

Miller (1983) cited in Li, Zhao, Tan and Liu (2008) originally characterised EO by three dimensions namely **innovativeness**, **risk taking** and **proactiveness.** Morris and Paul (1987) cited in Li *et al* (2008) are amongst the authors who support the three dimensions of EO as a construct. Lumpkin and Dess (1996), Tan (1996) and Miller (1983) have associated these dimensions with the promotion of technological innovation and performance within firms. Lumpkin and Dess (1996) cited in Rauch *et al* (2009) suggested that *two* additional dimensions, namely *competitive aggressiveness* and *autonomy* be added to the EO construct.

Citing Miller (1983) and Lumpkin and Dess (1996), Domke-Damonte (2008) have summed-up all these previous research and adopted that EO is characterised by five dimensions namely the propensity to act autonomously **(autonomy),** a willingness to innovate **(innovativeness)** and take risks **(risk taking),** and a tendency to be aggressive towards competitors **(competitive aggressiveness)** and proactive **(proactiveness)** relative to market opportunities.

In conclusion, the current author agrees with Miller (1983), Slater and Narver (1995) cited in Zhou *et al* (2005) that EO is the key for initiating innovative activities hence it is a major construct to study in Entrepreneurship. The research as alluded to earlier, is focused on *studying and comparing EO of entrepreneurial and non-entrepreneurial engineers.*

The following section presents an academic debate that argues whether or not the five dimensions of EO make up a **uni- or multi- dimensional EO construct.**

2.2.5 EO - One-dimensional or Multi-dimensional

Different conceptual arguments exit in terms of whether EO is a *uni-dimensional* or *multi-dimensional* construct. The literature review has revealed that authors view EO as uni- or multidimensional construct relative to their research construct.

According to Miller (1983) cited in Lumpkin, Wales and Ensley (2006), the original three dimensions of EO namely *risk taking, innovativeness and proactiveness* are complementary and together they constitute a basic *uni-dimensional* construct. Citing Covin *et al* (2004) and Lee *et al* (2001), Naman and Slevin (1993), Walter *et al* (2006) and Wiklund and Shepherd (2003), Ruach *et al* (2009) have presented that most studies combined and treated the dimensions of EO as a uni-dimensional construct. Fulford and Rizzo (2009) have supported the view that EO is uni-dimensional construct.

Rauch *et al* (2009) citing Covin *et al* (2006) and Lumpkin and Dess (1996), have argued that dimensions of EO may occur in different combinations, each representing a different and independent aspect of the multi-dimensional concept of EO.Frishammar and Horte (2007) in their study of the role of Market Orientation (MO) and EO for new product development performance in manufacturing firms found that innovativeness the dimension of EO was strongly correlated with new

product development performance compared to proactiveness and risk taking which showed lack of association.

As a result of this finding, Frishammar and Horte (2007) concluded that this result supports the view that the EO dimensions are multi-dimensional rather than a uni-dimensional single strategic posture. In this study the three EO dimensions, namely *risk taking, innovativeness and proactiveness* did not contribute equally to high or low new product development performance.

Furthermore Marino, Strandholm, Steensma and Weaver (2002) cited in Lumpkin *et al* (2006), have found evidence to support that EO is multi-dimensional as they found low correlations amongst the three dimensions within an international sampling of firms.

As a result, Lumpkin *et al* (2006) have suggested that a firm may be considered entrepreneurial without necessarily scoring high in all three dimensions. Furthermore West III *et al* (2008) citing Lumpkin and Dess (1996) said that in addition to EO being multi-dimensional construct, the dimensions are context based and impact varies across different experiences.

As both schools of thoughts about whether EO is a uni-dimensional or multi-dimensional construct present a convincing argument in their context, the author of this paper intends to test both arguments in the current study to assess the validity of these findings within the study context.

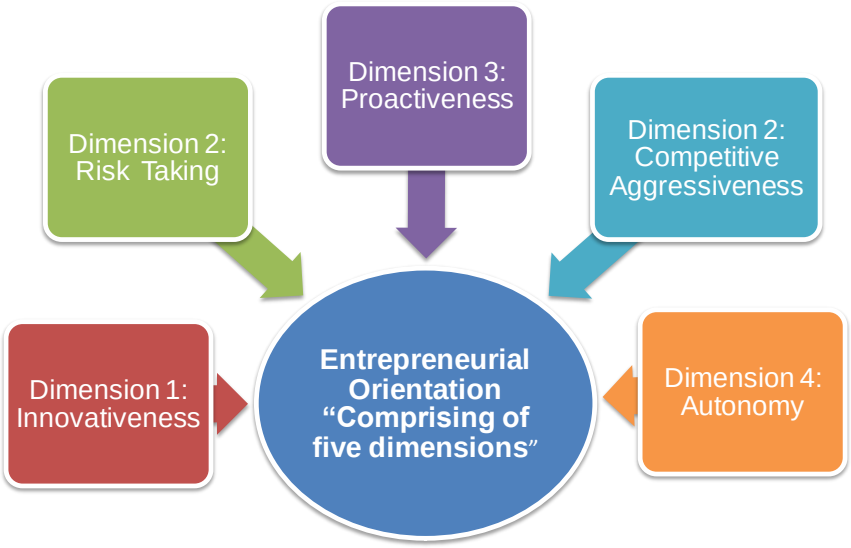
The following sections explain what each of the dimensions mean in relation to the behaviour of an entrepreneur, conversely about the non-entrepreneurs as well.

2.2.6 Dimensions of EO

2.2.6.1 Introduction

The five dimensions namely, r*isk-taking, innovativeness, proactiveness, autonomy and competitive aggressiveness* identified in the previous section and depicted in *Figure 2* below are adopted for this study. This section presents past research in relation to these dimensions and builds the foundation of research propositions which are stated in Chapter 3.

Figure 2: Picture depicting five dimension of entrepreneurial orientation



According to Pownall and Lawson (2005), it is expected that entrepreneurs, when compared to non-entrepreneurs, have behavioural differences due to their cognitive differences. In view of this finding it is expected that on all EO dimensions, entrepreneurs will be different from their non-entrepreneurial counterparts. Additionally Krauss *et al* (2005) suggested that the EO behaviour

pattern is expected to be common in entrepreneurs and it will be higher in entrepreneurs than in non-entrepreneurs.

2.2.6.2 Innovativeness Orientation

Innovative orientation refers to a positive mind-set towards identifying new ideas (Krauss *et al*, 2005). Based on Miller's (1983) conceptualisation cited in Rauch *et al* (2009), **innovativeness** is the predisposition to engage in creativity and experimentation through the introduction of new products/services as well as technological leadership via R&D in new processes.

Frishammar and Horte (2007) stated that innovativeness resembles a culture, climate or orientation rather than an outcome. Additionally Frishammar and Horte (2007) citing Lumpkin and Dess (1996) present that innovativeness occurs along a continuum, for example: from trying a new product line or experimenting with new products, to trying to master the latest technologies.

Innovativeness refers to a willingness to support creativity and experimentation in new product development and technology adoption (Baker & Sinkula, 2009).Hamel (2007) advocates that for businesses to maintain competitive advantage and stay ahead of competition, it is imperative for business to continuously adapt to the changing environment and market needs by generating innovative solutions continuously.

Research cited above supports the view that an entrepreneur ought to have a higher degree of innovation orientation when compared to that of a non-

entrepreneur, as innovation is integral part of entrepreneurial venture creation (Wood *et al*, 2004).

2.2.6.3 Risk Taking Orientation

Based on Miller's (1983) conceptualisation cited in Rauch *et al* (2009), risk taking involves taking bold actions by venturing into the unknown, borrowing heavily and or committing significant resources to ventures in uncertain environments. Additionally, citing Miller and Friesen (1978), Madsen (2007) state that risk-taking is associated with a willingness to commit large amounts of resources to projects where the cost of failure may be high.

In view of the above it is interpreted that an entrepreneur will need to take a certain level of risk being it personal or financial in anticipation of future rewards. In view of this theory, it is expected that engineers who are entrepreneurs would be more risk takers than those who are non-entrepreneurs.

2.2.6.4 Proactiveness Orientation

Proactiveness Orientation refers to a personal initiative to shape environmental conditions and this has been shown to be related to entrepreneurial success in Uganda (Krauss *et al*, 2005)**.** Based on Miller's (1983) conceptualisation cited in Rauch *et al* (2009), proactiveness refers to an opportunity-seeking, forward looking perspective characterised by the introduction of new products and services ahead of competition and acting in anticipation of the future. Additionally

Frishammar and Horte (2007) citing Lumpkin and Dess (1996) suggested that a proactive firm is a leader rather than a follower, since it has the will and foresight to seize new opportunities. On this basis it is assumed that engineers who are self-employed display a higher level of proactiveness than their counterparts in employment

2.2.6.5 Competitive Aggressiveness Orientation

Competitive aggressiveness refers to the desire of business owners to assert themselves, enjoying competition and striving for victory (Krauss *et al*, 2005). Rauch *et al* (2009) describe competitive aggressiveness as the intensity of a firm's effort to outperform rivals and is characterised by a strong offensive posture or aggressive responses to competitive threats.

It is common knowledge that industry rivalry exists between competitors and therefore for a business owner to succeed, a competitive aggressiveness is necessary particularly in a highly competitive industry**.** Based on theory, it is inferred that engineers who are self-employed would display a greater competitive aggressiveness to their counterparts in formal employment.

2.2.6.6 Autonomy Orientation

Autonomy Orientation has been defined by Lumpkin, Cogliser and Schneider (2009) as a driving force of entrepreneurial value creation as it is the independent spirit and freedom of action necessary to advance a new venture development.

Furthermore, autonomy refers to actions undertaken by individuals or teams intended to establish a new business concept, idea or vision (Aloulou and Fayolle, 2005). Utsch *et al* (1999) cited in Krauss *et al* (2005) have found higher autonomy orientation in business owners than in managers. Additionally Rauch *et al* (2009) describe autonomy as an independent action undertaken by entrepreneurial leader or teams directed at bringing about a new venture and seeing it to fruition. Based on this it is inferred that engineers who are entrepreneurs would have high autonomy orientation than their non-entrepreneur counterparts.

2.2.6.7 Overall Five Dimension EO Construct

Confirmatory factor analyses supported the idea of a one-factor EO construct that consists of autonomy orientation, competitive aggressiveness (in South Africa and the formal sector), innovative, and risk-taking orientation (Krauss *et al*, 2005). This is in support of all the authors who were quoted saying that EO is a uni-dimensional construct. Contrary to a uni-dimensional construct research, EO studies have also supported the idea that EO is a multi-dimensional construct (Lumpkin and Dess, 2001; Covin et al, 2006; Rauch *et al*, 2009). As part of this study, the possibility of EO being a uni-dimensional or multi-dimensional construct is tested within this context.

2.2.6.8 Conclusion

The overall idea presented in this section is summed up by Krauss *et al* (2005) who suggested that EO the behaviour pattern is expected to be common in entrepreneurs and it will be higher in entrepreneurs than in non-entrepreneurs.

Additionally, Pownall and Lawson (2005) is that an individual should have the necessary EO before developing an entrepreneurial intention to be an entrepreneur. In view of the above, the following section about entrepreneurial intention (EI) is introduced.

In view of the above, the following section explores the intention of engineers to be entrepreneurs relating it to the presence of an ideal EO necessary to enter entrepreneurship.

2.3 Entrepreneurial Intention (EI)

Domke-Damonte *et al* (2008) citing Bird (1988) stated that entrepreneurial intention is the precursor to entrepreneurial activity as entrepreneurial interest must exist before a business can be started. Additionally, Pownall and Lawson (2005) argued that individuals will become entrepreneurial should they recognise both the desirability and feasibility of a new venture creation or development. In view of the above findings and in relation to this study, the author therefore infers that engineers with a high EO may not enter entrepreneurship unless there is an entrepreneurial intention to do so.

Pownall and Lawson (2005) citing Kruger *et al* (2000) advocated that EO is a mix of both *situational* and *individual* factors. Pownall and Lawson (2005) citing Baron and Ward (2004) stated that Entrepreneurial Intention (EI) is developed from cognitive viewpoints.

Pownall and Lawson (2005) also cited Baron and Ward (2004) by stating that that the relevance of cognitive science to the study of entrepreneurship, has suggested that entrepreneurs (when compared to non-entrepreneurs) may possess differences in terms of their knowledge (the sum of what they know), how they interact with their environment (what is recognised as valid information source and which may constitute a previously unidentified opportunity) and their likely greater use of heuristics as satisfying decision making mechanisms.

Furthermore Pownall and Lawson (2005) supported the views tabled above by stating that there is a clear relationship between cognition of desirability and feasibility of a venture and the environment within which the individual is active.

In the context of this research, the research findings tabled above suggest that engineers with different cognitive viewpoints will act differently towards an opportunity that manifests itself to both individuals in the same way. Additionally the cognitive viewpoints that enable one engineer to enter entrepreneurship and the other not to can be attributed to situational factors. This finding is in line with the findings of the previous section that identified EO as a situational factor as it is influenced by the environment in which the individual is active.

Throughout the literature covered so far, it has emerged that EO is context specific and it is shaped by situational factors prevailing in a specific country's environment.

The following section seeks to highlight the specific factors that will be included in this study in fulfilment of the secondary objectives of this research.

2.4 Situational Factors

As alluded to in the previous sections, *situational factors* refer to elements of culture, work experience, education, environment created by institutions and government agencies that contribute towards the promotion and hindrance of entrepreneurship within a national economy. Situational factors have been described throughout literature review hence this section only highlights the situational factors that will be covered in this study in order to achieve the secondary objectives of the study.

2.4.1 Supportive Government Situational Factors

Supportive environment refers to amongst many entrepreneurship motivating factors such business development, mentoring, and funding which are offered by government agencies (Norman & Nieuwenhuizen, 2009).

Wiklund and Shepherd (2005) cited in Tang, Tand, Zhang and Li (2007) have found that institutional environment such as government can be enabling or a stumbling block to entrepreneurship. Additionally, Davidsson and Honig (2003) cited in Domke-Damonte *et al* (2008), have found that **social capital** is important to successful start-up. Furthermore, Domke-Damonte *et al* (2008) citing Peterson advocate that the social setting as a whole - such as community, government

agencies, financial resources, and family issues -form part of the integral national culture which is a contributing factor towards the individual's likelihood of entering entrepreneurship.

The implication of the above cited academic research is that a government that does not contribute towards shaping an environment that is conducive for entrepreneurship will record less creation of entrepreneurial ventures compared to if they contributed. In appreciation of the above, Litan and Song (2008) concluded that entrepreneurs within different economies shape their entrepreneurial activities in response to amongst many factors laws and cultures that drive entrepreneurial success in their context.

2.4.2 Cooperative Government Situational Factors

Cooporative environment refers to institutions actively involved in promoting entrepreneurship such as financial and academic institutions (Norman & Nieuwenhuizen, 2009). Domke-Damonte *et al* (2008) has advocated that it is the entire country's elements of community, including institutions within it, which can contribute positively towards entrepreneurship; for example; in terms of providing the financial resources and relevant education.

2.4.3 Entrepreneurial Orientation Situational Factors

Entrepreneurial orientation is shaped by social factors such as culture, work experience, education, networks and role models (Norman & Nieuwenhuizen, 2009).

Aldrich and Martinez (2001) cited in Domke-Damonte *et al* (2008), have found that suitable networks is one of the situational factors that enable business start-ups. Additionally, Wagner and Sternberg (2004) cited in Domke-Damonte *et al* (2008), have found that role models are important for a successful start-up. Furthermore, the authors' research found evidence that students who have parents who are entrepreneurs will have a higher EO compared to students whose parents are not entrepreneurs.

West III *et al* (2008) found evidence that knowledge which is acquired through education and working experience amongst other sources is an important resource that is required for gestating entrepreneurship.

Lastly, in view of Baron and Ward's (2004) findings that entrepreneurs may possess a difference in terms of the knowledge when compared to their non-entrepreneurial counterparts, the following section seeks to advance Baron and Ward's (2004) findings that knowledge is a key contributor to identification of entrepreneurial opportunities; particularly the engineering knowledge that is possessed by this research's population group namely engineers.

2.5 Knowledge Worker

In order to bring context about the importance of knowledge workers in entrepreneurship, the definition of entrepreneurship is re-visited and based on findings that are presented to advance the understanding that knowledge about identifying opportunities in a specific market is of key importance.

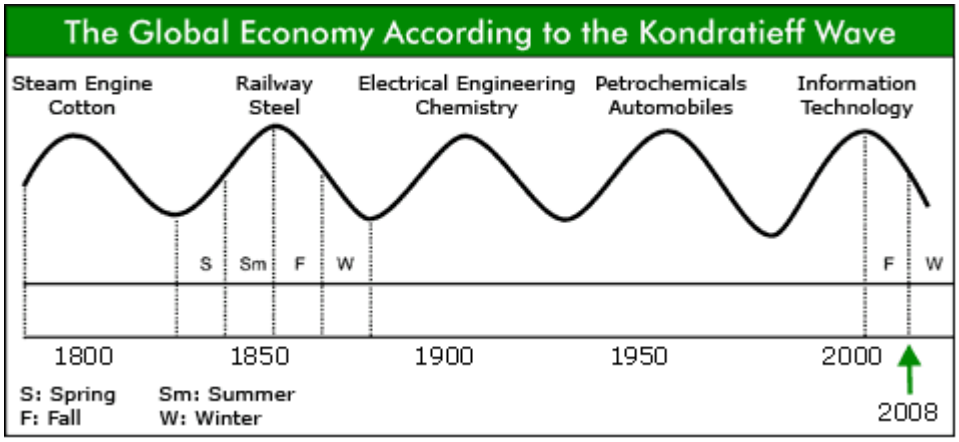
As alluded to earlier in the report, entrepreneurship has been defined as the ability to channel creative innovations into ventures that have value as well as ability to create and sell new idea and building new businesses (Wood *et al*, 2004). Building on the above, Baron (2007), and Aloulou and Fayolle (2005) have suggested that part of entrepreneurs' activities include identifying the resources necessary to develop ideas to launch new products and services.

Reviewing the study by West *et al* (2008) citing Green and Brown (1997) has led to an understanding that based on resource-based theory, five resources namely human, social, physical, organisational and financial, need to be acquired to enable entrepreneurship. Knowledge or intellectual property components of the five resources have been identified as the most critical for new entrepreneurial ventures (West III, 2008).

Carlaw, Oxley and Walker (2006) have argued that the world population has become a knowledge society or economy that requires the use of knowledge to advance innovation. In a knowledge society, a **knowledge worker** defined as someone who has both a formal education and practical experience uses knowledge as a base required to compete and innovate (Carlaw *et al*, 2006).

Dutiro (2009) citing Drucker (1985) stated that innovation is a tool that entrepreneurs utilise to exploit shifts in the economy. Additionally, Dutiro (2009) citing Drucker (1985) stated that entrepreneurial innovations are instrumental to the birth of a Kondratieff spring, which denotes a period of economic growth. Drucker's (1985) view was supported by Draper (2009) cited in Dutiro (2009) who asserted that through innovations, entrepreneurs and technologists can course an economic recovery. *Figure 3* below presents the **Kondratieff** wave, showing alternating periods of low and high growth which last for between 40 and 60 years (Wall Street Survivor University, 2010).

Figure 3: Kondratieff Wave (Source - Wall Street Survivor University, 2010)



These findings discussed above further advance the importance of knowledge workers in the light of Carlaw *et al's* (2006) assertion that this era represents a knowledge economy where entrepreneurs compete and innovate on the basis of knowledge.

Carlaw *et al* (2006) further concluded that the economic growth is fuelled by technological change in which individual pieces of technological knowledge are complimentary with other pieces of technological knowledge as these pieces of knowledge are recombined to form innovative ideas that fuels the knowledge economy. Simpler phrased, Carlaw *et al* (2006) suggested that different technologies required in the current economy can emerge from the combination of different aspects of technical knowledge. They further argued that economic growth driven by a technological change is more sustainable as the combination of new and existing knowledge is unlimited.

In addition to the above findings, West III *et al* (2008) found evidence that the knowledge is an important resource that is required for gestating entrepreneurship. On the same note, West III *et al* however also found evidence that the knowledge resource is only effective in a presence of an entrepreneurial orientation. This finding provides clarity that engineers, although they may have the same academic qualification and applied knowledge, will not all become entrepreneurs because of a lack of entrepreneurial orientation.

In view of the above, it is apparent that entrepreneurs who will be successful should possess knowledge or intellectual property that enables opportunity recognition and exploitation in a specific environment and should be in possession of a high EO and EI.

The above is supported by West *et al* (2008) citing Malecki (1997), Wiklund and Shepherd (2003) who suggested that knowledge resources are complex and encompass the **"know-how"** and the **"know-what"** related to a specific skill

suitable to identify opportunities within a specific market. Put Differently, these authors citing Wright, Robbie and Ennew (1997) state that this know-how and know-what is in relation to markets, innovation capabilities and citing Wright, Robbie and Ennew (1997) stated these are dimensions of starting up new ventures.

Building on the above, West III *et al* (2008) further concluded that technological resources that encompass intellectual property rights have become important to entrepreneurship. These authors reached this conclusion in acknowledgement of Venkataranan's (2004) observation cited in their paper that science-based and technology- based new ventures constitute an important economic development effort. Furthermore, West III *et al* (2008) concluded that knowledge-based resources have been identified as critical to new venture creation.

In view of the findings presented above, the author of this study appreciates that having a specific knowledge or skill can form a cognitive foundation necessary to recognize opportunities related to the specific knowledge. On the same note, it can be inferred that engineers may be more inclined to recognising opportunities in the engineering space compared to non-engineers; hence it may be justified to study industry specific entrepreneurship

These research findings discussed in this section have created the motivation to conduct entrepreneurial research focusing on specific types of knowledge workers which are engineers in the case of this research. Engineers by virtue of requiring both academic qualifications and working experience to make economic contributions fit a definition of a knowledge worker.

2.6 Engineers as Entrepreneurs

With reference to the previous section, engineers form part of the knowledge economy by virtue of having been formally educated and possessing specific experience in their application of engineering knowledge. Additionally, as appreciated in the previous section, innovation in the knowledge economy is driven by the combination and recombination of existing and new knowledge.

It is with this appreciation in mind that engineers with the correct EO have the capability to utilise their current technical knowledge to contribute to the innovation space and hence advance economic growth through entrepreneurship. This is in alignment with Zhou *et al's* (2005) theory that EO highlights the spirit of creating new business out of on-going practices.

The idea that engineers have the unique capability to contribute to economic growth through entrepreneurship is further fuelled by Baron's (2007) findings that certain people recognize opportunities that others may not be able to due to better access to information associated with factors such as being in that particular market. This finding does not necessary state that non-engineering individuals will not realize engineering opportunities, it just brings the idea that engineers may have the higher probability of grasping engineering opportunities as they better understand the market, the customers and the gap created by the current market offering.

Engineers' contributing to an economic growth is not a new concept as Lacquet (2004) cited in Esbach (2009) claims that engineering has over time underpinned and continues to underpin economies around the world. Esbach (2009) further asserts that although that technological age has introduced rapid changes that meet customer demands, this change continues to be integrative and iterative presenting engineering as a static element of economic structure.

Coetzer (2006) cited in Esbach (2009), suggested that engineering entrepreneurship could help in creating the engine that drives the economy of South Africa. Additionally Esbach (2009) stated in his paper that engineers with their innovation channelling skills create products and processes that people use. On the same note, Magnanti (2005) cited in Esbach (2009) concludes that together the combination of management and engineering provide an ideal underpinning for technology innovation and entrepreneurship.

It is with the above assertion that this specific group of the population namely engineers has become the unit of analysis for this research. These individuals with the correct EO dimensions advocated by the many authors referenced and the knowledge base and innovation channelling skills as referred to by Esbach (2009) they possess, have the potential of continuing to make a significant contribution to the economic growth through entrepreneurship.

This is further supported by Wu, Chang, and Chen (2008) in advocating that EO can enhance the relationship between knowledge-based resources and firm performance, as innovation involves the combination of assets and EO may

facilitate the ability to discern and combine appropriate resources to enable innovation.

2.7 Conclusion

The literature review highlighted that within entrepreneurship there is a positive relationship between entrepreneurship and economic growth. The individual entrepreneur was identified as key to the process of creating new entrepreneurial ventures and possess specific behaviour pattern which is termed an EO. Entrepreneurship was said to be a behavioural phenomenon that thrives under specific environment. The entire society inclusive of government, institutions and social networks are the variables that shapes the specific environment as it creates a culture in which entrepreneurship thrives or not.

Entrepreneurs are expected to have a higher EO than their non-entrepreneurial counterparts. It was also highlighted that individuals who have a high EO are most likely to develop an intention to enter entrepreneurship which is termed entrepreneurial intention. The positive contribution made by knowledge workers such as engineers in the economy were acknowledged on the backdrop of research that suggests that now is a knowledge era where entrepreneurs compete and innovate on the basis of knowledge.

The following section presents the research propositions which were built on the backdrop of the literature review presented in this section.

CHAPTER 3: RESEARCH PROPOSITIONS

3.1 Introduction

The main objective of this research is to study the EO of engineers in South Africa. The previous section has highlighted that EO has five dimensions, namely innovativeness, risk taking, proactiveness, competitive aggressiveness and autonomy. The EO of entrepreneurial and non-entrepreneurial engineers is to be compared. On the basis of literature presented in Chapter 2, it is expected that the EO of entrepreneurial engineers on all five dimensions will be higher than non-entrepreneurial engineers on all five dimensions.

In line with literature, propositions were developed to enable the comparison of scores between the two groups of engineers. Propositions are defined as statements concerned with the relationships amongst concepts (Zikmund, 2003). In view of the literature that suggests a specific well understood relationship between EO of non-entrepreneurs and that of entrepreneurs, the use of research propositions is appropriate for this study (Zikmund, 2003).

The secondary and complementary objectives were to understand the situational factors that have shaped EO of engineers in South Africa. No propositions were developed for the situational factors as they are used to understand the context in which the two groups of engineers are engaged. On an exploratory basis, the

situational factors provide insights into factors attributable to a specific EO make-up of the groups.

3.2 Research Proposition 1

Engineers who are entrepreneurs will measure significantly higher innovative orientation score than the non-entrepreneurial engineers.

3.3 Research Proposition 2

Engineers who are entrepreneurs will measure significantly higher risk-taking orientation score than non-entrepreneurial engineers.

3.4 Research Proposition 3

Engineers who are entrepreneurs will measure significantly higher proactiveness orientation score than non-entrepreneurial engineers.

3.5 Research Proposition 4

Engineers who are entrepreneurs will measure significantly competitive aggressiveness orientation score than their non-entrepreneurial engineers.

3.6 Research Proposition 5

Engineers who are entrepreneurs will measure significantly higher autonomy orientation score than the non-entrepreneurial engineers.

3.7 Research Proposition 6

The seven dimensions of entrepreneurial orientation combine to make a uni-dimensional construct.

3.8 Research Proposition 7

The uni-dimensional EO construct of engineers who are entrepreneurs will measure significantly higher than those of non-entrepreneurial engineers.

3.9 Research Proposition 8

The EO construct is multi-dimensional with the each dimension not interrelated with one another.

3.10 Conclusion

The propositions above will form the basis of statistical testing to reveal whether or not the two groups of engineers are statistically different in terms of their EO. As alluded to above, based on literature, it is expected that these groups will have statistically significantly different EO scores. EO of entrepreneurial engineers is expected to be statistically significantly higher than that of non-entrepreneurial engineers.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

The main objective of the research was to study the EO of two groups of engineers namely the entrepreneurial and the non-entrepreneurial engineering. The secondary objective was to understand the situational factors that promote or hinder entrepreneurship in SA and to establish the entrepreneurial intention of this group of engineers.

The methodology provides details about how the actual research process was carried out and what the limitations were. This section also provides the rationale for having chosen a specific type of research methodology considering that methodologies are appropriate for specific kinds of studies and not for all types of study (Zikmund, 2003).

The research methodology chapter is divided into eight main components namely, proposed research design, defence of research design, research method, population and unit of analysis, size and nature of sample, measuring instrument design, data collection, and data analysis.

4.2 Research Design

A descriptive quantitative research was carried out to characterise the entrepreneurial orientation of engineers within South Africa and situational factors

that hindered or promoted entrepreneurial entry within both groups of engineers. Additionally, the establishment of general interest in entering entrepreneurship by non-entrepreneurial engineers was carried out.

4.3 Defence of Research Design

Zikmund (2003) advocates that a descriptive study is designed to describe the characteristics of a population or a phenomenon. Engineers were classified as either entrepreneurial or non-entrepreneurial. Various descriptive statistics such as sample means, standard deviations and frequency distributions amongst others were utilised to describe the characteristics of the two engineers groups. In view of the objectives of the research and Zikmund's (2003) assertion about the descriptive study method, the choice of a method is deemed appropriate.

Zikmund (2003) also indicates that descriptive studies are to be based on some previous understanding of the nature of the research problem. In this case, with reference to the literature review presented in this document, the research propositions are based on well researched EO dimensions and situational factors are based on well documented findings. In view of the above, a descriptive study method is an appropriate research method for this research.

A quantitative study seeks to determine the quantity or extent of some phenomenon in the form of numbers (Zikmund, 2003). In this case each engineer's scores on each EO dimension, situational factors and demographics were

quantified and described. This also supports the notion that a descriptive quantitative research method was appropriate for the purposes of this research.

4.4 Research Method

There are four research methods for a descriptive research namely surveys, experiments, secondary data studies and observations (Zikumund, 2003). Zikmund (2003) advocates that surveys attempt to describe a characteristic in terms of *"what", "who", "when", "where", "how"* and/or to quantify certain factual information. In view of the above, both EO and situational factors quantify factual information and hence the use of a survey by administering a questionnaire was appropriate to carry out this quantitative descriptive research. The study will be a cross-sectional study as engineers will be sampled around the single period of time.

4.4.1 Population and Unit of Analysis

The **population** is defined as engineers per definition provided in chapter 1. The ***unit of analysis*** is the individual engineer because each individual engineer completed a questionnaire and their individual EO, demographics and situational factors information was measured and analysed.

4.4.2 Size and Nature of Sample

Several engineers' associations such as the Engineering Council of South Africa were requested to distribute the survey to their members. Although this would

introduce self-selection bias to the results as all these engineers' associations are affiliated to on a voluntary basis, it was perceived that members of these associations would have had an equal and known chance of participating in this research and hence could be regarded as a probability sample.

After *four* weeks of data collection, with very few responses particularly from entrepreneurial engineers, it was decided to employ a non-probability sampling technique termed snowball to increase the number of responses particularly from the entrepreneurial engineers. Zikmund (2003) advocates that snowball is an appropriate sampling technique to use to locate members of rare populations. For snowballing, every e-mail request post this decision included a note in bold letters requesting individuals to send the questionnaire to other individuals in their networks. Initial respondents who indicated that they are entrepreneurs were also asked to share the survey request with their networks.

In total **189** responses were received, however, *35* number of responses were deemed unusable as they did not comply with the definition of the population group. A total of **154** responses comprising of **52** entrepreneurial and **102** non-entrepreneurial engineers was deemed usable. *Snowballing* improved the number of responses from 35 (entrepreneurial engineers) and 65 (non-entrepreneurial engineers) to 52 valid (entrepreneurial engineers) and to 102 valid (non-entrepreneurial engineers) responses.

Although the groups comprised of unequal responses, it is noted that each group had responses greater than 30 which is a minimum requirement to perform tests to

test for significant difference such as t-tests (Zikmund,2003). For factor analysis, a rule of thumb is that at least a ratio of 5:1 (responses to variables ratio) is required. In the case of this research there were a total of **18** items or variables on the EO scale and **154** valid responses were received which translates to a responses to variable ratio of 8.5:1 which indicates that the sample was more than adequate to perform factor analysis.

4.5 Instrument Design

4.5.1 Introduction

The measuring instrument is comprised of three sections, namely the demographics, the EO dimensions and situational factors sections. The measuring instrument details are discussed below and the actual instrument is attached hereto as **Annexure B**.

4.5.2 Demographics

Demographic questions were included for the purposes of understanding the nature of the sample. Additionally an inclusion of questions about the qualification of the respondent as well as the academic institution that issued the qualification, the author was able to identify the 35 unusable responses alluded to in the previous section. This section comprised of 11 items.

4.5.3 Entrepreneurial orientation scale

This section provides details on which the EO scale has been adopted for this study. Firstly, the origins of the EO scale and the latest expanded version of the EO scale are reviewed. Secondly, based on past research the validity, reliability and dimensionality of these scales is discussed. In view of the above, the rationale for adopting these scales for this research is presented.

4.5.3.1 Original Three Dimension EO Scale

4.5.3.1.1 Origins

Kreiser, Marino and Weaver (2002) stated that the nine-item EO scale was originally developed by Covin and Slevin (1989) based on the earlier work by Khandwalla (1977) and Miller and Friesen (1982). This scale is commonly used to operationalise EO (Kreiser et al, 2002). The original EO scale was developed to measure three EO dimensions namely risk-taking, innovativeness and proactiveness. The original EO scale comprised nine-items, with three items for each EO dimension.

4.5.3.1.2 Reliability and Validity

Kreiser *et al (*2002) study supported the findings that Covin and Slevin's EO scale is cross-culturally valid. Additionally, Kreiser *et al* (2002) have stated that the original Covin and Slevin EO scale has been utilised and found highly reliable and valid in a variety of research settings.

Furthermore, Knight (1997) cited in Urban (2008) and Richard, Wu and Chadwick (2009) have found the Covin and Slevin EO scale to be highly valid and reliable at cross cultural levels. Lastly, Chadwick, Barnett and Dwyer (2008) further asserted that EO is a valid concept as his study confirmed the psychometric properties of the EO scale particularly the nomological validity.

4.5.3.1.3 Rationale for adopting the scale in this context

In view of the above research that the original Covin and Slevin EO scale has been found to be valid and reliable in various research and cultural settings, the author deemed this scale to be appropriate for this research. The following section discusses two additional EO dimensions which were not part of the original Covin and Slevin scale.

4.5.3.2 Five Dimension EO Scale

4.5.3.2.1 Origins

In addition to the three original EO dimensions, two dimensions namely competitive aggressiveness and autonomy were found to form part of the EO construct by Lumpkin and Dess (2001) and Lumpkin and Dess (1996) respectively (Lumpkin et al, 2009). Furthermore, Lumpkin *et al* (2009) enhanced the original Covin and Slevin scale by adding two items to it. The overall result was a five dimension 18 item EO scale. Lumpkin *et al* (2009) study utilising the five dimension 18 items EO construct scale indicated that the content was adequate to measure the five

dimension EO construct. However it was highlighted, for example, that the autonomy dimension should be included in tests of discriminant and concurrent validity with the other four dimensions in order to refine the measurement tool.

4.5.3.3 Rationale for adopting the 5 dimension scale

The five dimension EO scale incorporating the original EO scale developed by Covin and Slevin (1989) and Lumpkin *et al* (2009) study was adopted for this study. Although, the recent five dimension EO scale has not been as extensively tested for validity and reliability as the original EO scale, Lumpkin *et al* (2009) findings that the five dimension scale is content adequate to measure the EO constructs informed the authors' view to adopt this scale for this study. This scale features 18 items on a 7 point Likert scale and the questionnaire is annexed hereto as **Annexure B**.

4.5.3.4 Dimensionality of EO

As alluded to in the literature review, although EO was originally understood to be a uni-dimensional construct, recent studies have supported that EO is a multi-dimensional construct as the five dimensions can vary independently with one another (Lumpkin *et al*, 2009; Aloulou and Fayolle, 2005). For the purposes of this study, factor analysis tests will be conducted to determine if the 18 item five dimension EO scale forms a uni-dimensional or a multi-dimensional EO construct.

4.5.3.5 Adaptations Made To the Five Dimension EO Scales

The original three dimension Covin and Slevin (1989) EO scale and the five dimension scale developed by Lumpkin and Dess (2009) measure EO on a firm level (Foo & Lee, 2005). The questions were therefore adapted to the individual level as authors such as Foo and Lee (2005) have done so in their individual level EO studies. For example, instead of asking the original question about how a firm would react to specific situations, this study asks how the individual would react to that specific situation.

4.5.4 Situational factors and entrepreneurial intention or inclination

As alluded to in the literature review, individuals within a high EO score may not enter entrepreneurship owing to the lack of entrepreneurial intent (EI) to follow an entrepreneurial career. Additionally the literature review revealed that both EI and EO are situational factors. These situational factors act as catalyst or deterrent to individuals to enter entrepreneurship.

Furthermore, in line with the secondary objectives of this study of creating a context for interpreting and analysing this EO study, a pre-tested structured measuring instrument developed by Popli and Rao (2010) that measures both of these secondary objectives was adopted. The items which were included in Popli and Rao's (2010) questionnaire but not relevant for this study were deleted. Two situational factors sub-section were developed to cater for slight variations between questions targeted at entrepreneurial and non-entrepreneurial engineers.

4.5.5 Data Collection

A self-administered electronic survey in a form of a questionnaire was distributed to the chosen sample. As alluded to in previous sub-section, the questionnaire comprised of three sections namely the demographics, the EO dimensions and the situational factors sections.

In appreciation of Zikmund's (2003) assertion, the questionnaire was coded meaning that each item of the questionnaire was assigned a numerical number for example CD12 (represents code 12) which enabled ease of interpreting, classifying and recording data. The questionnaire is annexed hereto as to **Appendix A.**

The data type collected from the demographics and situational factors' sections was categorical data specifically nominal-level data with mutually exclusive and exhaustive categories such as race. Additionally, metric measurement data specifically ratio-level data such as questions related to age and number of years a person has been in employment was collected.

Metric measurement data was collected from the EO scale as it features a Likert scale which is considered to be an interval-level measurement which forms part of a metric measurement (Blaikie, 2003; Zikmund, 2003).

4.6 Data Analysis

The following describes the data collection process, statistical tests which were performed and the basis presenting and analysing the results.

4.6.1 Pilot Testing

Zikmund (2003) advocates that pre-testing a questionnaire using a sub-sample may determine whether the data collection plan for the study is appropriate or not in terms of length of questions, confusing interview instructions, field errors and etc. Pre-testing is particularly important for self-administered survey like this study because good results are dependent on the clarity of written word rather than on interviewer skills.

Six individuals from the population were requested to complete the questionnaire prior to sending it to the entire sample and all provided their feedback. The pilot feedback mostly entailed slightly changing the sentence grammatical construction to avoid ambiguity and to add situational factors items relating to a wider industry information and staff complement for entrepreneurial engineers.

4.6.2 Data Collection Procedure

An electronic questionnaire was sent out by means email, requesting individual engineers to complete the survey. The survey was self-administered and completed questionnaires were returned via fax and email.

4.6.3 Data Editing Process and Procedure

Completed questionnaires which were received via e-mail were separated - the e-mails and attachments were stored separately to ensure anonymity of the respondents.

Firstly, each response was checked for validity in terms of ascertaining that the respondent forms part of the targeted population group. Invalid responses which amounted to 35 were removed from the sample which was to be further processed. Secondly, all valid responses were checked for item non-response, which refers to an item(s) which were not completed on otherwise almost fully completed questionnaire (Zikmund, 2003). In total, only one missing frequency was reported on the EO scale and the missing frequency was replaced with the mean of the group which is permissible according to Zikmund (2003). On the situation factors' section, the worst was two missing frequencies on two items and these were reported as a non-response on the statistics which is permissible according to Zikmund (2003). None of the completed questionnaires were deemed unsuitable for planned analysis on the basis of item non-response.

Thirdly, responses to open-ended questions were rationalised to capture the essence of the response, for example, respondents used a large variety of synonyms to answer the questions.

Lastly, the responses were summarised onto a single spread sheet using the codes referred to in the data collection section and sent for statistical testing.

4.6.4 Statistical Testing

For the accuracy of results, Blaikie (2003) advocates that it is essential to select a measure of association that is appropriate for the level of measurement of the variables being analysed.For this study five types of statistical testing, namely descriptive statistics, reliability testing, factor analysis, T-tests and chi-square tests

which were performed and identified as appropriate to achieve various study objectives. The tests are described in detail in the following section.

4.6.5 Descriptive Statistics

Discriptive statistics such as determining the means, standard deviations and distributions are key to any quantitative study like this current one and are used to describe the data characteristics (Zikmund, 2003). These statistics are appropriate for categorical and metric measurement data which was collected for this research (Zikmund, 2003).

4.6.6 Results - Reliability Testing

A reliability test was performed to confirm the validity of the 18 item five EO dimensions within the South African context. Reliability refers to the capacity of measure to produce consistent results (Blaikie, 2003). Composite reliability tests assess consistency which the scale will be operationalised by using internal consistency methods (Li, Guo, Liu, & Li, 2008). A measure or a dimension in this context is unreliable if all or at least some of its items are unreliable (Blaikie, 2003).

A **Cronbach's Alpha** is a commonly used statistical tool to measure scale reliability (Blaikie, 2003) and it ranges from between a value of 0 and 1. A Cronbach's Alpha of 0.7 or higher is be considered acceptable (Zikmund, 2003; Li *et al*, 2008; Duygulu, 2008), indicative of the validity of the construct and would suggest that the theoretical constructs exhibit good psychometric properties (Li et

al, 2003) and indicating a high level of consistency amongst the items (Blaikie, 2003). Nunnally (1978) cited in Li, Guo, Liu and Li (2008) advocates that permissible values can be lower than 0.7 but higher than 0.6 in case of newer scale. Considering that the five EO scale utilised for this research contains relatively new two dimensions which were not part of the original three EO scale, the entire five EO dimension scale is considered to be a new scale by the author of this research and the criteria of Cronbach's Alpha of 0.6 set by Nunnally (1978) cited in Li,Guo, Liu and Li (2008)was adopted.

Cronbach's Alpha was determined for the entire EO construct to check for the reliability of the scale in this context. Cronbach's Alpha values of below 0.6 were considered unreliable and considerations for exclusion of a specific item from the relevant EO dimensions were made. Prior to excluding any items from relevant EO dimensions with Cronbach's Alpha value of less than 0.6, the unreliable items were removed and tests were re-run to assess if the Cronbach's Alpha value improved.

The unreliable item was removed from the scale and tests were re-run to establish whether or not the removal of the item resulted in an improved Cronbach's Alpha value for the specific EO dimension. The improvement of Cronbach's Alpha with an unreliable item removed indicates that a particular item is unreliable (Blaikie, 2003). A non-improvement improvement of Cronbach's Alpha value with an unreliable item removed warranted further analysis (Blaikie, 2003).

It should be noted that Cronbach's Alpha values are influenced by the number of items in a scale and even on each EO dimension, the higher the number of items the higher the Cronbach's Alpha value (Blaikie, 2003). The relevance of this

information is that prior to excluding any EO dimension, the number of items that constitutes a specific unreliable dimension was compared to the number of items of other reliable EO dimensions.

4.6.7 Factor Analysis

Factor analysis is an interdependence technique in which a large set of variables is considered simultaneously in terms of their bivariate relationships (Blaikie, 2003). It is used to discover the underlying patterns or relationships in a large number of variables and can be used to determine which items ought to be removed from the scale should they be considered unreliable (Blaikie, 2003).

Factor analysis can establish whether a common factor is presented meaning that all items are highly correlated and can be regarded as making up a common factor on a single scale (Blaikie, 2003). In the case of this research, factor analysis was used to detect the relationship between variables to establish if the 18 item five dimensions EO construct is uni- or multi-dimensional.

Firstly, factor analysis is an appropriate tool for this purpose because the prerequisite of having metric variables was met because the EO instrument features a seven point Likert scale (Blaikie, 2003). Secondly, because this tool can be used to detect whether all the 18 item five dimension EO construct make up a uni- or multidimensional EO construct, as alluded to above (Blaikie, 2003; Zikmund, 2003).

For the purposes of this study, prior to determining the dimensionality of the EO construct, it was established if the sample was adequate to run factor analysis,

then correlations and factor loadings were determined. All these tests are described in the subsections below.

4.6.7.1 Sample adequacy

A way of determining suitability to run factor analysis is by assessing whether the number of respondents is sufficiently large to run factor analysis reliably (Blaikie, 2003). Although Blaikie (2003) advocates that the sample should at least be 300 to provide reliable results, a rule of thumb is that at least a ratio of 5:1 (responses: variables) is required. In the case of this research, 154 responses where achieved which translates to a ratio of 8.5:1 considering the 18 item scale. The sample was adequate for this test.

4.6.7.2 Correlations

Item-to-total correlation is a way to test for uni-dimensionality (Blaikie, 2003) as possible patterns of relationships between items are determined. A low correlation co-efficient between responses to any item and the total score indicates that either the item is measuring other variables or else the item is unreliable which means the wording could have led to different interpretations hence inconsistent responses (Blaikie, 2003). Item-to-total correlations of less than 0.5 were examined and possible exclusion of the item from the scale was considered.

4.6.7.3 Factor loading

A factor loading indicates a relationship that any item has to a factor (Blaikie, 2003). It is a measure of the contribution each item makes to a particular factor (Blaikie, 2003). The factor loading value indicates whether or not the item makes a statistically significant contribution to a factor (Blaikie, 2003). For a level of statistical significance of 0.01 (two tailed), the minimum loading for a sample of 50 is 0.72, for 100 is 0.51, for 200 is 0.36, for 600 is 0.21 and for 1000 is 0.16 (Blaikie, 2003).

The total sample size for this research (non-entrepreneurial and entrepreneurial engineers) is 154, which based on Blaikie (2003), and the factor loading should be between 0.51 (for sample of 100) and 0.36 (for a sample of 200). Blaikie (2003) further advocates that a factor loading of 0.40 across the board and even above 0.30 have been recommended by other scholars.

Factor loadings greater or equal to 0.30 are regarded as significant (Urban, 2008). A loading of 0.30 and 0.40 means that 9% and 16% respectively of item's variance contributes to a factor or a construct in this case. For this research, the author adopted that for a level of significance of 0.01 (two tailed); the minimum factor loading should be 0.30 for level of significance.

Blaikie (2003) states that an un-rotated solution refers to an initial solution on the number of factors that might be present in the responses to the items based on running exploratory factor analysis on a set of attitude items.

Subsequent solutions involve some method of rotation as an attempt to find a small number of items that have high loadings on a factor which enables easy

interpretation of factors (Blaikie, 2003). Obliquely rotated factor loadings were reported on this research, which is appropriate in a case like this research where correlations are expected between factors or dimensions.

4.6.7.4 Eigenvalues

A statistical tool eigenvalue is used to measure the amount of total variance for which each factor account (Blaikie, 2003). The higher the eigenvalue, the greater the variance explained by that factor (Blaikie, 2003). Blaikie (2003) advocates that only factors with eigenvalues of greater 1.0 should be considered however also states that a value above 0.70 can be considered. For the purposes of this research an eigenvalue greater than 0.7 were be considered significant.

4.6.7.5 T-Tests

Following reliability testing using factor analysis, the EO mean scores for every dimension were compared between the two groups of engineers. Group 1 was the entrepreneurial engineers whereas group 2 was the non-entrepreneurial engineers. T-tests were an appropriate statistical tool for the purposes of comparing the mean difference between these two groups as they are commonly used to evaluate the difference in means between two groups when the number of responses per group is greater than 30 (Zikmund, 2003; Blaikie, 2003).

In line with literature, as the two groups comprised of unequal number of responses, a non-parametric T-test called Welch-Satterthwaite was used (Blaikie, 2003; Zikmund, 2003).

Confidence level of 95% corresponding significance level (α-value) of 0.05 was used. The above means that if a p-value obtained from a test is less than significance level of 0.05, the result indicates the proposition will not be rejected (Blaikie, 2003) (Zikmund, 2003) or will show statistical significance difference.

4.6.7.6 Chi-Square

Blaikie (2003) has suggested that chi-square tests are considered appropriate to test for significance on nominal-level as well as ordinal-level data. Based on the literature review, it was expected that the two groups would have statistically significant differences on some of the situational factors. For example, an individual who has role models who are entrepreneurs may be more keen to enter entrepreneurship compared to an individual who has no role model who is an entrepreneur.

Chi-square tests were only used to test for differences between the two engineers groups on the situational factors where difference was expected based on literature review. Chi-square test was appropriate because all these situational factors were nominal-level variables (Bleikie, 2003).

4.7 Research Limitations

The following were the limitations of the study:

- The sample was not representative as it was sourced by employing non-probability sampling techniques and hence the findings cannot be generalised to the population of engineers in SA.
- The majority of entrepreneurial engineers had entrepreneurial ventures of 0 to 2 years operating life. The narrow sampling band in terms of business operating life and size in terms of the number of employees presents another sampling bias that suggests that the results cannot be generalised to population of engineers.
- There was limited research available for entrepreneurial studies conducted on engineers.
- A non-response bias is reported as not everyone who received the questionnaire responded and it is not possible to estimate the non-response rate because of the non-probability sampling technique “snowball” that was employed.
- Self-selection bias is acknowledged as it was introduced by the snowballing technique in addition to the fact the engineering association with voluntary member affiliations were asked to distribute the questionnaire.
- The survey was sent to the population via e-mail and therefore individuals who had no access to e-mail at all or during the seven week period when the survey was conducted did not have a chance of being included in the responses.

4.8 Conclusion

This chapter has described the details of the research methodology. The quantitative research was done via e-mail distributed questionnaires. An existing pre-structured EO scale was used to measure EO of the two groups of engineers. Another pre-structured questionnaire was used to assess the situational factors that promote or hinder entrepreneurship.

Literature presented in this section revealed that a quantitative descriptive study was appropriate for this study in which EO dimensions and situational factors are described. **189** responses were received and **35** were deemed unusable as they did not comply with the definition of the study population, which implies that **154** responses were used for statistical testing.

Scale reliability testing was conducted to confirm that the scale is accurate for use in this context. The number of respondents was large enough to conduct all the tests which were planned which are factor analysis, Cronbach's Alpha reliability T-tests and chi-square tests.

The following section presents the results of the study.

CHAPTER 5: RESULTS

5.1 Introduction

The purpose of this chapter is to present results which were obtained from five types of statistical tests which were performed, namely descriptive statistics, reliability testing, factor analysis, T-tests and chi-square tests.

Descriptive statistics were used to describe the sample in relation to all the 67 questions which formed part of the questionnaire. This was done to understand the nature of and to quantify the sample.

Prior to using the T-test and the chi-square to determine whether or not the two engineers groups have statistically significantly different EO and situational factor scores, the EO scale reliability using Cronbach's Alpha test had to be confirmed. A reliable EO scale was a prerequisite for performing T-tests and chi-square. Furthermore, once the reliability of the scale was established, factor analysis tests were performed to confirm the dimensionality of the EO construct.

In view of the above, descriptive statistics are presented first followed by EO scale reliability, then T-test and chi-square tests and lastly factor analysis results. In all cases, statistical results are presented for all the 67 questions which were included in the questionnaire.

5.2 Descriptive Statistics

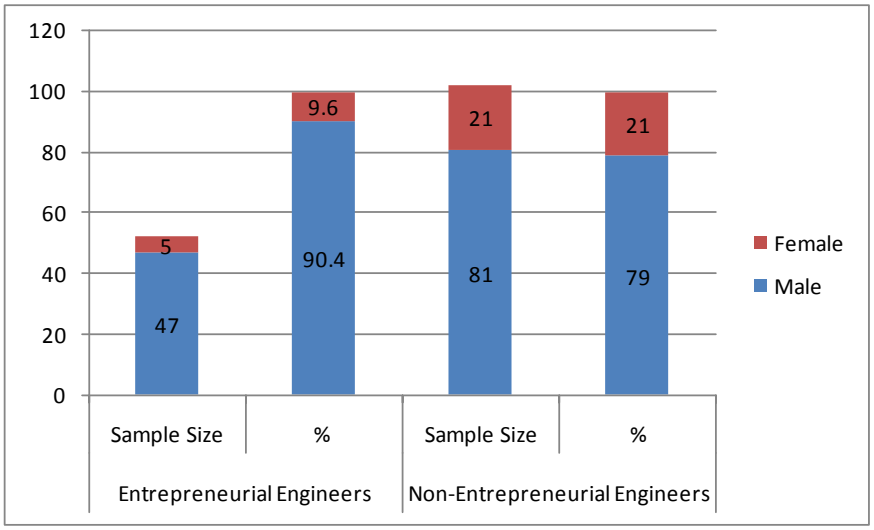
This section therefore presents the characteristics of the sample in accordance with the structure of the administered questionnaire.

5.2.1 Section A: Demographics

5.2.1.1 Question CD2: What is Your Gender?

Respondents were asked to disclose their gender. Figure 4 below shows that males accounted for **90.4%** and **79%** of the entrepreneurial and non-entrepreneurial engineers groups respectively.

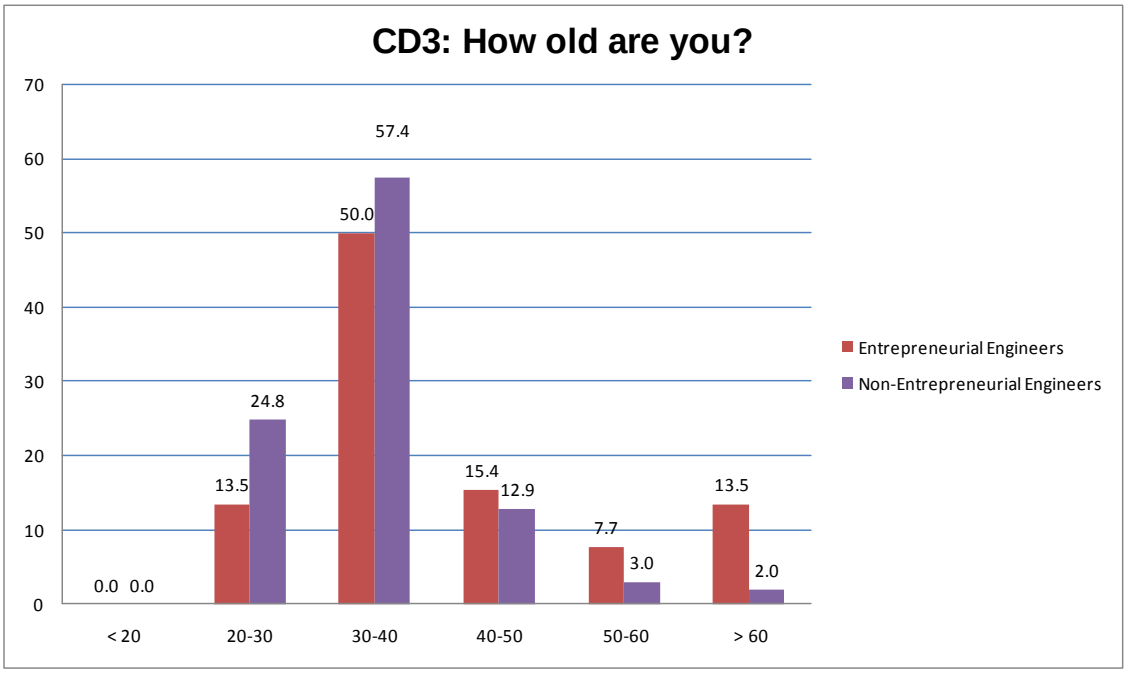
Figure 4: Percentage and frequency distribution of respondents' gender.



5.2.1.2 Question CD3: Age

Respondents were asked to indicate their age group bracket. Figure 5 below shows that majority of respondents were of ages **30- 40** years in both the entrepreneurial (**50%**) and non-entrepreneurial (**50%)** groups.

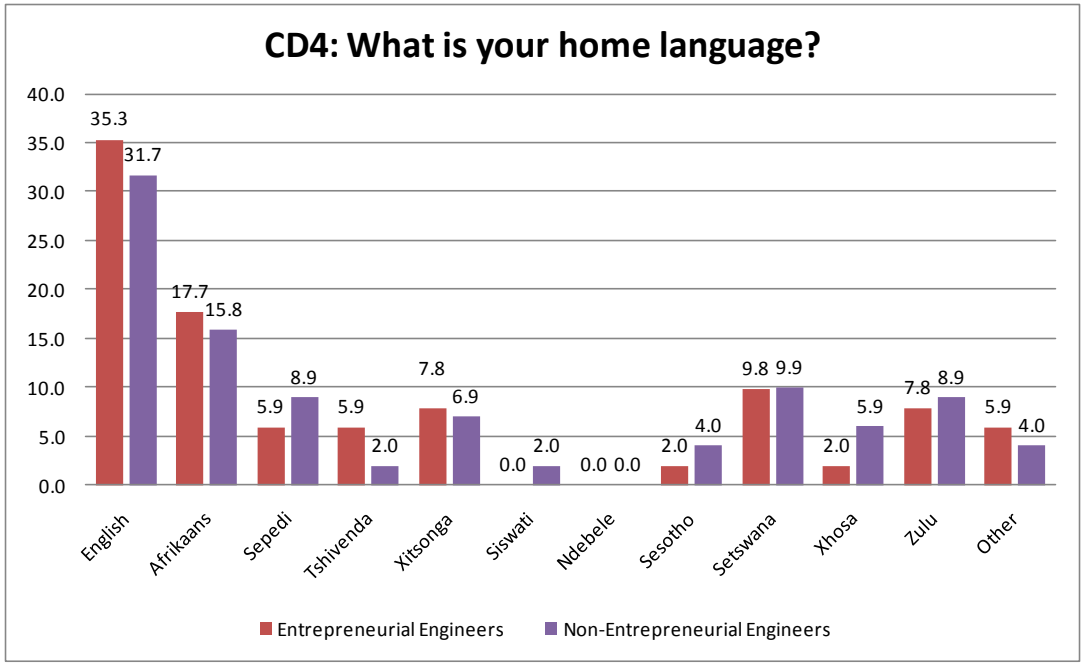
Figure 5: Percentage distribution of respondents' age



5.2.1.3 Question CD4: What is your home language?

Respondents were asked to disclose their home language. It is evident from figure 6 below that the majority of respondents are English

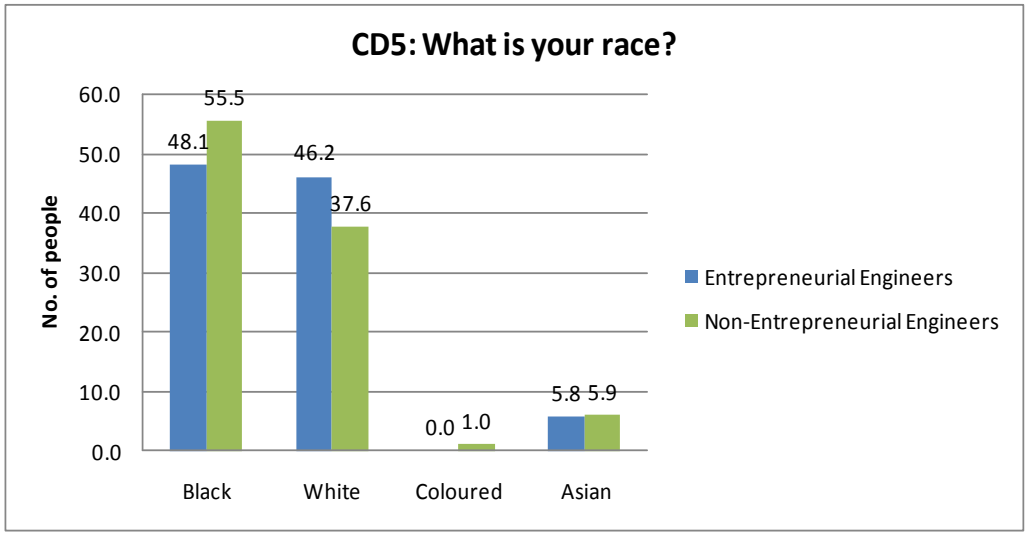
Figure 6: Home Language Percentage Distribution



5.2.1.4 Question CD5: What is your race?

Respondents were asked to indicate their race grouping. It is evident from Figure 7 below that the majority of respondents, both entrepreneurial and non-entrepreneurial, are black (**48 and 55 %** respectively)

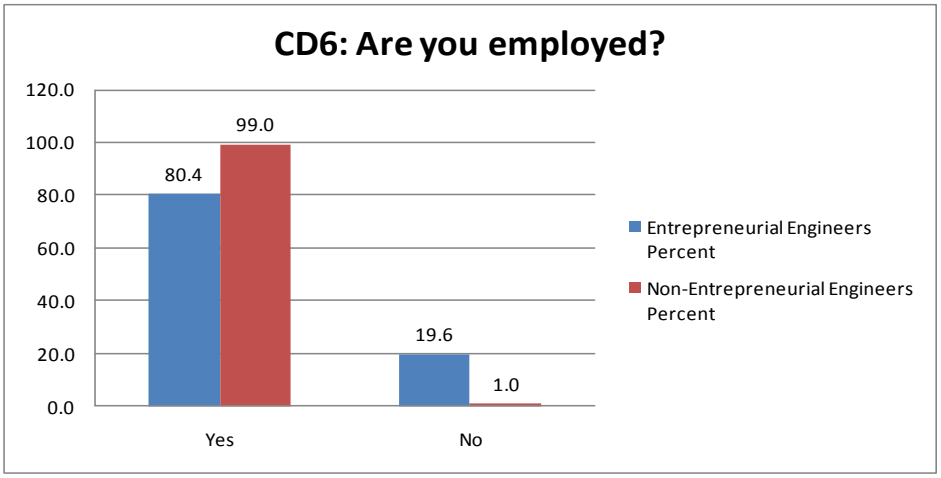
Figure 7: Percentage distribution of respondents' race



5.2.1.5 Question CD6: Are you employed?

Respondents were asked to indicate their employment status. Figure 8 indicates that **80.4%** of entrepreneurial engineers and **99%** of non-entrepreneurial engineers are currently employed.

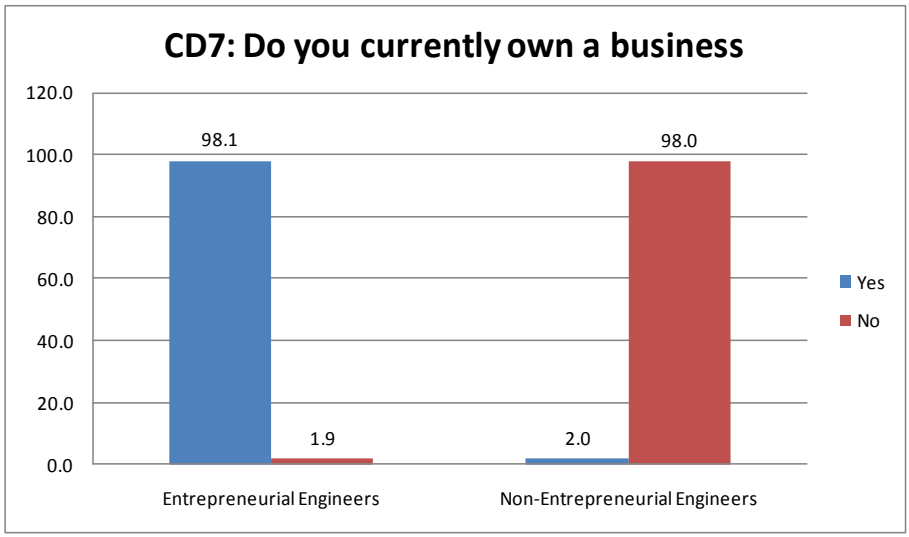
Figure 8: Percentage distribution of respondents' employment status



5.2.1.6 Question CD7: Do you currently own a business?

Respondents were asked to indicate whether or not they own a business. Figure 9 below indicates that **98.1%** of entrepreneurial engineers and **98%** of non-entrepreneurial engineers currently own a business.

Figure 9: Percentage distribution of respondents' business ownership



5.2.1.7 Question CD8: What engineering qualification do you possess?

Respondents were asked to indicate what engineering qualification they possess. This question enabled the author to identify invalid respondents on the basis of qualification.

Figure 10: Percentage distribution of respondents engineering qualifications

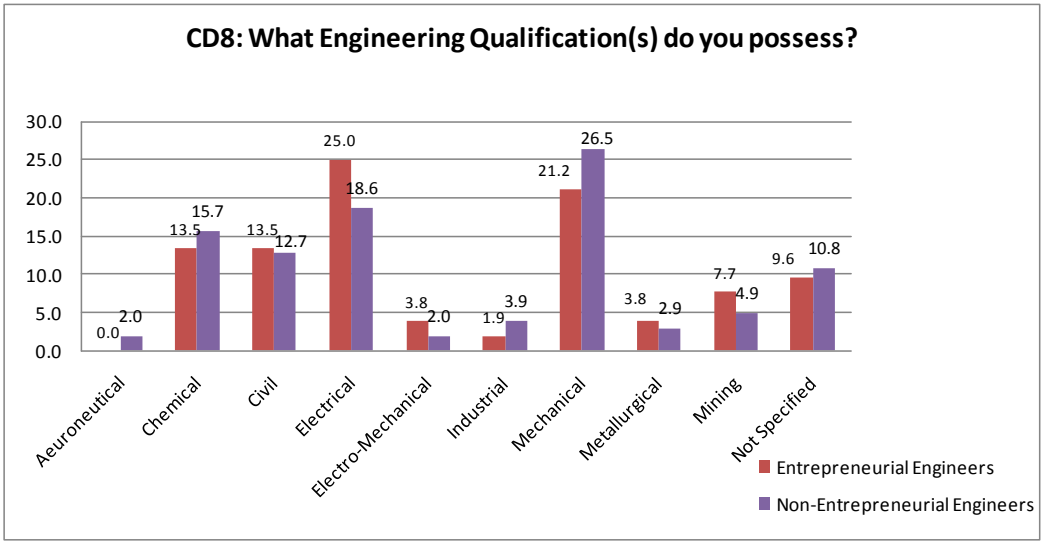
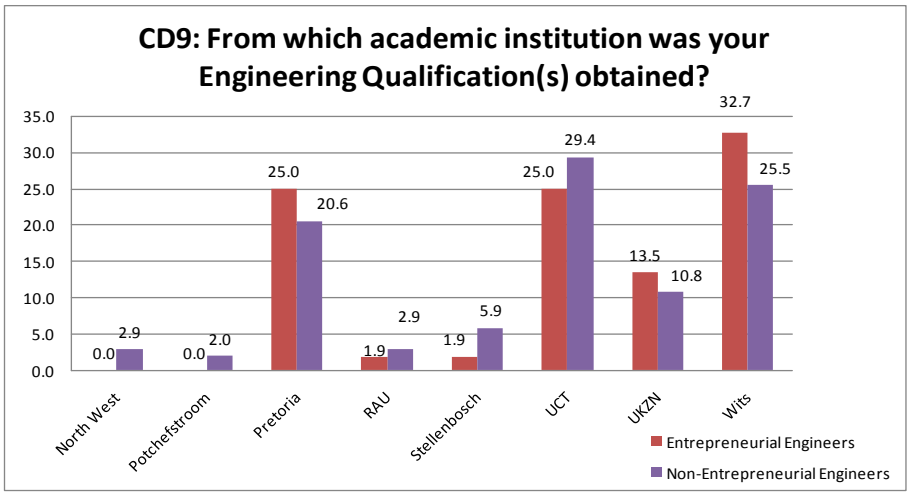


Figure 10 above shows that the majority (**25%**) of entrepreneurial engineers (**25%)** and non-entrepreneurial (**26.5%)** have electrical and mechanical engineering qualifications, respectively.

5.2.1.8 Question CD9: From which academic institution was your Engineering Qualification(s) obtained?

Respondents were asked to indicate from which academic institution their engineering qualification was obtained. Figure 11 below shows that the majority of entrepreneurial engineers **(32.7%)** and non-entrepreneurial engineers **(29.4%)** graduated from Wits University and the University of Cape Town, respectively.

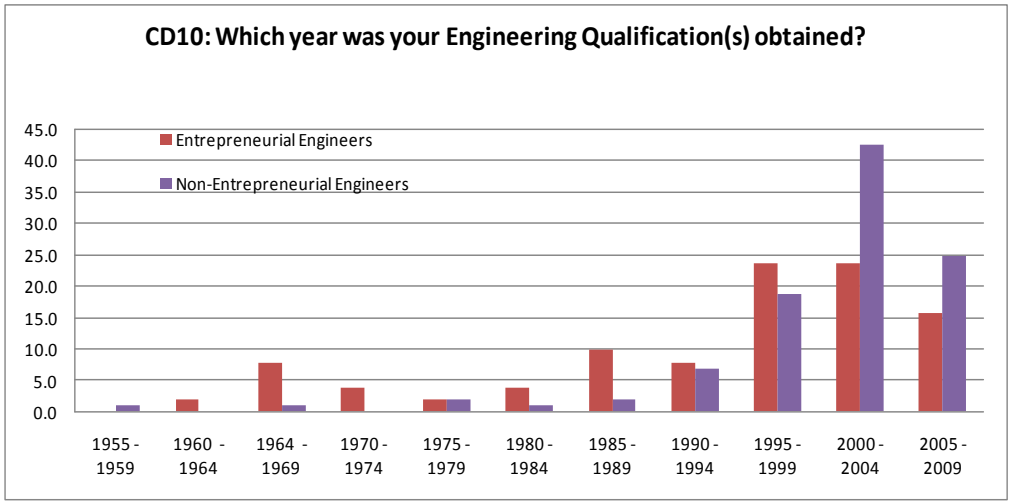
Figure 11: Percentage distribution of institutions from where respondents' graduated



5.2.1.9 Question CD10: Which year was your Engineering Qualification(s) obtained?

Respondents were asked to indicate in which year their engineering qualification was obtained. Figure 12 below shows that the majority **(46.2%)** of the entrepreneurial engineers obtained their engineering qualification between year 1995 and 2004. The majority **(43%)** of non-entrepreneurial engineers obtained their engineering qualification between years 2000 and 2004.

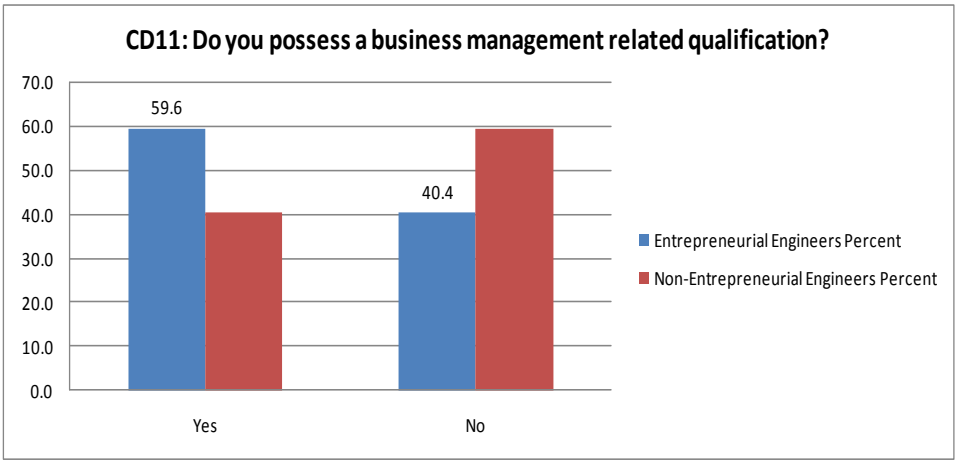
Figure 12: Percentage distribution of year on which engineering qualification was obtained



5.2.1.10 Question CD11: Do you possess a business management related qualification?

Respondents were asked if they possess a business management related qualification or not. Figure 13 below shows that **59.6%** and **47.1%** of entrepreneurial and non-entrepreneurial engineers respectively have completed a business management related qualification.

Figure 13: Percentage distribution of respondents' business management related qualification



5.2.2 Entrepreneurial orientation dimension

5.2.2.1 Introduction

The five dimension 18 item questionnaire incorporating the original EO scale developed by Covin and Slevin (1989) and Lumpkin *et al* (2009) study was adopted for this research. The EO scale features a 7-point Likert scale and respondents selected their answer by using a scroll-bar. Selecting one (1) indicated strong agreement with the statement the statement on the left of the Likert scale. Selecting seven (7) indicates a strong agreement with the statement on the right of the Likert scale. The numbers in between represented the degree of agreement with the statement one of the two statements.

5.2.2.2 EO Dimension – Innovativeness

As shown in Figure 14 below, the EO dimension "innovativeness" featured five items coded CD25, CD26, CD27, CD28 and CD29.

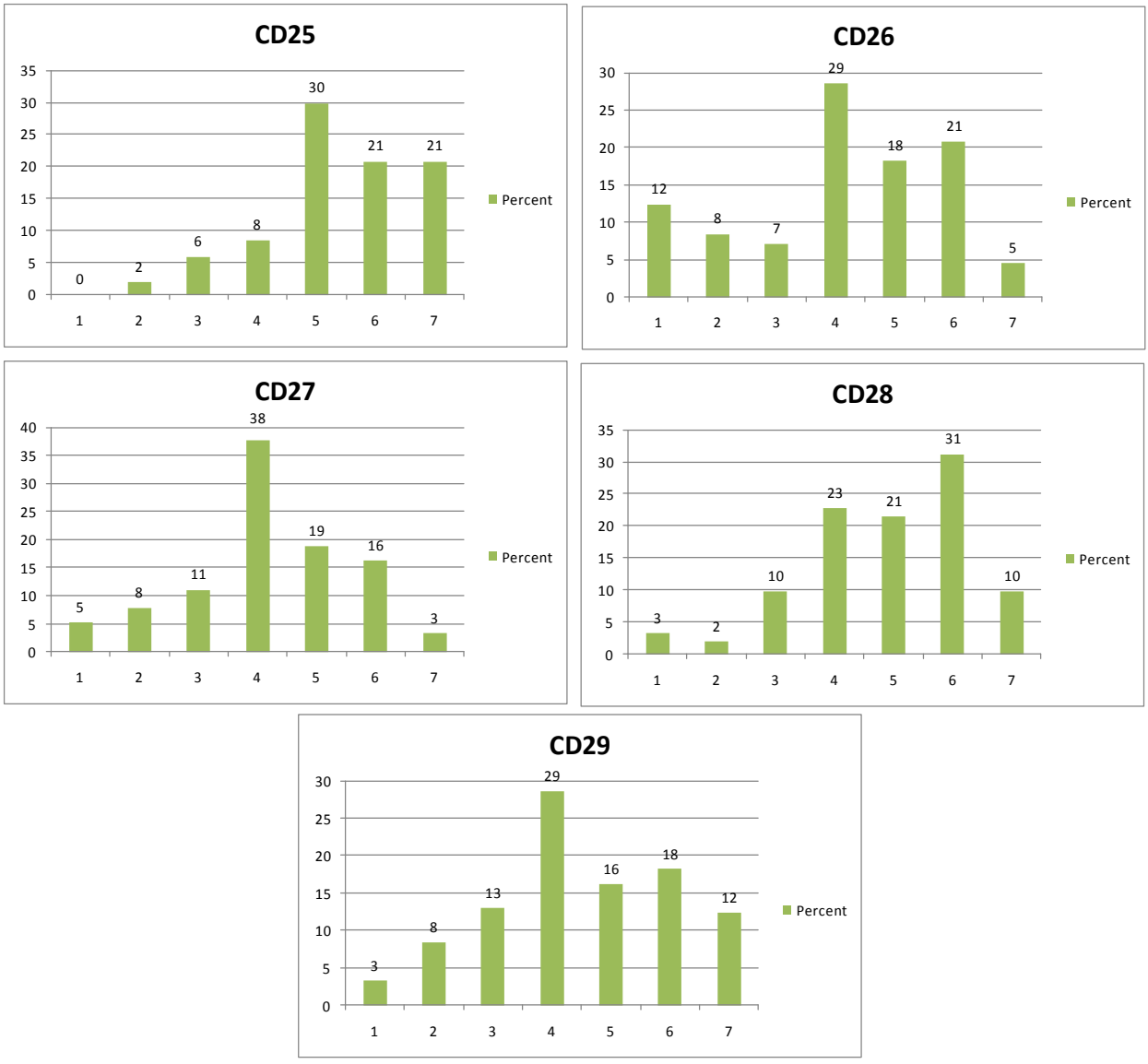
Figure 14: Innovativeness Items

Innovativeness Items			
14. I favour a strong emphasis on marketing of tried and true products and services	1 2 3 4 5 6 7	I favour a strong emphasis on R&D, technological leadership and innovations	CD25
15. In the last five years I have marketed no new lines of products or services	1 2 3 4 5 6 7	In the last five years I have marketed many new lines of products or services	CD26
16. My changes in product or service lines or processes have been mostly of a minor nature	1 2 3 4 5 6 7	My changes in product or service lines or processes have been mostly quite dramatic	CD27
17. I favour imitating methods that other people or firms have used for problem solving	1 2 3 4 5 6 7	I favour experimentation and original approaches to problem solving	CD28
18. I prefer to adapt to processes and methods of production and techniques that others have developed and proven.	1 2 3 4 5 6 7	I prefer to design my own unique new processes and methods of production rather than adapting method and techniques that others have developed.	CD29

Figure 15 below shows that for item CD25, the majority of the individuals (**46%**) had a score of 4 on the Likert scale. For item CD26, the majority of the individuals

(**44%)** had a score of 4 on the Likert scale. For item CD27, the majority of the individuals (44%) had a score of **4** on the Likert scale. For item CD28, the majority of the individuals (**48%**) had a score of 6 on the Likert scale. For item CD29, the majority of the individuals (**44%**) had a score of 4 on the Likert scale. There were no missing frequencies on all items.

Figure 15: Percentage distribution of innovativeness score



5.2.2.3 EO Dimension – Risk Taking

As shown in Figure 16 below, the EO dimension "risk taking" had four items coded CD16, CD17, CD18 and CD19.

Figure 16: Risk taking items

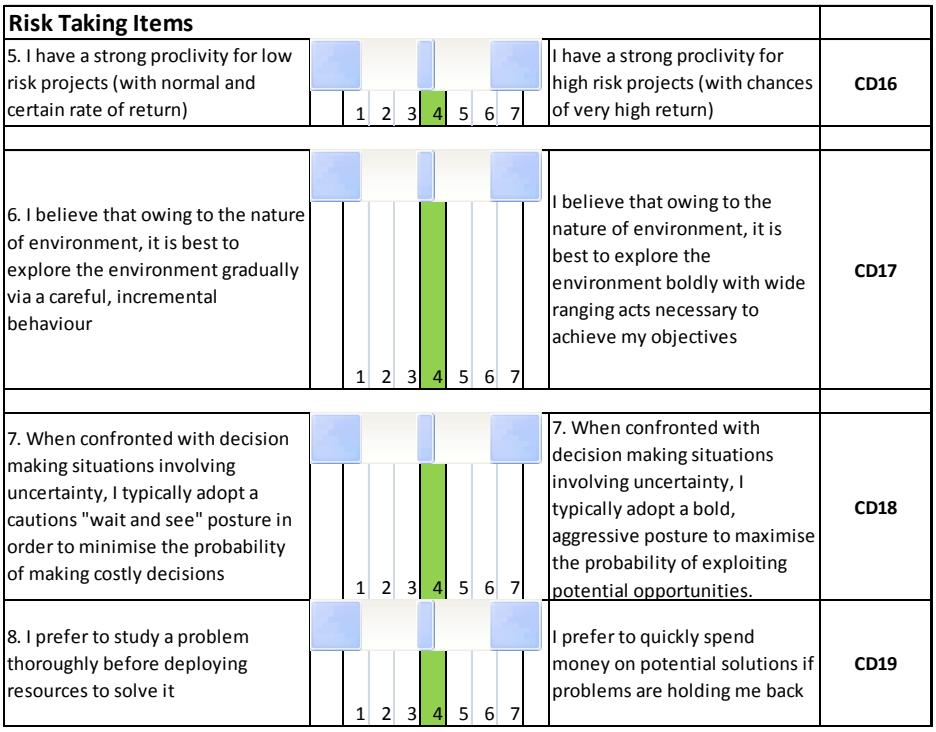
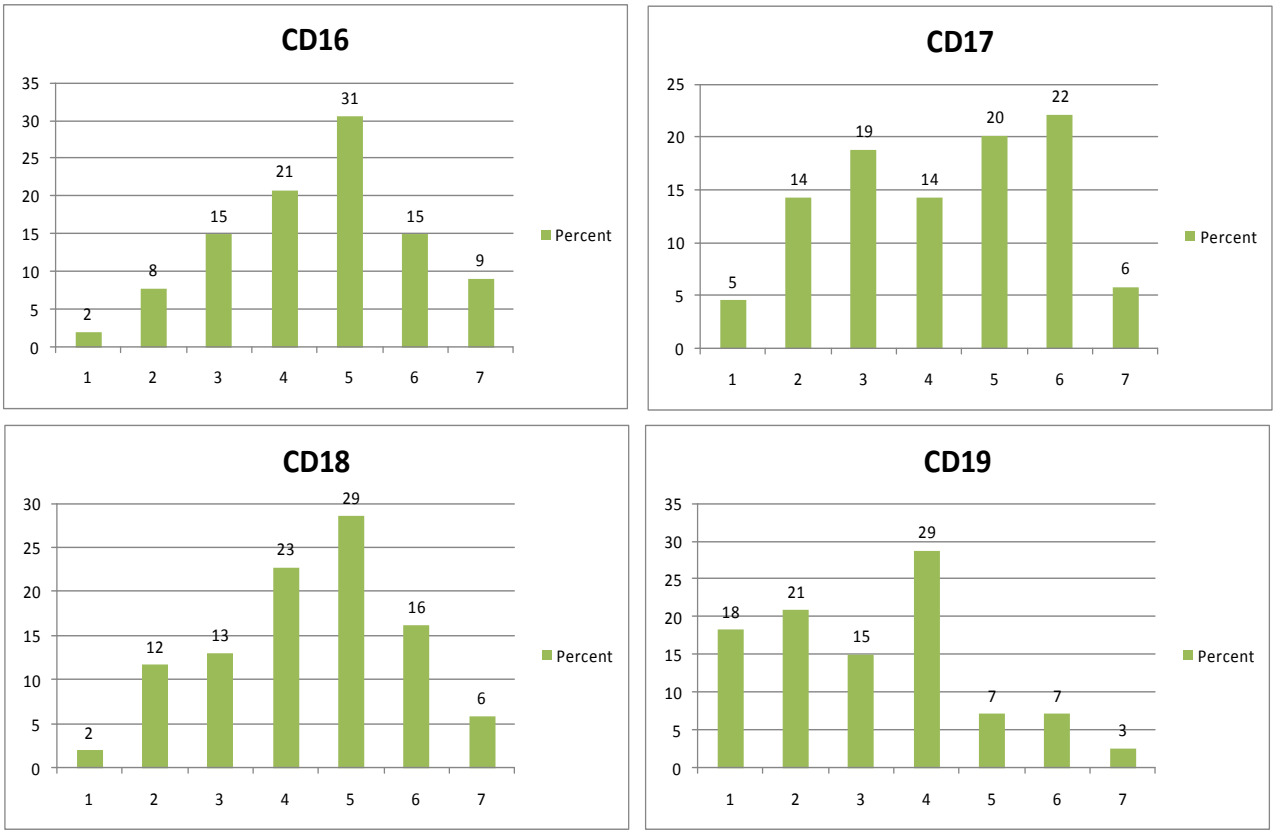


Figure 17 below shows that the majority of the individuals had a score of 5 on the Likert scale for items **CD 16 (31%)** and **CD 18 (29%).** The majority **(22%)** of individuals had a score of 5 on CD17 and the majority of individuals had a score of 4 on CD19. There were no missing frequencies on all items with the exception of CD19 where there was one missing frequency.

Figure 17: Percentage distribution of risk taking items scores



5.2.2.4 EO Dimension - Proactiveness

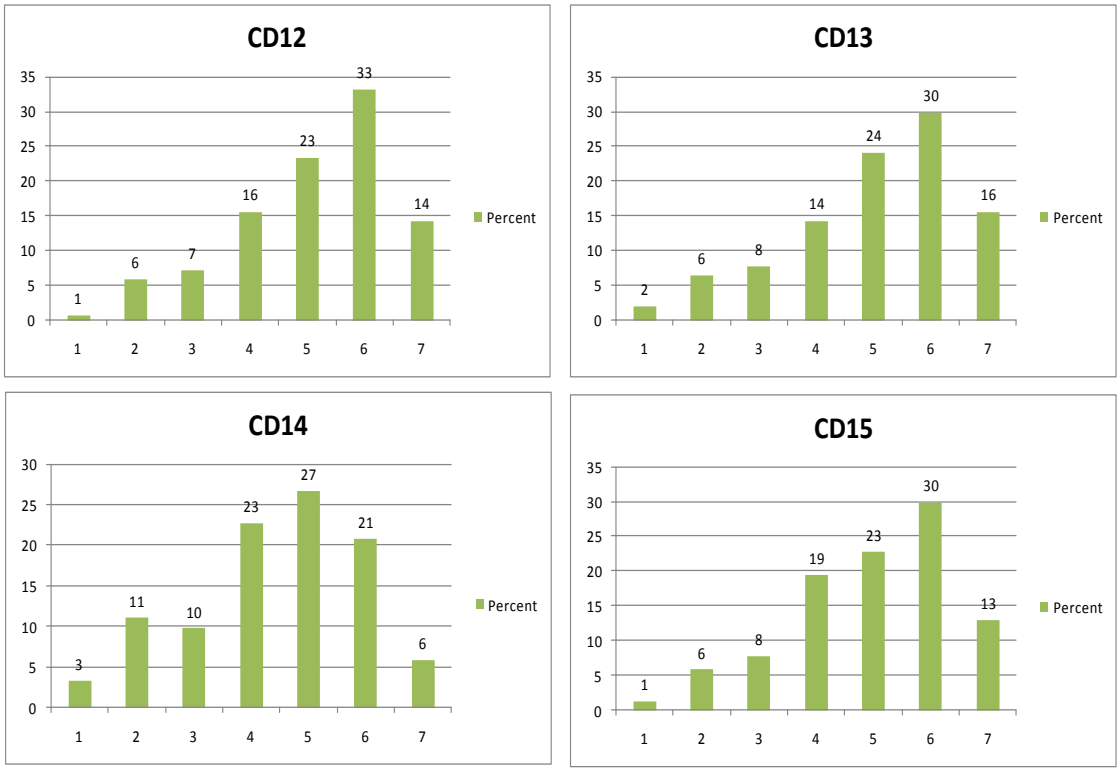
As shown in Figure 18 below, the EO dimension "proactiveness" featured four questions coded CD12, CD13, CD14 and CD15.

Figure 18: Proactiveness Items

Proactiveness Items		
In dealing with competition I would…….		**CODING**
1. Most likely respond to actions which competitors initiated	1 2 3 4 5 6 7	Most likely initiate actions that competitors will respond to	**CD12**
2. Very seldom to introduce new products/services, administrative techniques and operating technologies.	1 2 3 4 5 6 7	Very often to introduce new products/services, administrative techniques and operating technologies.	**CD13**
3. Typically seek to avoid competition clashes, preferring a "live and let-live" posture	1 2 3 4 5 6 7	Typically rather undo-the-competitors posture	**CD14**
I am likely to have……			
4. A strong tendency to "follow the leader" in introducing new products or services	1 2 3 4 5 6 7	A strong tendency to be ahead of competition in introducing novel ideas or practices	**CD15**

Figure 19 below show the scores of all proactiveness items. It is evident that on all four items with the exception of CD14, the majority of respondents had a score of six on Likert scale. There were no missing frequencies on all proactiveness items.

Figure 19: Percentage distribution of proactiveness scores



5.2.2.5 EO Dimension – Competitive Aggressiveness

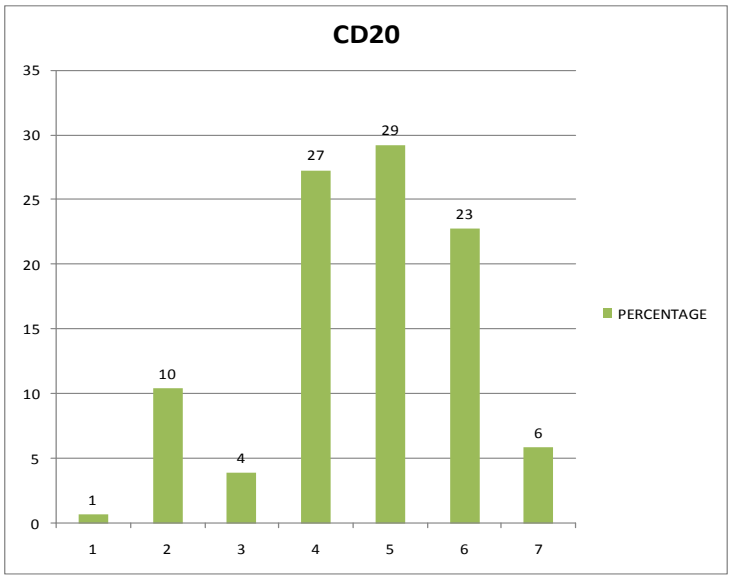
Figure 20 show one of the competitive aggressiveness item coded CD20.

Figure 20: Competitive aggressiveness scores

Competitive Aggressiveness Items			
In dealing with competition I would likely…….			
9. Make no special effort to take the business from competition	1 2 3 **4** 5 6 7	Be aggressive and intensely competitive	**CD20**

Figure 21 below show that for item CD20, The majority (44%) of the individuals had a score of 4 on the Likert scale. There was no missing frequency.

Figure 21: Percentage distribution of competitive aggressiveness scores



5.2.2.6 EO Dimension – Autonomy

As shown in Figure 22 below, the EO dimension **"autonomy"** featured four items coded CD21, CD22, CD23 and CD24. Figure 23 below shows that the majority of the individuals **(34%)** had a score of **4** on the Likert scale on item CD21. For item CD22, the majority of the individuals **(47%)** had a score of 6 on the Likert scale. For item CD23, the majority of the individuals **(49%)** had a score of **4** on the Likert scale. For item CD24 the majority of the individuals **(57%)** had a score of **4** on the Likert scale. There were no missing frequencies on all items.

Figure 22: Autonomy items

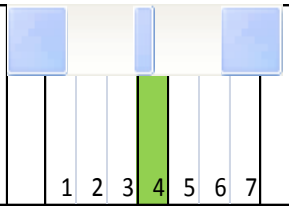
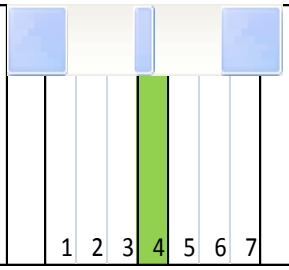
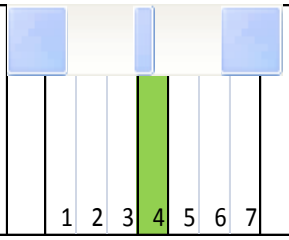
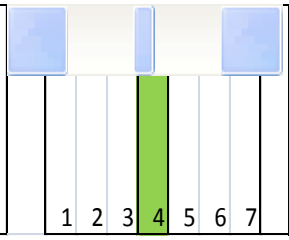
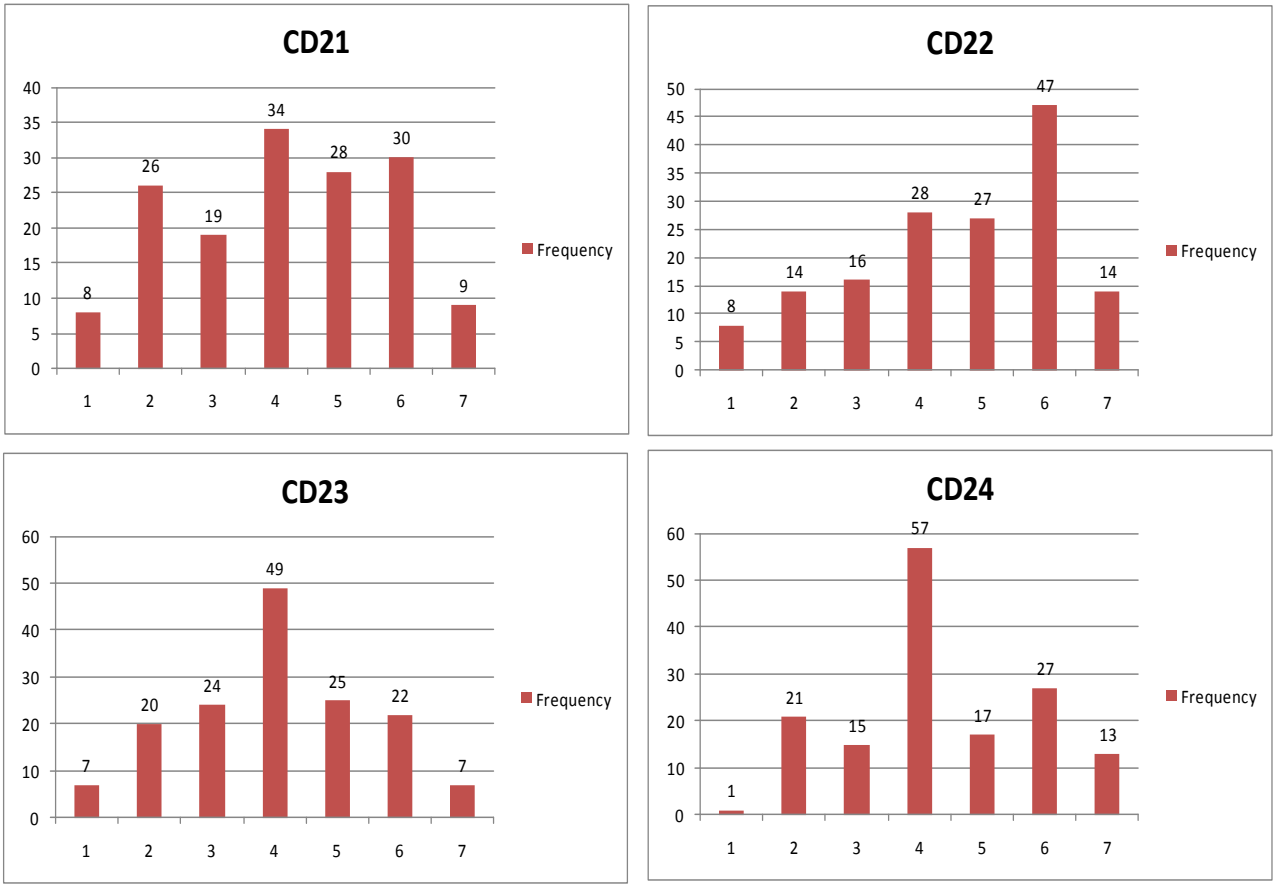
Autonomy Items			
10. I prefer to working in teams with guidance from seniors		I prefer to work autonomously with no reliance on teamwork and guidance from seniors	**CD21**
11. I believe that best results occur when top managers provide primary impetus for pursuing business opportunities		I believe that best results occur when individuals and teams provide primary impetus for pursuing business opportunities	**CD22**
12. When pursuing business opportunities I prefer obtaining approval from supervisors and superiors before making the decision		When pursuing business opportunities I make decisions without obtaining approval from supervisors and superiors	**CD23**
13. My seniors/partners/role models/others play a major role in identifying and selecting the entrepreneurial opportunities that I persue or may persue in future		I play major role in identifying and selecting the entrepreneurial opportunities that I persue or may persue in future	**CD24**

Figure 23: Percentage distribution of autonomy item scores



5.2.3 Situational factors

5.2.3.1 Introduction

This section of the questionnaire sought to understand the situational factors that hindered or promoted entrepreneurial entry amongst engineers. Some of the situational factor questions where directed at a specific group of engineers in order to gain understanding of that particular group. Some situational factor questions

were, however, directed at both group with the purpose of gaining a collective understanding of the main hindrances and enablers of entrepreneurship.

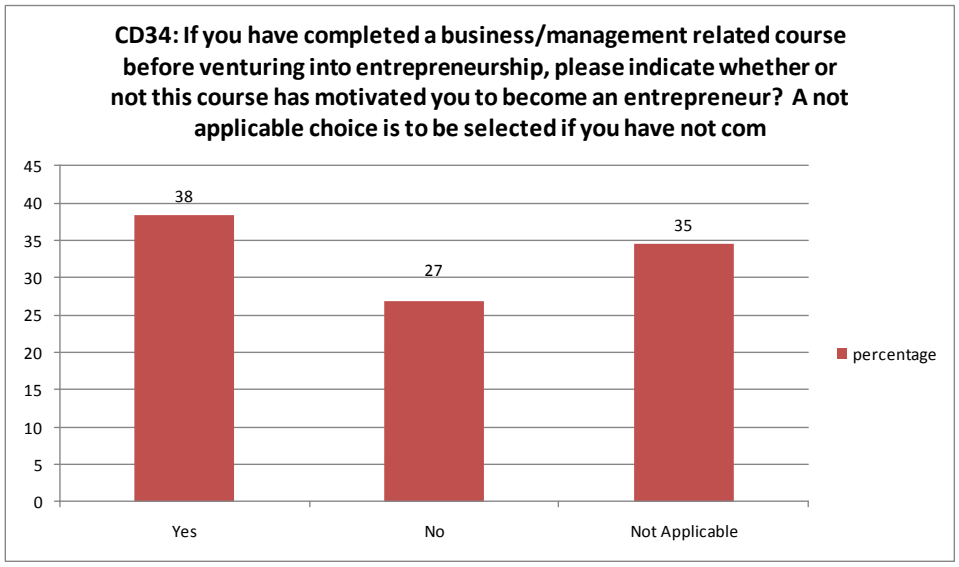
Chi-square tests were performed to compare the results between these two groups only on questions which were directed to both groups. This section only presents the situational factor descriptive statistics for only those questions which were directed at a specific group. The descriptive statistics for situational factors questions which were directed at both groups of engineers are presented in Section 5.11 along with the Chi-square test results to avoid repeating the presentation of these results.

5.2.3.2 *Question CD 34 Entrepreneurs ONLY - If you have completed a business/management related course before venturing into entrepreneurship, please indicate whether or not this course has motivated you to become an entrepreneur? A not applicable choice is to be selected if you have not completed a business related course.*

Entrepreneurial engineers who have completed a business/management related course prior to venturing into entrepreneurship were asked to answer if the course had motivated them to become an entrepreneur. Figure 24 below shows that **38%** compared to **27%** of entrepreneurial engineers sample indicated that the complete business related course motivated them to become entrepreneurs. **35%** of this

sample indicated not applicable indicating that they possess no business related qualification.

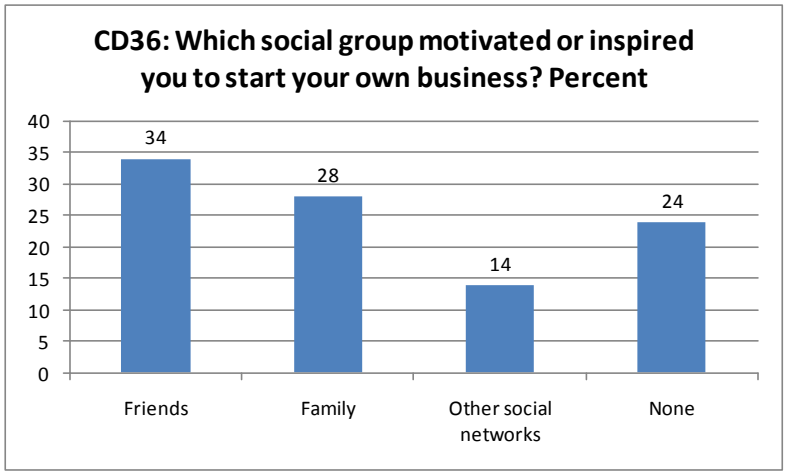
Figure 24: Percentage distribution on whether business course in motivational to becoming an entrepreneur



5.2.3.3 Question CD 36 Entrepreneurs ONLY - Which social group motivated or inspired you to start your own business?

Entrepreneurs were asked which of the social groups motivated them to become entrepreneurs. Figure 25 below shows that friends followed by family are the leading social groups that have motivated these entrepreneurs to entrepreneurship.

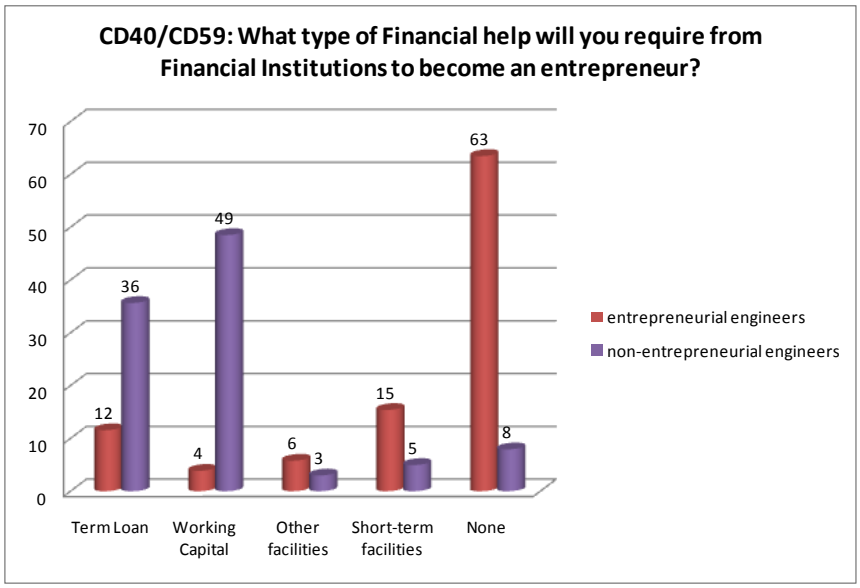
Figure 25: Percentage distribution of social groups that motivated entrepreneurs



5.2.3.4 Question CD 40/CD59 - What type of Financial help did you get (entrepreneurs) or would you require (non-entrepreneurial) from Financial Institutions to start a business?

All respondents were asked what type of help from financial institutions they required or would require for starting a business. Figure 26 shows that the majority of entrepreneurial **(63%)** engineers stated that they did not get any assistance from financial institutions. On the same note, the majority **(49%)** of non-entrepreneurial engineers indicated that they would require working capital; overall, **92%** of this group require assistance from financial institutions to start a business.

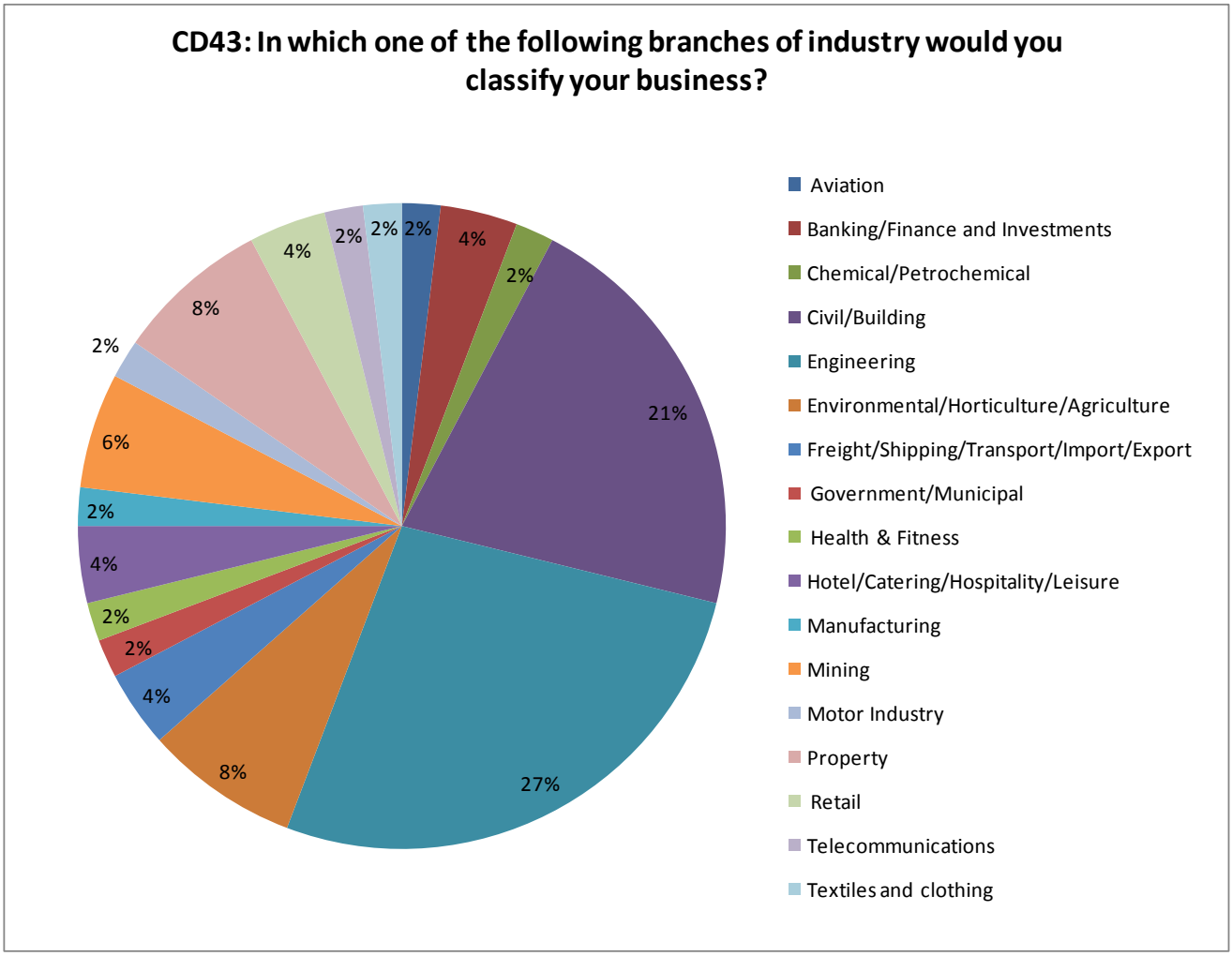
Figure 26: Percentage distribution of financial assistance required from financial institutions



5.2.3.5 Question CD 43 Entrepreneurs ONLY- In which one of the following branches of industry would you classify your business?

Figure 27 below shows the majority of the entrepreneurs business in manufacturing **(27%),** civil/building **(21%)** and environmental and property **(8%)** industries. The least percentage of engineers has businesses in the motor **(2%),** chemical **(2%)** and health and fitness **(2%)** industries**.**

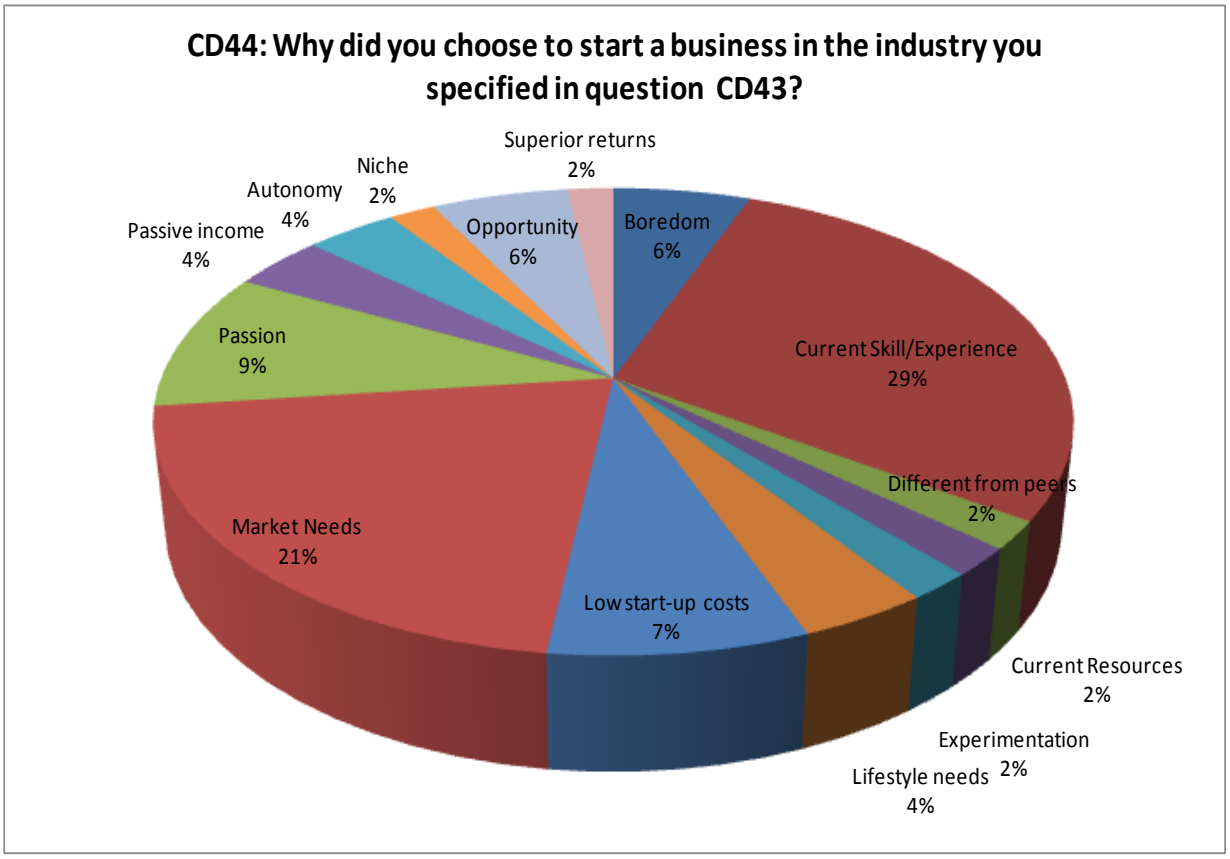
Figure 27: Percentage distribution of entrepreneurs' business classification



5.2.3.6 Question CD 44 Entrepreneurs ONLY - Why did you choose to start a business in their industry?

Entrepreneurs were asked to specify a reason they have chosen to start a business in a specific industry. The majority of individuals started a business because of their current skills followed by market needs.

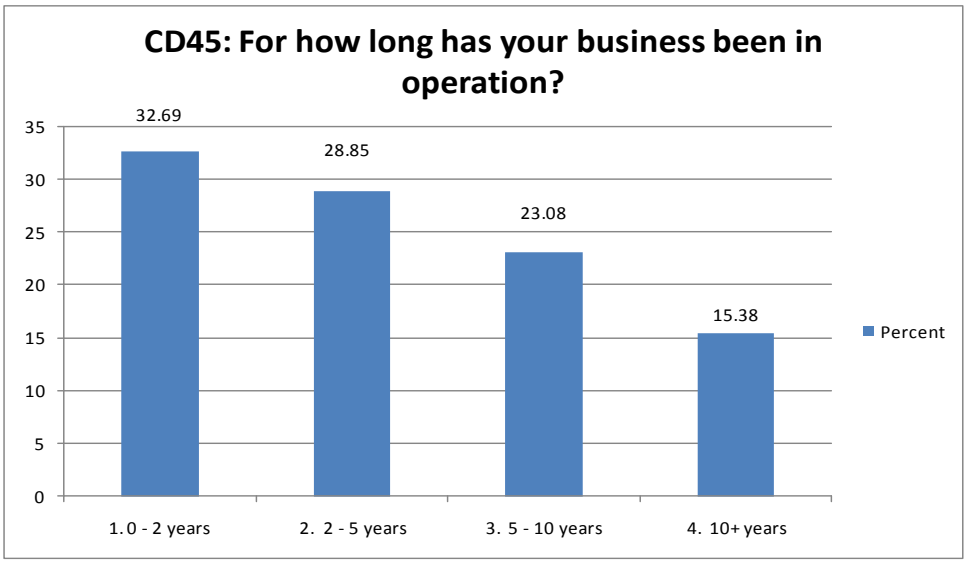
Figure 28: Percentage distribution of reasons for starting a business in a specific industry



5.2.3.7 Question CD 45 Entrepreneurs ONLY- For how long has your business been in operation?

Entrepreneurs were requested to state how many years that respective businesses have been in operation. Figure 29 below shows that the majority of businesses represented in this sample have been in operation for a period 0 - 2 years **(33%),** the 2-5 years **(29%),** then 5-10 years **(23%)** and above 10 years **(15%).**

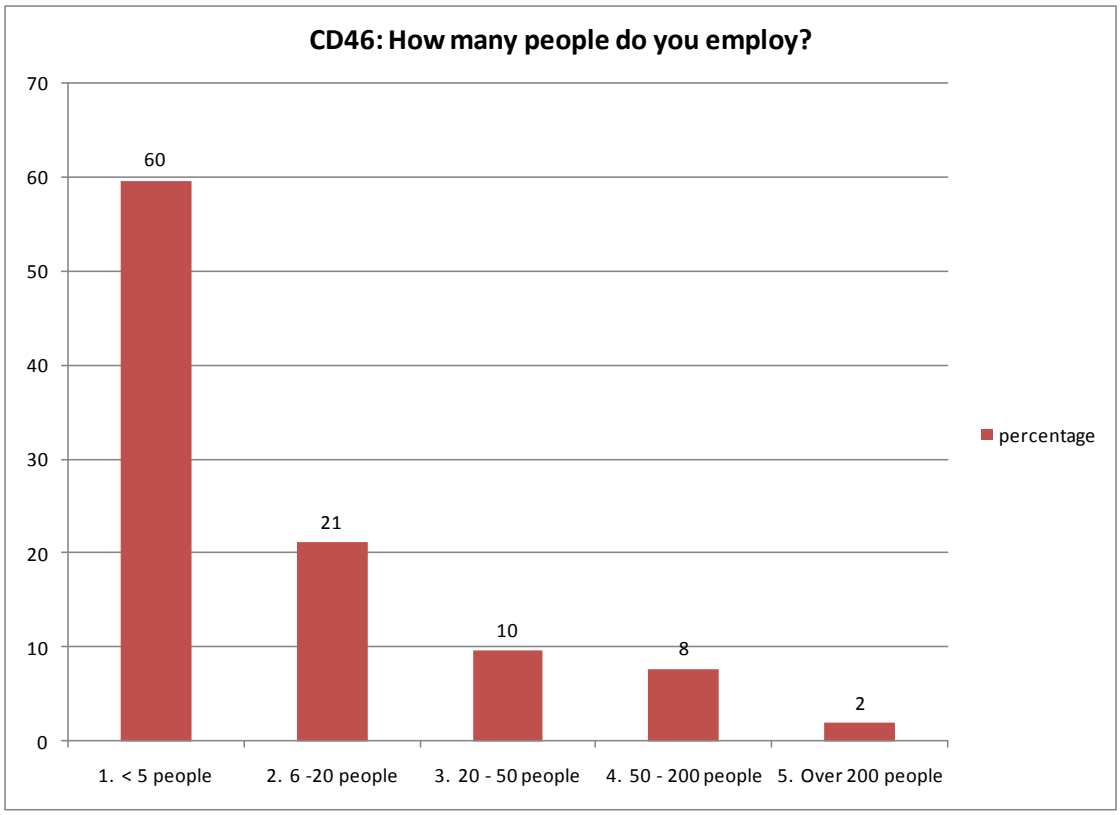
Figure 29: Percentage distribution indicating the number of business operating life



5.2.3.8 Question CD 46 Entrepreneurs ONLY- How many people do you employ?

Entrepreneurs were asked to indicate the number of people they currently employ in their businesses. Figure 30 below shows that the majority **(59.6%)** of sampled entrepreneurs employ less than five individuals and only **1.92%** employs over 200 people.

Figure 30: Percentage distribution of number of employees employed by a business



5.2.3.9 Question CD 47 Entrepreneurs ONLY- How many years were you employed before you started your own business?

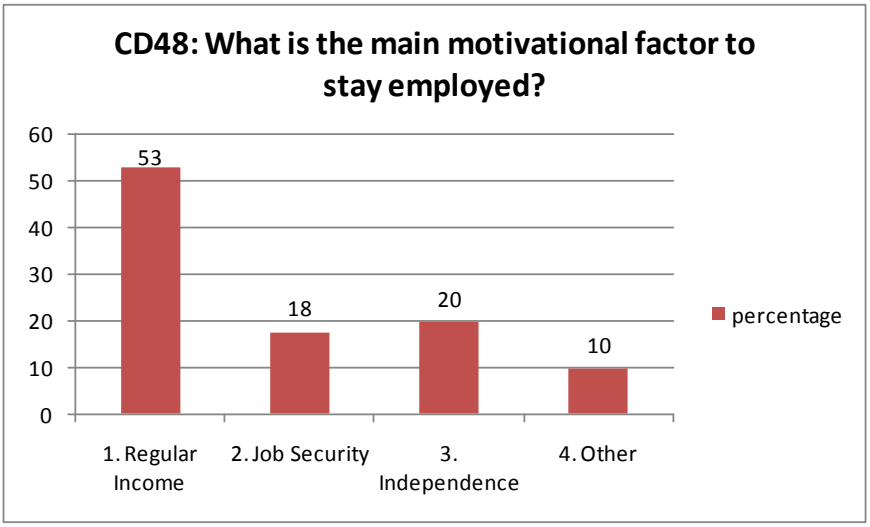
Entrepreneurs indicated the number of years they had been in employment prior to starting a business. Figure 31 below shows that the majority **(38%)** of entrepreneurs started their business after 6-10 years of experience.

Figure 31: Percentage distribution of business life

5.2.3.10 Question CD48 Non-entrepreneurs ONLY - What is the main motivational factor to stay employed?

Non-entrepreneurs were asked to indicate the main motivational factor to stay employed. Figure 32 below shows that the main motivational factor to stay employed is regular income **(52.9%),** then independence **(19.6%),** then job security **(17.6%)** and other **(4%).**

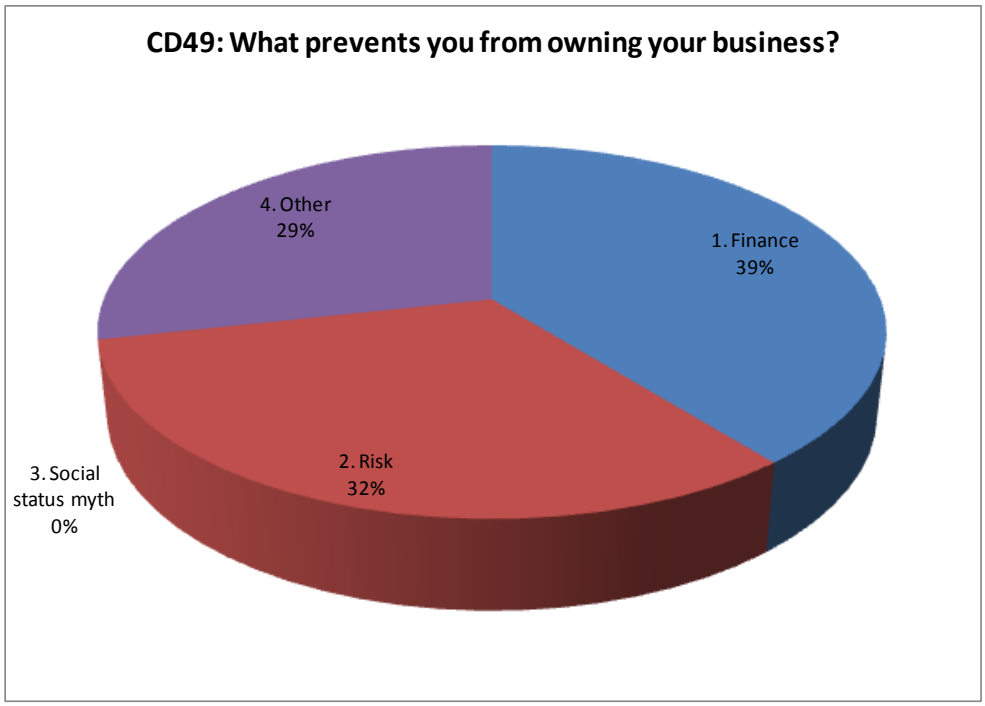
Figure 32: Percentage distribution of factors that keep this group employed



5.2.3.11 Question Cd49 Non-entrepreneurs ONLY - What prevents you from owning your business?

Non-entrepreneurs were asked to specify the factor that prevents them from starting a business. Figure 33 below shows that finance **(39%)** is the leading factor followed by risk **(32%),** the other **(29%)** and social myth was not stated as a factor.

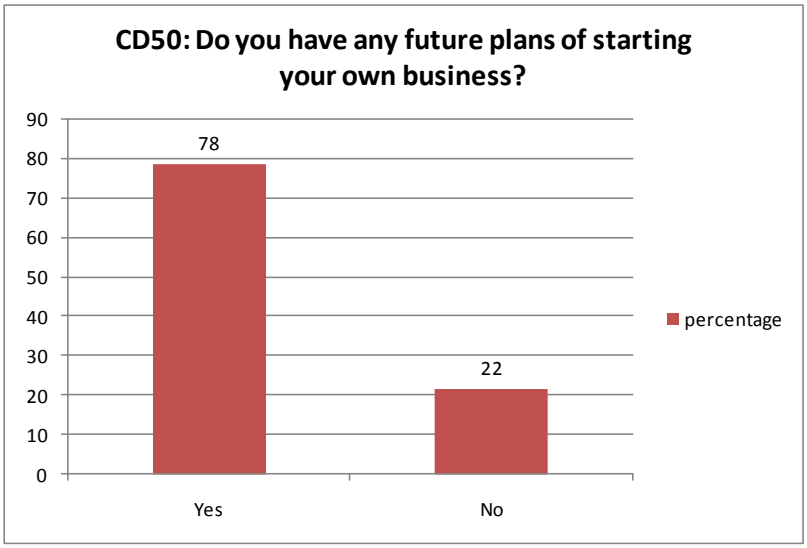
Figure 33: Percentage distribution of factors that hinder entrepreneurial entry



5.2.3.12 Question Cd50 Non-entrepreneurs ONLY - Do you have any future plans of starting your own business?

Non-entrepreneurs were asked to state whether or not they are interested in starting a business. Figure 34 below shows that **78%** of non-entrepreneurial engineers have plans of starting their own business.

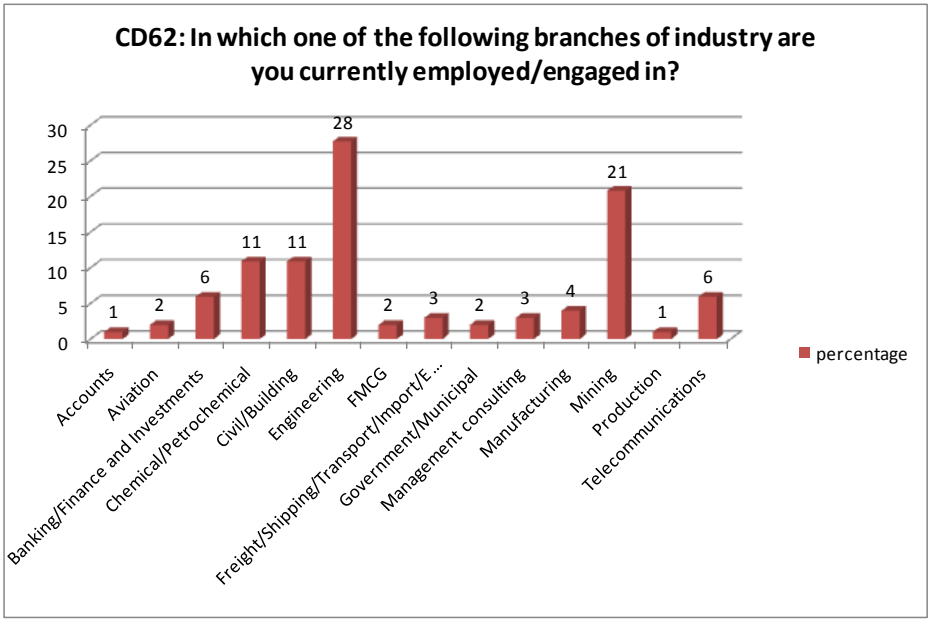
Figure 34: Percentage distribution of this group future plans to start a business



5.2.3.13 Question CD 62 Non-entrepreneurs ONLY - In which one of the following branches of industry are you currently employed/engaged in?

Non-entrepreneurs were asked to indicate in which industry they are currently employed. Figure 35 below shows that the top three employers of this group are engineering **(27.7%),** mining **(20.8%)** and petrochemical and civil **(10.9%)** industries.

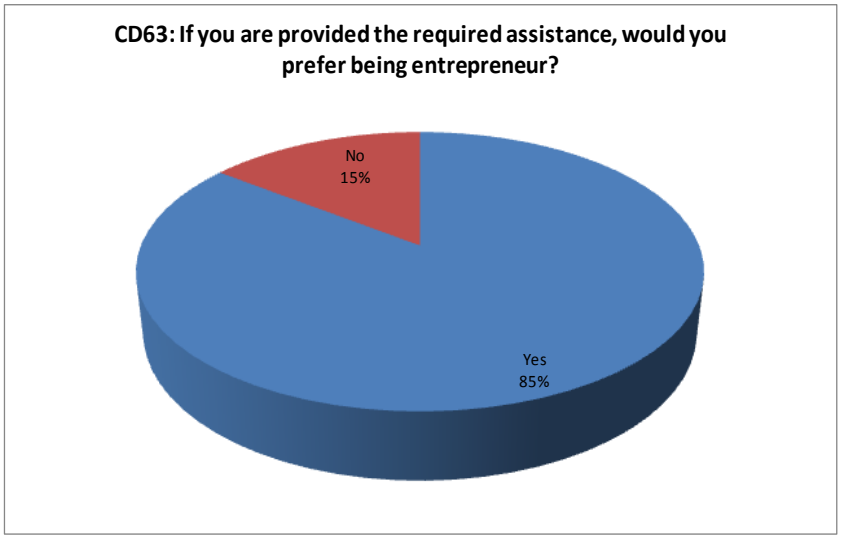
Figure 35: Percentage distribution of industry employers of this group



5.2.3.14 Question CD 63 Non-entrepreneurs ONLY - If you are provided the required assistance, would you prefer being entrepreneur?

Non-entrepreneurs were asked to indicate if they would consider being an entrepreneur, should they get the required assistance. Figure 36 below shows that **85%** of this group would consider being an entrepreneur if the required assistance is received.

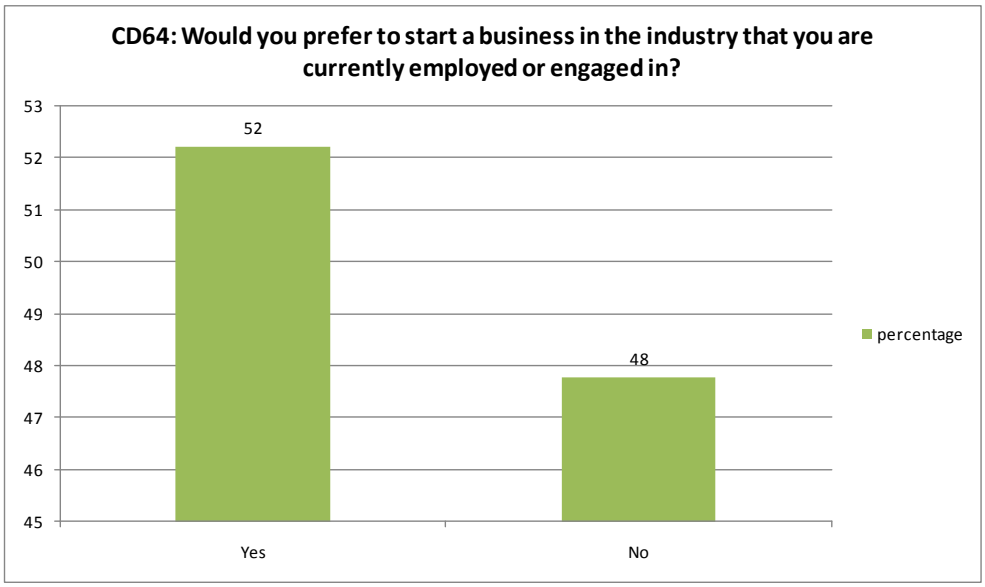
Figure 36: Percentage distribution of consideration of non-entrepreneurs to be entrepreneurs



5.2.3.15 Question CD64 Non-entrepreneurs ONLY - Would you prefer to start a business in the industry that you are currently employed or engaged in?

Non-entrepreneurs were asked if they would start a business in the industry they are currently employed in. Figure 37 below shows that **52 %** and **48%** provided yes and no as an answer respectively.

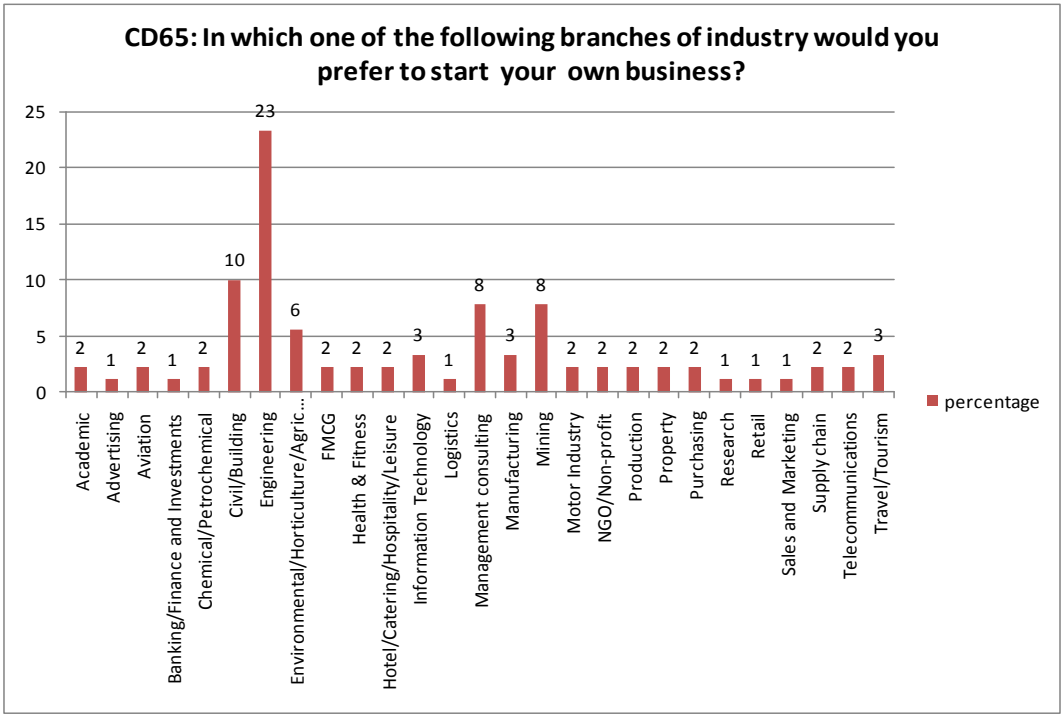
Figure 37: Percentage distribution indicating preference to start a business in the same area of current employment



5.2.3.16 Question CD65 Non-entrepreneurs ONLY - In which one of the following branches of industry would you prefer to start your own business?

Non-entrepreneurs were asked to indicate in which industry they would like to start a business. Figure 38 below shows that the majority of respondents favour starting a business in engineering.

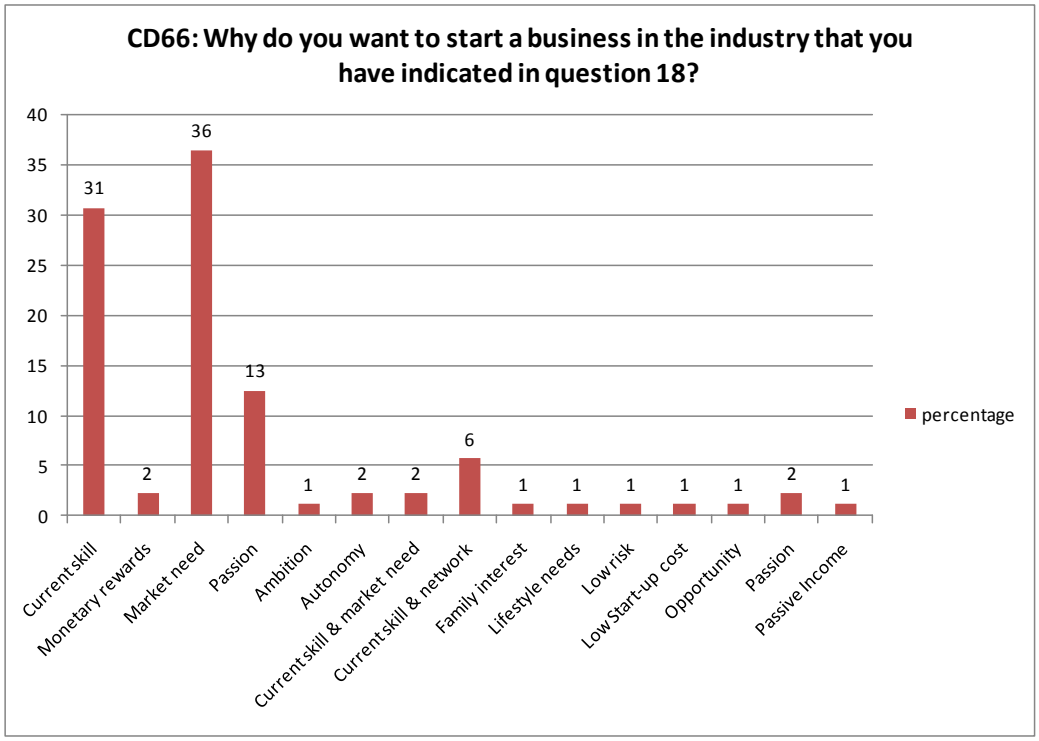
Figure 38: Percentage distribution of attractive industries to start a business



5.2.3.17 Question CD66 Non-entrepreneurs ONLY - Why do you want to start a business in the industry that you have indicated in question 18?

Non-entrepreneurs were asked to state a reason why they would like to start a business in the industries stated in the section above. Figure 39 shows that market need (36%), current skill (31%) and passion (13%) are the leading reasons for this group wanting to start a business in a specific industry.

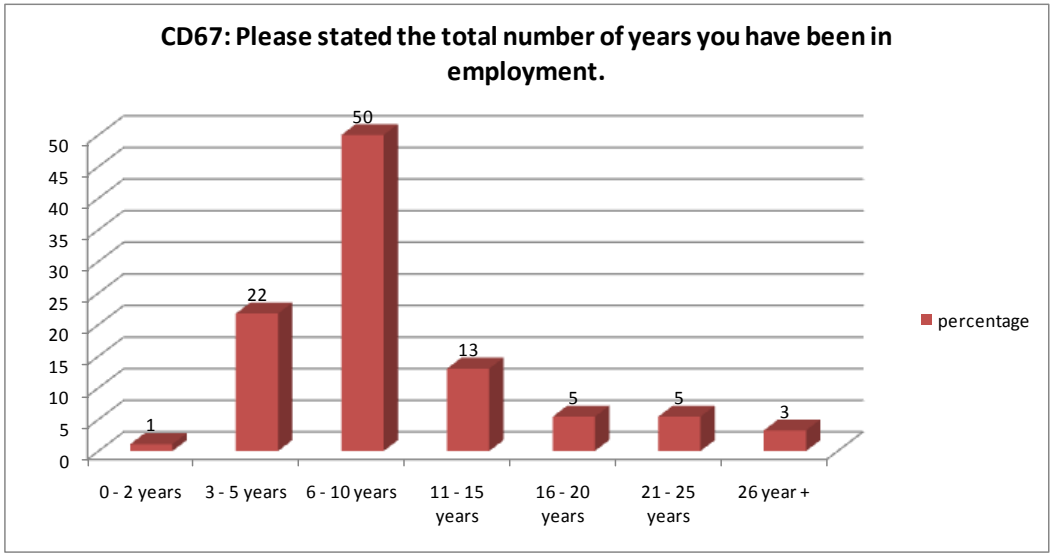
Figure 39: Percentage distribution of reasons for starting a business in a specific industry



5.2.3.18 Question CD67 Non-entrepreneurs ONLY -Please stated the total number of years you have been in employment

Non-entrepreneurs were asked for the total number of years that they have been in employment. Figure 40 below shows that **50%** have been in employment for 6 -10 years, followed by those in employment for 3-5 years **(22%).**

Figure 40: Percentage distributions on total years of employment



5.3 Measuring instrument reliability testing

As alluded to in the previous section, it was a necessary step to establish the reliability of the EO scale prior to using it to compare the EO of the two groups of engineers. Without a reliable EO scale, the comparison of the groups would not be valid. Cronbach's Alpha test results are presented to report the ability of the five dimension 18 item EO scale to produce consistent results. As alluded to in the research methodology section, a Cronbach's Alpha value of less than 0.6 on any of the EO items suggests that the item is unreliable and warrants an investigation of the item attributable to the low Cronbach's Alpha score. The reliability testing results for all EO dimensions are presented below:

5.3.1 Innovativeness

Table 1 below shows the innovativeness results in terms of means, standard deviation, correlation with total and Cronbach's Alpha. Overall, the five items innovativeness dimension has a Cronbach's Alpha 0.63 which indicates that the dimension is reliable and all of these items make up a uni-dimensional EO dimension.

Table 1: Innovativeness dimensions descriptive and Cronbach's Alpha's statistics

Innovativeness: Descriptive Statistics and Cronbach's Alpha Results

Simple Statistics			
Variable	N	Mean	Std Dev
CD25	154	4.73377	1.4554
CD26	154	4.12338	1.71624
CD27	154	4.18831	1.41315
CD28	154	4.8961	1.41961
CD29	154	4.5	1.58938
Cronbach Coefficient Alpha		0.635343	

Cronbach Coefficient Alpha with Deleted Variable		
Deleted Variable	Raw Variables	
	Correlation with Total	Alpha
CD25	0.388564	0.582238
CD26	0.35651	0.602216
CD27	0.41626	0.570052
CD28	0.523936	0.518518
CD29	0.285258	0.633727

5.3.2 Risk taking

Table 2 below shows the risk taking results in terms of means, standard deviation, correlation with total and Cronbach's Alpha. Overall, the four items risk taking dimension has a Cronbach's Alpha 0.60 which indicates that the dimension is reliable and all of these items make up a uni-dimensional EO dimension.

Table 2: Risk taking dimensions descriptive and Cronbach's Alpha's statistics

Risk Taking: Descriptive Statistics and Cronbach's Alpha Results

Simple Statistics			
Variable	N	Mean	Std Dev
CD16	154	4.51299	1.45178
CD17	154	4.20779	1.6595
CD18	154	4.36364	1.4544
CD19	154	3.18182	1.59842
Cronbach Coefficient Alpha		0.601794	

Cronbach Coefficient Alpha with Deleted Variable		
Deleted Variable	Raw Variables	
	Correlation with Total	Alpha
CD16	0.406492	0.514335
CD17	0.45518	0.470171
CD18	0.399563	0.519267
CD19	0.278534	0.610401

5.3.3 Proactiveness

Table 3 below shows the proactiveness results in terms of means, standard deviation, correlation with total and Cronbach's Alpha. Overall, the four items proactiveness dimension has a Cronbach's Alpha 0.65 which indicates that the dimension is reliable and all of these items make up a uni-dimensional EO dimension.

Table 3: Descriptive and Cronbach's Alpha statistics for proactiveness dimension

Proactiveness: Descriptive Statistics and Cronbach's Alpha Results

Simple Statistics			
Variable	N	Mean	Std Dev
CD12	154	5.11688	1.4047
CD13	154	5.03896	1.51197
CD14	154	4.44156	1.50809
CD15	154	4.98052	1.43928
Cronbach Coefficient Alpha		0.65176	

Cronbach Coefficient Alpha with Deleted Variable		
Deleted	Raw Variables	
	Correlation with Total	Alpha
CD12	0.336512	0.645059
CD13	0.502503	0.53207
CD14	0.314678	0.664101
CD15	0.595427	0.466634

5.3.4 Competitive aggressiveness

Competitiveness dimension only comprised of one item and hence reliability testing was not necessary.

5.3.5 Autonomy

Table 4 below shows the autonomy results in terms of means, standard deviation, correlation with total and Cronbach's Alpha. Overall, the four items risk taking dimension has a Cronbach's Alpha 0.45 which indicates that the dimension is unreliable and requires further investigation.

Table 4: Autonomy dimension's descriptive and Cronbach's Alpha's statistics

Autonomy: Descriptive Statistics and Cronbach's Alpha Results

Simple Statistics			
Variable	N	Mean	Std Dev
CD21	154	4.12987	1.6596
CD22	154	4.61688	1.6694
CD23	154	4.03247	1.49692
CD24	154	4.32468	1.47698
Cronbach Coefficient Alpha		0.455096	

Cronbach Coefficient Alpha with Deleted Variable		
Deleted Variable	Raw Variables	
	Correlation with Total	Alpha
CD21	0.241513	0.402776
CD22	0.199372	0.445896
CD23	0.391609	0.255561
CD24	0.216448	0.423146

5.3.6 Overall EO dimension

Cronbach's Alpha testing for the overall EO dimension was performed to determine the overall reliability of the total EO scale. Tests were run with all 18 items and the

result was that a Cronbach's Alpha of 0.78 was calculated indicating that the 18 item EO scale is reliable as shown on Table 5 below.

Table 5: Overall EO construct descriptive and Cronbach's Alpha's statistics (18 items)

18 Item EO Construct : Descriptive Statistics and Cronbach's Alpha Results

Simple Statistics				Cronbach Coefficient Alpha with Deleted Variable		
Variable	N	Mean	Std Dev	Deleted Variable	Raw Variables	
					Correlation with Totals	Alpha
CD12	154	5.11688	1.4047			
CD13	154	5.03896	1.51197	CD12	0.334854	0.77181
CD14	154	4.44156	1.50809	CD13	0.463373	0.762651
CD15	154	4.98052	1.43928	CD14	0.305347	0.773901
CD16	154	4.51299	1.45178	CD15	0.578399	0.755033
CD17	154	4.20779	1.6595	CD16	0.40894	0.766757
CD18	154	4.36364	1.4544	CD17	0.340941	0.77164
CD19	154	3.18182	1.59842	CD18	0.524352	0.758696
CD20	154	4.65584	1.3498	CD19	0.186456	0.782812
CD21	154	4.12987	1.6596	CD20	0.371926	0.769512
CD22	154	4.61688	1.6694	CD21	0.257121	0.778061
CD23	154	4.03247	1.49692	CD22	0.272049	0.776984
CD24	154	4.32468	1.47698	CD23	0.480122	0.761527
CD25	154	4.73377	1.4554	CD24	0.19638	0.781186
CD26	154	4.12338	1.71624	CD25	0.267605	0.776328
CD27	154	4.18831	1.41315	CD26	0.310917	0.774197
CD28	154	4.8961	1.41961	CD27	0.389557	0.768188
CD29	154	4.5	1.58938	CD28	0.501077	0.760619
				CD29	0.322137	0.772889
Cronbach Coefficient Alpha		0.780283				

Considering that some items were specifically identified to have relatively low item-to-total correlations as shown in the Table 5 above (Items 19 and Item 24), As shown in Table 6 below, the Cronbach's Alpha tests were re-run with the unreliable items removed and the result was the a Cronbach's Alpha value for 16 item EO construct was **0.784**, which is a **0.004** improvement from a figure of **0.78** for Cronbach's Alpha value measured for the 18 item EO construct.

Table 6: Overall EO construct descriptive and Cronbach's Alpha statistics (16 items)

16 Item EO Construct : Descriptive Statistics and Cronbach's Alpha Results						
Simple Statistics				Cronbach Coefficient Alpha with Deleted Variable		
Variable	N	Mean	Std Dev	Deleted Variable	Raw Variables	
					Correlation with Total	Alpha
CD12	154	5.11688	1.4047	CD12	0.348796	0.775347
CD13	154	5.03896	1.51197	CD13	0.493435	0.764154
CD14	154	4.44156	1.50809	CD14	0.302732	0.77891
CD15	154	4.98052	1.43928	CD15	0.595822	0.756834
CD16	154	4.51299	1.45178	CD16	0.394424	0.771991
CD17	154	4.20779	1.6595	CD17	0.315322	0.778593
CD18	154	4.36364	1.4544	CD18	0.507003	0.763499
CD20	154	4.65584	1.3498	CD20	0.398188	0.771985
CD21	154	4.12987	1.6596	CD21	0.243786	0.784486
CD22	154	4.61688	1.6694	CD22	0.277679	0.781779
CD23	154	4.03247	1.49692	CD23	0.437358	0.768621
CD25	154	4.73377	1.4554	CD25	0.306293	0.778474
CD26	154	4.12338	1.71624	CD26	0.30574	0.77974
CD27	154	4.18831	1.41315	CD27	0.364169	0.774247
CD28	154	4.8961	1.41961	CD28	0.520155	0.762797
CD29	154	4.5	1.58938	CD29	0.335719	0.776627

5.4 T-tests

As the EO scale has proven to be reliable, t-tests for mean difference tests could be performed to establish if the EO of the two groups is statistically significantly different. The t-tests results are presented in accordance with the research propositions. As alluded to in the research methodology section, for statistical significance difference between mean scores of two groups, the p value should be lower than 0.05

5.5 Research Proposition 1

Engineers who are entrepreneurs will measure significantly higher innovativeness orientation score than the non-entrepreneurial engineers.

Table 7 below shows that the mean difference between the two groups on the autonomy dimension is **0.47** at a **0.97** standard deviation. It is evident from Table 7 that the p-value is higher than 0.05 implying that at 5% confidence level there is no statistical significant difference between the innovativeness EO scores of the two groups. This implies that the research proposition is not supported.

Table 7: Innovativeness dimension descriptive statistics and t-test results

The TTEST Procedure - means , standard deviations and error and P-value						
Dimension	**group**	**N**	**Mean**	**Std Dev**	**Std Err**	**Pr > |t|**
Innovativeness	ENT	52	4.5192	1.0053	0.1394	0.7825
	NONENT	102	4.4725	0.9585	0.0949	
	Diff (1-2)		0.0467	0.9744	0.166	
* Denotes that mean difference is significant at %5 confidence level						

5.6 Research Proposition 2

Engineers who are entrepreneurs will measure significantly higher risk-taking orientation score than non-entrepreneurial engineers.

Table 8 below shows that the mean difference between the two groups on the risk taking dimension is 0.47 at a 1.02 standard deviation. It is evident from Table 8 that

the p-value is lower than **0.05** implying that at 5% confidence level there is statistically significant difference between the risk taking EO scores of the two groups. This implies that the research proposition is supported.

Table 8: Risk taking dimension descriptive statistics and t-test results

The TTEST Procedure - means , standard deviations and error and P-value						
Dimension	**group**	**N**	**Mean**	**Std Dev**	**Std Err**	**Pr > |t|**
Risk Taking	ENT	52	4.3798	1.0067	0.1396	0.0073*
	NONENT	102	3.9069	1.028	0.1018	
	Diff (1-2)		0.4729	1.0209	0.174	
* Denotes that mean difference is significant at %5 confidence level						

5.7 Research Proposition 3

Engineers who are entrepreneurs will measure significantly higher proactiveness orientation score than the non-entrepreneurial engineers.

Table 9 below shows that the mean difference between the two groups on the proactiveness dimension is **0.36** at a standard deviation of **1.014**. It is evident from Table 9 that the p-value is lower than 0.05 implying that at 5% confidence level there is statistically significant difference between the proactiveness EO scores of the two groups. This implies that the research proposition is supported.

Table 9: Proactiveness dimension mean difference scores and t-test results

The TTEST Procedure - means , standard deviations and error and P-value						
Dimension	**group**	**N**	**Mean**	**Std Dev**	**Std Err**	**Pr > |t|**
Proactiveness	ENT	52	5.1346	0.9516	0.132	0.0327*
	NONENT	102	4.7721	1.0449	0.1035	
	Diff (1-2)		0.3626	1.0145	0.1729	

* Denotes that mean difference is significant at %5 confidence level

5.8 Research Proposition 4

Engineers who are entrepreneurs will measure significantly higher competitive aggressiveness orientation score than non-entrepreneurial engineers.

Table 10 below shows that the mean difference between the two groups on the competitive aggressiveness dimension is 0.17 at a 1.35 standard deviation. It is evident from Table 10 that the p-value is higher than 0.05 implying that at 5% confidence level there is no statistical significant difference between the competitive aggressiveness EO scores of the two groups. This implies that the research proposition is not supported.

Table 10: Competitive aggressiveness descriptive statistics and t-test results

The TTEST Procedure - means , standard deviations and error and P-value						
Dimension	**group**	**N**	**Mean**	**Std Dev**	**Std Err**	**Pr > |t|**
Competitive Aggressiveness	ENT	52	4.7692	1.3227	0.1834	0.4543
	NONENT	102	4.598	1.3662	0.1353	
	Diff (1-2)		0.1712	1.3518	0.2303	
* Denotes that mean difference is significant at %5 confidence level						

5.9 Research Proposition 5

Engineers who are entrepreneurs will measure significantly autonomy orientation score than their non-entrepreneurial engineers.

Table 11 below shows that the mean difference between the two groups on the autonomy dimension is 0.45 at a 0.95 standard deviation. It is evident from Table 11 that the p-value is higher than 0.05 implying that at 5% confidence level there is a statistical significant difference between the autonomy EO scores of the two groups. This implies that the research proposition is supported.

Table 11: Autonomy dimension descriptive statistics and t-test results

The TTEST Procedure - means , standard deviations and error and P-value						
Dimension	**group**	**N**	**Mean**	**Std Dev**	**Std Err**	**Pr > |t|**
Autonomy	ENT	52	4.5769	0.9821	0.1362	0.0069*
	NONENT	102	4.1225	0.9352	0.0926	
	Diff (1-2)		0.4544	0.9512	0.1621	
* Denotes that mean difference is significant at %5 confidence level						

5.10 Research Proposition 7

The uni-dimensional EO construct of engineers who are entrepreneurs will measure significantly higher than of non-entrepreneurial engineers.

Table 12 below shows that the mean difference between the two groups on the overall 18 item five dimension EO construct is 0.30 at a 0.68 standard deviation. It is evident from Table 12 that the p-value is higher than 0.05 implying that at 5% confidence level there is statistical significant difference between the autonomy EO scores of the two groups. This implies that the research proposition is supported.

Table 12: Overall 18 item five dimensions EO construct descriptive statistics and t-test results

The TTEST Procedure - means , standard deviations and error and P-value						
Dimension	**group**	**N**	**Mean**	**Std Dev**	**Std Err**	**Pr > |t|**
All Five Dimensions (EO CONSTRUCT)	ENT	52	4.6517	0.6888	0.0955	0.0095*
	NONENT	102	4.3426	0.6825	0.0676	
	Diff (1-2)		0.3091	0.6846	0.1167	
* Denotes that mean difference is significant at %5 confidence level						

5.11 Chi-square tests

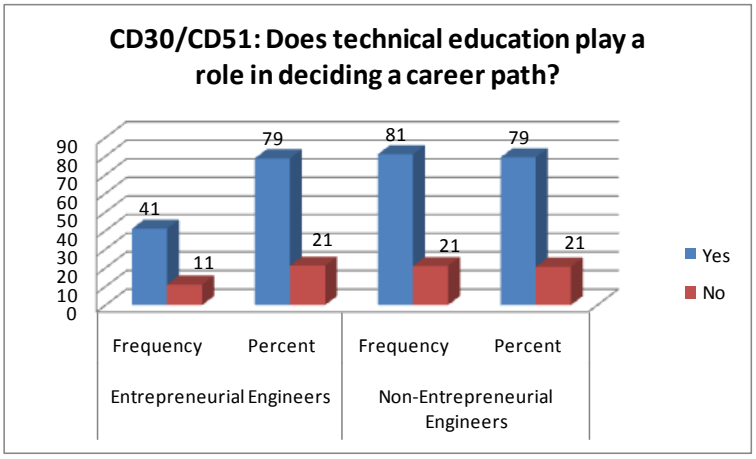
Chi-square tests were used to test for significance between frequency distributions scores of the two engineers groups in relation to some of the situational factors. As alluded to in the research methodology section, some situational factor questions were directed at both groups whereas others where specific to each group. Chi-

square tests were only performed for the situation factors which both groups answered and the purpose is to get a collective understanding of what factors are considered to be hindrances and enablers of entrepreneurship within South Africa.

5.11.1.1 Question CD 30 /CD51- Does technical education play a role in deciding a career path?

All respondents were asked to provide an option on whether or not education plays a role in deciding a career path. Figure 41 below indicated 79% of both groups think that technical education plays a role in deciding a career path.

Figure 41: Percentage and frequency distribution on the role of technical education on choice of a career



It is evident from Table 13 below that the p-value is higher than 0.05 implying that at 5% confidence level there is no statistical significant difference between the two

engineers groups in relation to this question. This result shows that both engineer groups think that technical education plays a role on career choice.

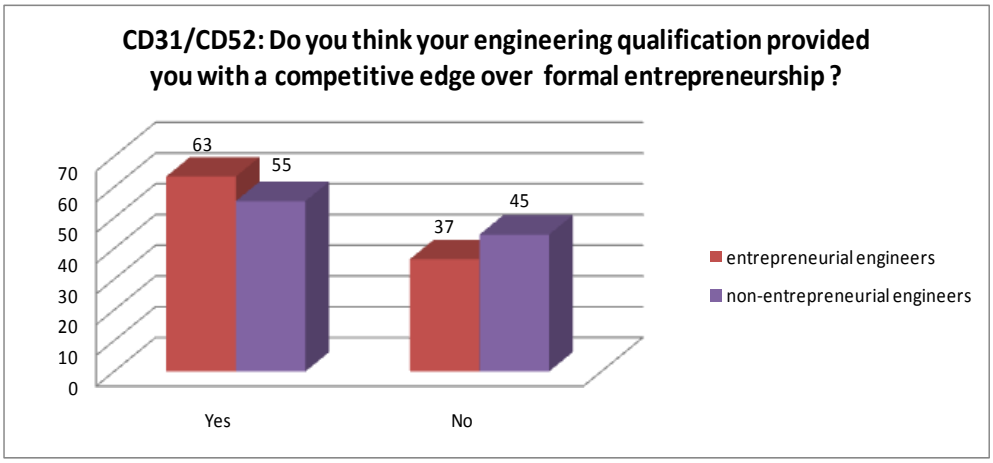
Table 13: Chi-square test results for CD30/CD51

Chi-square Results		
Variable	**value**	**Probability**
CD30/CD51	0.0067	0.9348
*Denotes statistically significance difference at 5% confidence level		

5.11.1.2 Question CD 31/D52 - Do you think your engineering qualification provided you with a competitive edge over formal entrepreneurship to become an entrepreneur.

All respondents were asked if their engineering qualification has provided them with a competitive edge over formal entrepreneurship to become an entrepreneur. Figure 42 below shows that 63% of entrepreneurs compared to 37% of non-entrepreneurs think that engineering provides a competitive edge over formal entrepreneurship training to become an entrepreneur.

Figure 42: Percentage Distribution of Engineering Qualification Competitive Edge



It is evident from Table 14 below that the p-value is higher than 0.05 implying that at 5% confidence level there is no statistical significant difference between the two engineers groups in relation to this question. This results show that both engineer groups think that the engineering qualification has provided them with a competitive edge over formal entrepreneurship qualification.

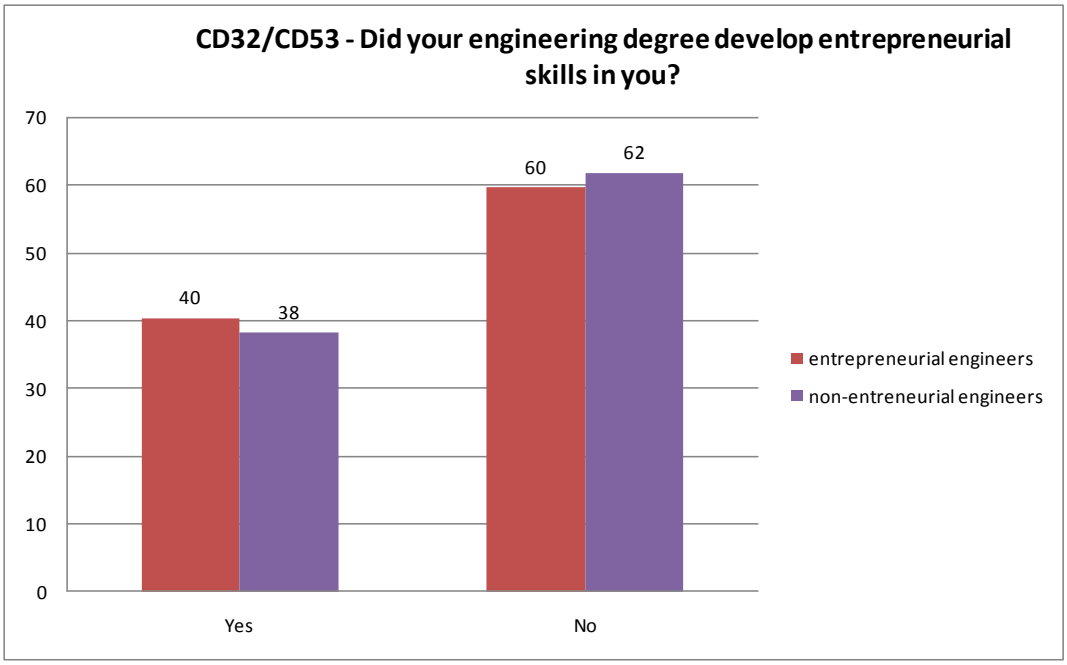
Table 14: Chi-square results for CD31/CD52

Chi-square Results		
Variable	**value**	**Probability**
CD31/CD52	0.9065	0.341
*Denotes statistically significance difference at 5% confidence level		

5.11.1.3 Question CD 32/CD53 - Did your engineering degree develop entrepreneurial skills in you?

All respondents were asked to indicate if their engineering qualification developed entrepreneurial skills in them. Figure 43 below shows that 62% of entrepreneurial compared to 37% of non-entrepreneurial think that their engineering degree developed entrepreneurial skills in them.

Figure 43: Percentage distribution on whether engineering degree develops entrepreneurial skills



It is evident from Table 15 below that the p-value is higher than 0.05 implying that at 5% confidence level there is no statistical significant difference between the two engineers groups in relation to this question. This results show that both engineer

groups think that the engineering qualification has not developed entrepreneurial skills in them.

Table 15: Chi-square results for CD32/CD53

Chi-square Results		
Variable	**value**	**Probability**
CD32/CD53	0.5584	0.7564
*Denotes statistically significance difference at 5% confidence level		

5.11.1.4 Question CD 33/CD54 - Do you feel that a management programme like MBA is necessary before venturing into Entrepreneurship?

All respondents were asked if they feel a management programme is necessary before venturing into entrepreneurship. Figure 44 below shows that 21% of entrepreneurial compared to 45% of non-entrepreneurial think that management programmes are necessary before venturing into entrepreneurship.

It is evident from Table 16 below that the p-value is lower than 0.05 implying that at 5% confidence level there is a statistical significant difference between the two engineers groups in relation to this question. This results show that more non-entrepreneurial engineers than entrepreneurial engineers think that it is necessary for one to have a management qualification prior to venturing into entrepreneurship.

Figure 44: Percentage distribution indicating the perceived necessity of management programmes prior to entering entrepreneurship

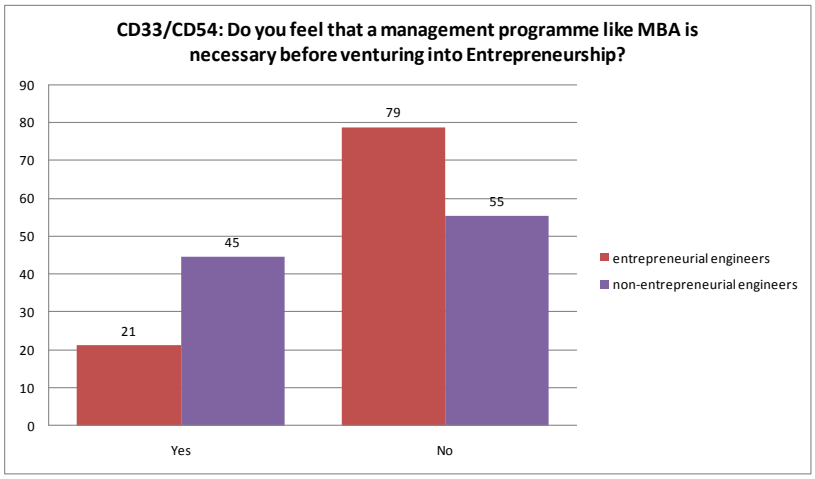


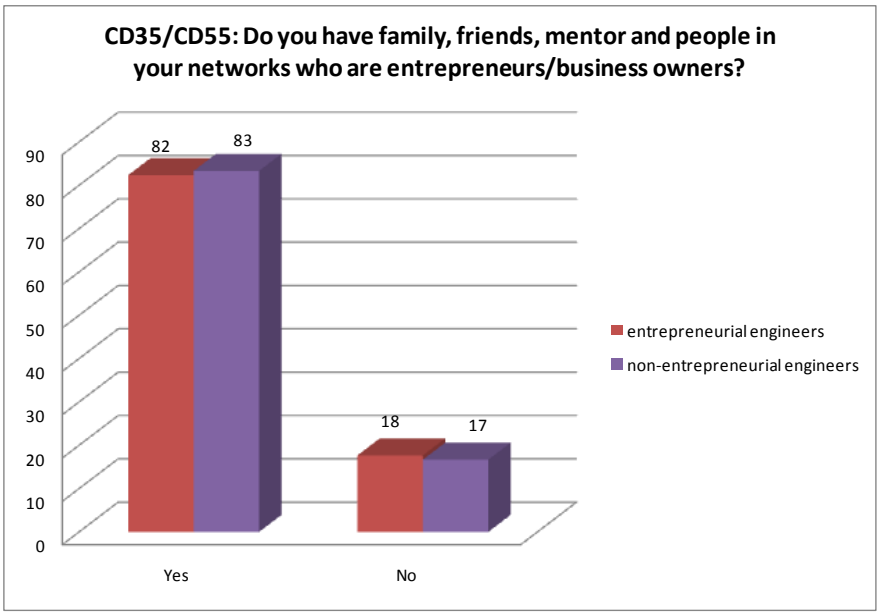
Table 16: Chi-square results for CD33/CD54

Chi-square Results		
Variable	**value**	**Probability**
CD33/CD54	8.1005	0.004*
*Denotes statistically significance difference at 5% confidence level		

5.11.1.5 Question CD 35/CD55 - Do you have family, friends, mentor and people in your networks who are entrepreneurs?

All respondents were asked to indicate if they have a family member, friends, mentor and networks who are entrepreneurs. Figure 45 above shows that that 82% of entrepreneurial compared to 83% of non-entrepreneurial engineers have a family, friend or an individual within their network who is an entrepreneur.

Figure 45: Percentage distribution on social groups that motivated entrepreneurs to own a business



It is evident from Table 17 below that the p-value is higher than 0.05 implying that at 5% confidence level there is no statistical significant difference between the two engineers groups in relation to this question. This results show that both groups have entrepreneurs within their social networks.

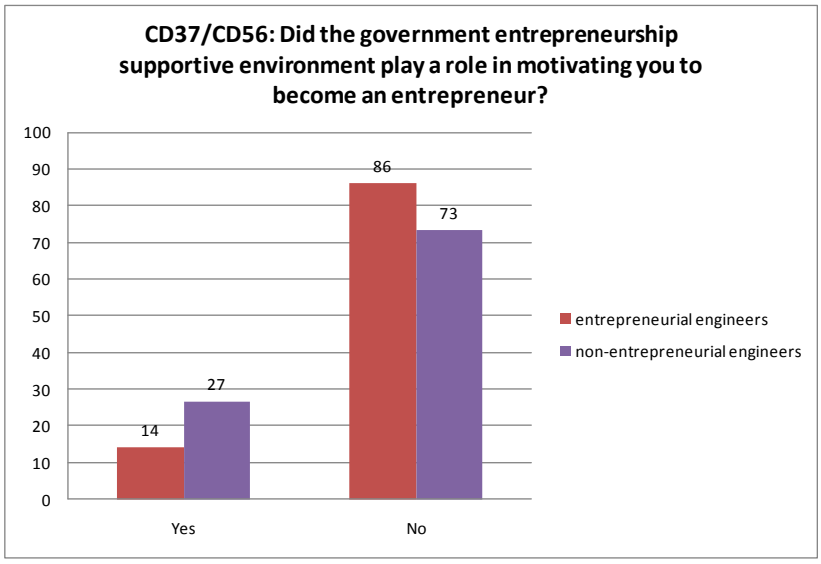
Table 17: Chi-square results for CD35/CD55

Chi-square Results		
Variable	**value**	**Probability**
CD35/CD55	4.0557	0.2555
*Denotes statistically significance difference at 5% confidence level		

5.11.1.6 Question CD 37/CD56 – Did/does the government entrepreneurship supportive environment play a role in motivating you to become an entrepreneur?

Respondents were asked if government played a role in motivating them to become entrepreneurs. Figure 46 show that 14% and 27% of the entrepreneurial and non-entrepreneurial groups respectively think that the government plays a role in motivating them to become entrepreneurs.

Figure 46: Percentage distribution on the supportive role of government on entrepreneurship



It is evident from Table 18 below that the p-value is higher than 0.05 implying that at 5% confidence level there is no statistical significant difference between the two engineers groups in relation to this question. This results show that both engineer

groups think that the government's supportive environment does not play a motivating role for them to become entrepreneurs.

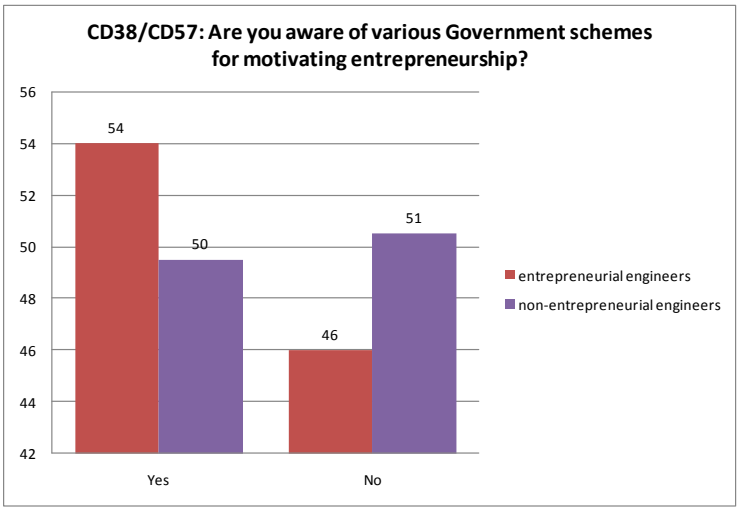
Table 18: Chi-square test results on government's motivating role

Chi-square Results		
Variable	**value**	**Probability**
CD37/CD56	3.1077	0.0779
*Denotes statistically significance difference at 5% confidence level		

5.11.1.7 Question CD 38/CD57 - Are you aware of various Government schemes for motivating entrepreneurship?

All respondents were asked if they are aware of government schemes for motivating entrepreneurship. Figure 47 below show that 54% of entrepreneurial compared to 50% of non-entrepreneurial engineers are aware of these schemes.

Figure 47: Percentage distribution of government motivational role



It is evident from Table 19 below that the p-value is higher than 0.05 implying that at 5% confidence level there is no statistical significant difference between the two engineers groups in relation to this question. This results show there is no difference between the awareness levels of the two groups regarding the government schemes for motivating entrepreneurship.

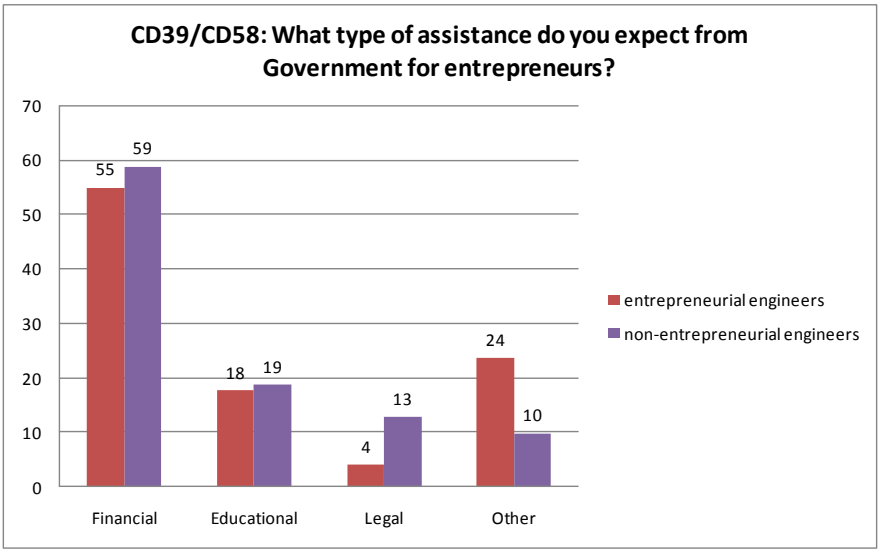
Table 19: Chi-square tests results for CD39/CD58

Chi-square Results		
Variable	**value**	**Probability**
CD39/CD58	8.2373	0.0833
*Denotes statistically significance difference at 5% confidence level		

5.11.1.8 Question CD 39/CD58 - What type of assistance do you expect from Government for entrepreneurs?

All respondents were asked what kind of assistance was expected from government for entrepreneurs. Figure 48 below show both entrepreneurial (55%) and non-entrepreneurial engineers (59%) rank financial assistance as the highest expectation from government.

Figure 48: Percentage distribution on assistance expected from government for entrepreneurs



It is evident from Table 20 below that the p-value is higher than 0.05 implying that at 5% confidence level there is no statistical significant difference between the two engineers groups in relation to this question. This results show these two groups expect different types of assistance from government, from the figure 48 the biggest gap between two groups responses was on Other types and Legal Assistance.

Table 20: Chi-square results for CD39/CD58

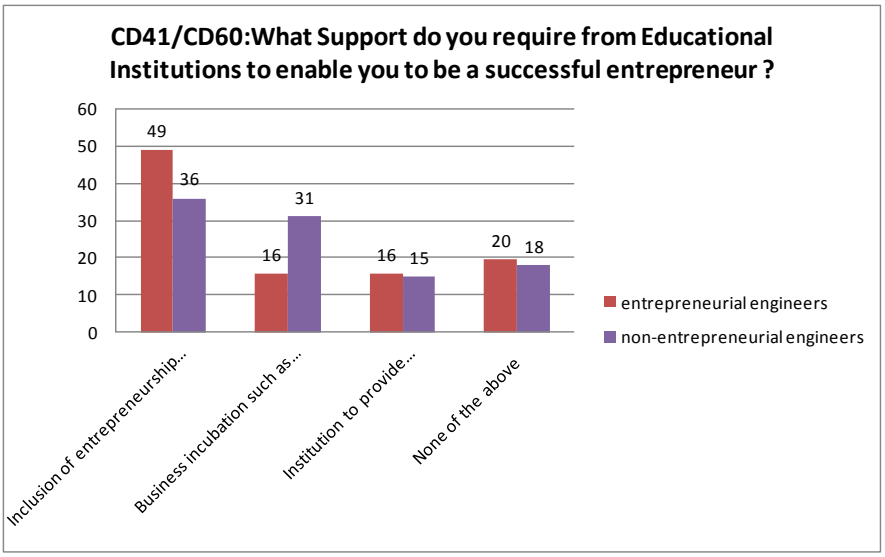
Chi-square Results		
Variable	**value**	**Probability**
CD39/CD58	8.2373	0.0833

*Denotes statistically significance difference at 5% confidence level

5.11.1.9 Question CD 41/CD60 - What Support do you require from Educational Institutions to enable you to be a successful entrepreneur?

All respondents were asked to state what education institutions can do to enable entrepreneurship. Figure 49 below shows that both the majority of the entrepreneurial (49%) and 36% non-entrepreneurial (36%) groups think that entrepreneurship should be included in the engineering curriculum.

Figure 49: Percentage distribution of support required from educational institutions



It is evident from Table 21 below that the p-value is higher than 0.05 implying that at 5% confidence level there is no statistical significant difference between the two engineers groups in relation to this question. This results show that both groups for instance believe that the engineering qualification should include entrepreneurship modules into the curriculum in order to enable entrepreneurship amongst engineers.

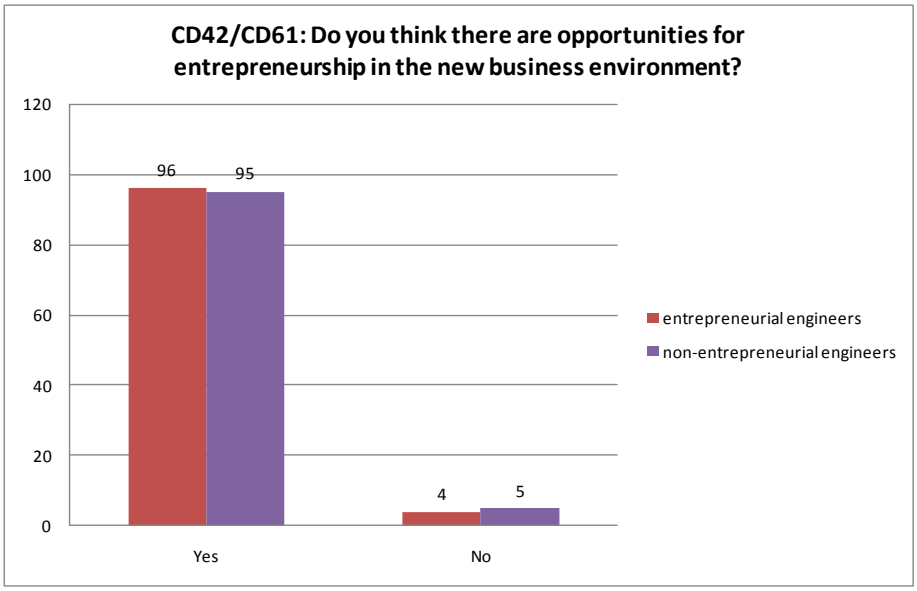
Table 21: Chi-square test results for CD41/CD60

Chi-square Results		
Variable	**value**	**Probability**
CD41/CD60	6.4575	0.1675
*Denotes statistically significance difference at 5% confidence level		

5.11.1.10 Question CD 42/CD61 - Do you think there are opportunities for entrepreneurship in the business environment?

All respondents were asked if they think there are opportunities with the business environment. Figure 50 below shows that 96% of entrepreneurial compared to 95% think that business opportunities do exist.

Figure 50: Percentage distribution of opportunity recognition



It is evident from Table 22 below that the p-value is higher than 0.05 implying that at 5% confidence level there is no statistical significant difference between the two engineers groups in relation to this question. This results show that both groups have same level of business opportunity perception or awareness.

Table 22: Chi-square test results for CD42/CD61

Chi-square Results		
Variable	**value**	**Probability**
CD42/CD61	0.0885	0.7661
*Denotes statistically significance difference at 5% confidence level		

5.12 Factor Analysis – Uni- or Multi-dimensional

Factor analysis was performed to detect if all of these items make up a uni- or multi- dimensional construct. Factor analysis can establish whether a common factor is presented meaning that all items are highly correlated and can be regarded as making up a common factor on a single scale (Blaikie, 2003). This section presents the factor analysis results that comprise of a factor loading, Eigenvalues and variance. This section is meant to provide answers to the following propositions:

5.13 Research Proposition 6

The seven dimensions of EO combine to make a uni-dimensional construct.

5.14 Research Proposition 8

The EO construct is multi-dimensional with the each dimension not interrelated with one another.

5.14.1 Factor loading

As discussed in the research methodology section, the author adopted that for a level of significance of 0.01 (two tailed), the minimum factor loading should be 0.30. As evident from Table 23 below, items CD19 and CD24 have factor loading of less than 0.30. This means that these items do not make a statistically

significant contribution to the EO construct. This confirms the results reported in section 5.3.6 that showed that these two items have the lowest item-to-total correlations suggesting that these two items may be unreliable. The rest of the items as indicated in Table 23 have factor loadings greater than 0.30 meaning that each of the items make a statistically significant contribution to the EO construct. Overall, the Cronbach's Alpha of 0.7850 supports the research proposition that the 18 item five dimensions EO construct is uni-dimensional.

Table 23: Factor loading for 18 EO items

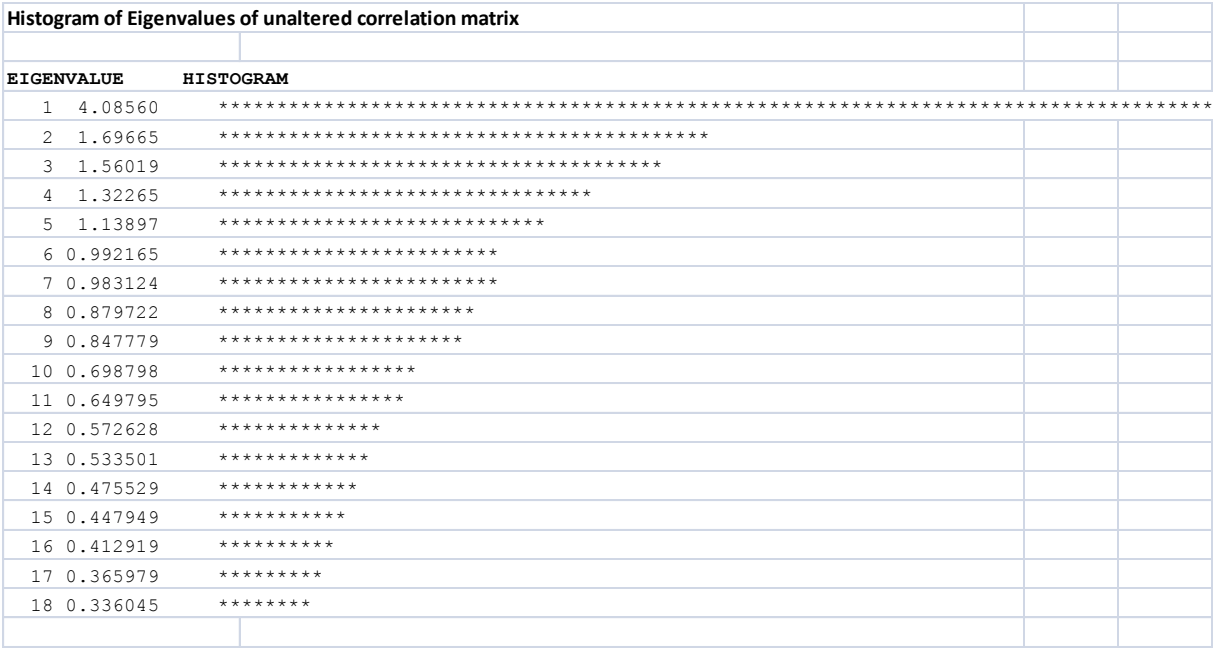
Factor matrix for EO measures: Factor loading		
CD12	1	0.409
CD13	2	0.59
CD14	3	0.392
CD15	4	0.697
CD16	5	0.428
CD17	6	0.4
CD18	7	0.571
CD19	8	0.195
CD20	9	0.456
CD21	10	0.272
CD22	11	0.314
CD23	12	0.488
CD24	13	0.209
CD25	14	0.291
CD26	15	0.359
CD27	16	0.401
CD28	17	0.539
CD29	18	0.371
CRONBACH'S ALPHA FOR ALL VARIABLES = 0.7850		
THIS IS CRONBACH'S STANDARDIZED ALPHA, COMPUTED FROM CORRELATIONS.		

5.14.2 Eigenvalues

A statistical tool Eigenvalue is used to measure the amount of total variance for which each factor account (Blaikie, 2003). The higher the Eigenvalue, the greater the variance explained by that factor (Blaikie, 2003). Blaikie (2003) advocates that only factors with Eigenvalues of greater 1.0 should be considered however also states that a value above 0.70 can be considered. For the purposes of this research an Eigenvalue of greater than 0.7 will be considered significant.

Figure 51 below presents the Eigenvalues obtained. It is evident that items 1 to 11 contributes strongly to the EO construct whereas items 12 to 18 have a relatively weaker contribution. Item 12 to 18 are candidates for exclusion from the scale.

Figure 51: Histogram of Eigen values



5.14.3 Variance explained

Table 24 below indicates that the one factor model explain 18.49% of the variance in the data.

Table 24: Variance on EO scale

FACTOR	VARIANCE EXPLAINED	CUMULATIVE PROPORTION OF VARIANCE IN DATA SPACE	CUMULATIVE PROPORTION OF VARIANCE IN FACTOR SPACE	CARMINES THETA
1	3.3279	0.1849	1.0000	0.7407

5.15 Conclusion

The findings of the quantitative research were presented in the sections above. With the exception of the autonomy dimension, Cronbach's Alpha tests confirmed the reliability of all dimensions. Overall, the Cronbach's Alpha tests confirmed that

the 18 item five dimensions EO scale is reliable and therefore suitable for use for this study. Factor analysis tests confirmed that the 18 item five dimension EO construct is uni-dimensional as opposed to being multi-dimensional as argued by some researchers which were quoted in the literature review.

All research propositions except for two which are related to the innovativeness and competitiveness dimensions were supported by the t-tests for mean difference results. The situational factor chi-square test results have shown that overall the two groups of engineers are subjected to common situational factors.

In the following chapter the results reported in this chapter will be discussed.

CHAPTER 6: DISCUSSION OF RESULTS

6.1 Introduction

The purpose of this chapter is to discuss the findings of this research in view of the literature review and the results presented in Chapter 5 of this document and research propositions.

The main objective of the study was to study the EO of engineers and eight propositions were proposed. The secondary objective was to understand the situational factors that have contributed to engineer's business entry or lack thereof into entrepreneurship. The results pertaining to the EO research proposition are discussed first, followed by the discussion of the situational factors. Additionally, the concluding remarks present an integrated view of the EO and situational factor results.

The descriptive statistics are discussed separately instead they are incorporated into the EO and situational factors discussion sections where relevenant.

Krauss *et al* (2005) suggested that EO the behaviour pattern is expected to be common in entrepreneurs and it will be higher in entrepreneurs than in non-entrepreneurs. In view of the above, it is expected that entrepreneurial engineers will measure higher scores on all dimensions than non-entrepreneurial engineers.

6.2 Entrepreneurial Orientation

6.2.1 Research Proposition 1

Entrepreneurial engineers will measure significantly higher innovative orientation score than the non-entrepreneurial engineers.

6.2.1.1 Introduction

Innovation has been an integral part of entrepreneurship since the dawn of the discipline as Aloulou and Fayolle (2005) cited Schumpeter (1934) who highlighted that entrepreneurship amongst other things is about combining resources in new ways resulting in disruption of market and how the same needs are served. Innovativeness can be defined as individuals' ability to identify new needs and to creatively engage in experimentation with the purpose of introducing a new needed product or service (Rauch *et al*,2009). Frishammar and Horte (2007) have argued that this orientation resembles a culture or climate rather than an outcome.

In view of the above literature, this research proposed that the entrepreneurial engineers will measure a significantly higher innovativeness orientation score than the non-entrepreneurial engineers.

6.2.1.2 Discussion of results

The reliability of the scale in relation to this dimension was determined by calculating Cronbach's Alpha values with a Cronbach's Alpha value of above 0.6 indicating the reliability of the scale. As tabled in the results section, a Cronbach's Alpha of **0.63** was obtained for the innovativeness dimension which suggests that this scale is reliable and it could be used for the purposes of this research.

The descriptive statistics presented in the results section indicated that the entrepreneurial engineers had a higher mean innovativeness score of **4.52** compared to **4.47** score achieved by the non-entrepreneurial counterparts. The t-tests however confirmed that the mean score difference between the two engineer groups is statistically not significantly different at 5% confidence level. This finding is contrary to literature and the research proposition that the entrepreneurial engineers will measure a significantly higher score than their non-entrepreneurial counterparts.

6.2.1.3 Conclusion

Although it is acknowledged that the innovativeness scale was found to be reliable, the research proposal was not supported as the mean difference of the two groups innovativeness score was found not to be statistically different. Research proposition 1 is rejected.

6.2.2 Research Proposition 2

Entrepreneurial engineers will measure significantly higher risk-taking orientation score than non-entrepreneurial engineers.

6.2.2.1 Introduction

Based on Miller's (1983) conceptualisation cited in Rauch *et al* (2009), risk taking involves taking bold actions by venturing into the unknown, borrowing heavily and or committing significant resources to ventures in uncertain environments. Risk taking is considered to be an individual's desire for high returns and proclivity to undertake risky ventures by investing amongst many other resources time, money and skills with purpose of generating higher monetary returns (Masden, 2007 citing Miller & Friesen, 1978).

In view of the above literature, this research proposed that the entrepreneurial engineers will measure a significantly higher risk taking orientation scores that the non-entrepreneurial engineers.

6.2.2.2 Discussion of results

The reliability of the scale in relation to this dimension was determined by calculating Cronbach's Alpha values with a Cronbach's Alpha value of above 0.6 indicating the reliability of the scale. As tabled in the results section, a Cronbach's Alpha of 0.60 was obtained for the risk taking dimension which suggests that this

scale is reliable for measuring this orientation and that it could be used for the purposes of this research.

The descriptive statistics presented in the results section indicated that the entrepreneurial engineers had a higher mean risk taking orientation score of 4.3 compared to 3.9 score achieved by the non-entrepreneurial counterparts. The t-tests confirmed that the mean score difference between the two engineers group is statistically significantly different at 5% confidence level. This finding is supportive of literature and the research proposition that said that the entrepreneurial engineers will measure a significantly higher risk taking orientation score than their non-entrepreneurial counterparts.

6.2.2.3 Conclusion

The research proposition which states that entrepreneurial engineers will measure a significantly higher risk taking orientation score than non-entrepreneurial engineers was supported by the findings of this research. Research proposition 2 is not rejected.

6.2.3 Research Proposition 3

Entrepreneurial engineers will measure significantly higher proactiveness orientation score than non-entrepreneurial engineers.

Proactiveness refers to the ability of individuals to look into the future (Fee & Loo, 2005) thus being able to identify and act on opportunities ahead of competition. It is considered a personal initiative to constantly survey the current environmental conditions and look into the future thereby being able to identify opportunities ahead of competition (Rauch *et al*, 2009; Foo & Lee, 2005).

In view of the above, it was proposed that entrepreneurial engineers will measure significantly higher proactiveness orientation score than their non-entrepreneurial counterparts.

6.2.3.1 Discussion of results

The reliability of the scale in relation to this dimension was determined by calculating Cronbach's Alpha values with a Cronbach's Alpha value of above 0.6 indicating the reliability of the scale. As tabled in the results section, a Cronbach's Alpha of 0.65 was obtained for the proactiveness dimension which suggests that this scale is reliable.

The descriptive statistics presented in the results section indicated that the entrepreneurial engineers had a high mean proactiveness score of 5.13 compared to 4.77 score achieved by the non-entrepreneurial counterparts. The t-tests confirmed that on this dimension, the mean score difference between the two engineers group is statistically significantly different at 5% confidence level.

6.2.3.2 Conclusion

The research proposition which states that entrepreneurial engineers will measure a significantly higher proactiveness orientation score than non-entrepreneurial engineers was supported by the findings of this research. Research proposition 3 is not rejected.

6.2.4 Research Proposition 4

Entrepreneurial engineers will measure significantly higher competitive aggressiveness orientation score than their non-entrepreneurial engineers.

6.2.4.1 Introduction

As discussed in the literature review section, competitive aggressiveness refers to the desire of business owners to assert themselves by striving to earn victory over competitors (Krauss *et al*, 2005). It can be said that individuals who exhibit competitive aggressiveness behaviour will put more effort into surpassing their rivals (Foo & Lee, 2005). This posture is necessary for entrepreneurs because it is commonly understood that the world of business is about being ahead of the pack in order not only to gain market share but to survive as well.

In view of the above, it was proposed that entrepreneurial engineers will measure significantly higher competitive aggressivness orientation score than their non-entrepreneurial counterparts.

6.2.4.2 Discussion of results

Competitive aggressiveness orientation scale comprised of only one item hence reliability testing was not necessary. The t-tests confirmed that on this dimension, the mean score difference of 0.17 at 1.35 standard deviation between the two engineers group is not statistically significantly different at 5% confidence level.

This finding was contrary to the study of Foo and Lee (2005) who found that entrepreneurial individuals had a higher competitive aggressiveness score compared to non- or low entrepreneurial individuals. Furthermore, this research proposition that entrepreneurial engineers will measure a statistically higher competitive aggressiveness score than non-entrepreneurial counterparts was not supported.

6.2.4.3 Conclusion

The research proposition which states that entrepreneurial engineers will measure a significantly higher competitive aggressiveness orientation score than non-entrepreneurial engineers was supported by the findings of this research. Research proposition 4 is rejected.

6.2.5 Research Proposition 5

Entrepreneurial engineers will measure significantly higher autonomy orientation score than the non-entrepreneurial engineers.

6.2.5.1 Introduction

As discussed in the literature review section, autonomy is defined as the ability of an individual to work independently, make decisions and take actions aimed not at only generating idea but turning them into an entrepreneurial venture as well (Lumpkin and Dess, 1996). Burgelman cited in Lumpkin *et al (*2009) advocates that when autonomy is encouraged and permitted to thrive, it becomes an element of new venture development and growth. Additionally, Krauss *et al* (2005) has argued that autonomy is higher in business owners than in non-business owners such as managers.

In view of the above literature, this research proposed that the entrepreneurial engineers will measure a significantly higher autonomy orientation scores that the non-entrepreneurial engineers.

6.2.5.2 Discussion of results

The reliability of the scale in relation to this dimension was determined by calculating Cronbach's Alpha values with a Cronbach's Alpha value of above 0.6 indicating the reliability of the scale. As tabled in the results section, a low Cronbach's Alpha of 0.45 was obtained for the autonomy dimension which suggests that this scale is unreliable. This unreliable result for autonomy was consistent with Lumpkin *et al* (2009) who concluded that although the new autonomy dimension content is adequate to measure the autonomy factor, it is

necessary to perform discriminant and concurrent validity testing with the other four dimensions in order to refine it.

The descriptive statistics presented in the results section indicated that the entrepreneurial engineers had a high mean autonomy score of 4.6 compared to 4.1 score achieved by the non-entrepreneurial counterparts. The t-tests confirmed that on this dimension, the mean score difference between the two engineers group is statistically significantly different at 5% confidence level. Although the autonomy dimension scale was found to be unreliable, the statistically significant different results from the two groups are accepted to be valid as it is argued by Foo & Lee (2005) that low Cronbach Alpha's are not threat to significant t-test results.

Foo & Lee (2005) made this assertion by citing Hunter & Schmidt (1990) who argued that statistically low Alphas attentuate the effect sizes but do not change signficance levels. Furthermore Pedhazur ad Schmelkin (1990) cited in Foo & Lee (2005) argued that low reliability scales lead to attentuation of correlation co-efficients between variables thus making it difficult to find significant correlation.

6.2.5.3 Conclusion

Although it is acknowledged that the autonomy scale was found to be unreliable, the significant different scores between the two groups on autonomy is considered valid in the light of Hunter & Schmidt (1990) cited in the Foo & Lee (2005) argument. The research proposition which states that entrepreneurial engineers will measure a significantly higher score than non-entrepreneurial engineers is supported by the findings of this research. Proposal 5 is not rejected.

6.2.6 Research Proposition 6

The five dimensions of EO combine to make a uni-dimensional construct or Research Proposition 8: The EO construct is multi-dimensional with the each dimension not interrelated with one another.

6.2.6.1 Introduction

As alluded to in the literature review section, there are two schools of thought when it comes to the dimensionality of the 18 item EO construct. Authors such as Lumpkin *et al* (2006), West III *et al* (2008) citing Lumpkin and Dess (1996), Frishammar and Horte (2007) and Rauch *et al* (2009) have found evidence to support the idea that the EO construct is multi-dimensional.

On the same note, authors such as Naman and Slevin (2003), Rauch et al (2009) and Fulford and Rizzo (2009) have also found evidence to support the view that EO is a uni-dimensional construct in line with convictions of the original EO scale authors Covin and Slevin (1983).

In recognition of the strong arguments presented by both opposing schools of thought in terms of the dimensionality of the EO construct, two propositions each supporting both schools of thoughts were proposed for this research. This study sought to determine whether or not EO is uni- or multi-dimensional.

6.2.6.2 Discussion of results

Factor analysis was performed to detect if all of the 18 items make up a uni- or multi-dimensional EO construct. The factor loading value indicates whether or not the item makes a statistically significant contribution to a factor (Blaikie, 2003). Items of a factor loading of 0.3 and above were considered to make statistically significance contribution to the EO construct. In relation to the results section, it was discovered that one risk taking item coded CD19 and one autonomy item coded CD24 had a statistically insignificant contribution towards the EO construct. The Cronbach's Alpha which was calculated for the entire EO scale including CD19 and CD24 was 0.7850 which lent a strong support to the view that EO is a uni-dimensional construct.

6.2.6.3 Conclusion

The findings of this research support the view that EO is a uni-dimensional construct in line with research proposition 6. Research proposition 6 is not rejected whereas research proposition 8 is rejected.

6.2.7 Research Proposition 7

The uni-dimensional EO construct of entrepreneurial engineers will measure significantly higher than of non-entrepreneurial engineers.

6.2.7.1 Introduction

In the section above it was presented that the findings of this research supports the view that the EO construct is uni-dimensional. It is was also expected that the entrepreneurial engineers will measure significantly higher uni-dimensional EO construct scores than of non-entrepreneurial engineers.

6.2.7.2 Discussion of results

The reliability of the scale in relation to this dimension was determined by calculating Cronbach's Alpha values with a Cronbach's Alpha value of above 0.6 indicating the reliability of the scale. As tabled in the results section, a Cronbach's Alpha of 0.78 was obtained for the overall uni-dimensional EO construct which supports the view that it is reliable.

The descriptive statistics presented in the results section indicated that the entrepreneurial engineers had a high mean uni-dimensional EO construct score of 4.65 compared to 4.34 score achieved by the non-entrepreneurial counterparts. The t-tests confirmed that on this dimension, the mean score difference between the two engineers group is statistically significantly different at 5% confidence level.

6.2.7.3 Conclusion

The research proposition which states that entrepreneurial engineers will measure a significantly higher uni-dimensional EO construct score than non-entrepreneurial

engineers was supported by the findings of this research. Research proposition 7 is not rejected.

6.3 Situational Factors

6.3.1 Introduction

The second objective was to understand the situational factors that promote or hinder entrepreneurship in South Africa as perceived by the population group. On the same note, it was to establish if the entrepreneurial engineers differed from their non-entrepreneurial counterparts in terms of their perceptions of these situational factors.

As alluded to in the literature review section, these situational factors can be classified as those contributing to the entrepreneurial orientation, supportive environment and cooperative environment. In view of the above, the results will be amalgamated and discussed in a situational factor themed manner. Additionally, the business opportunity recognition within the current business environment is highlighted.

6.3.2 Entrepreneurial Orientation Themed Situational Factors

Entrepreneurial orientation as discussed is shaped by social factors such as culture, work experience, education and role models amongst many other factors (Norman & Nieuwenhuizen, 2009).

6.3.2.1 Question CD 35/CD55 - Do you have family, friends, mentor and people in your networks who are entrepreneurs?

In view of Pownall and Lawson (2005), and Domke-Damonte *et al* (2008) who advocate that the availability of entrepreneurial role models in an environment contributes positively towards individuals making entrepreneurial decisions, the result that showed that a high percentage (82%) of entrepreneurial engineers that have entrepreneurial role models was expected.

A high percentage (83%) of non-entrepreneurs also indicated the existence of entrepreneurial role models within their networks. Although a high score on entrepreneurial role models was not expected from the non-entrepreneurial group on the basis of their current non-entrepreneurial status, this research found that 78% of non-entrepreneurs are intending to be entrepreneurs. This is acknowledged and it further supports Pownall and Lawson (2005) and Domke-Damonte et al's (2008) view that states that individuals who are exposed to entrepreneurial role models will seek to be entrepreneurial as well.

In view of the above and another result presented in chapter 5 that showed that from a chi-square test there is no statistically significant difference between the two groups in terms of role models, it is not surprising that chi-square tests showed that there was no statistically significant difference between the two groups in terms of presence of entrepreneurial role models in both groups social circles.

6.3.2.1 *Question CD 38 – In which one of the following branches of industry would you prefer to start your business?*

6.3.2.2 *Question CD 39 – Why would you want to start a business in the industry that you have indicated in CD38?*

Non-entrepreneurs were asked to specify an industry which they would prefer to start a business in and to stated reasons for the choice. The majority indicated engineering which is the field they are currently engaged in and leading two reasons for the choice was market opportunities and current skill. The finding is supportive of Baron's (2007) suggestion that individuals will recognise opportunities in the area of their expertise.

6.3.3 Supportive Environment Themed Situational Factors

Supportive environment refers to amongst many factors such business development, mentoring, funding and mentoring which are offered by government agencies (Norman & Nieuwenhuizen, 2009). Four situational factor questions were included in the questionnaire and the results are discussed below.

6.3.3.1 *Question CD 37/CD56 – Did/does the government entrepreneurship supportive environment play a role in motivating you to become an entrepreneur? And Question CD 38/CD57 - Are you aware of various Government schemes for motivating entrepreneurship?*

The chi-square tests results presented in the results section indicated that there was no statistically significant difference of opinion between the two groups with regards to government's motivating role and awareness of government entrepreneurship schemes.

Domke-Damonte *et al* (2008) claim that entrepreneurial activity is shaped by a social setting that includes government agencies that contribute towards carving the culture of entrepreneurship within a nation. Lumpkin and Dess (1996) cited in Fulford and Rizzo (2009) added to the above and stated argument by stating that external environment that includes governments supportive environment shape the EO of individuals which is a necessary behavioural trait that entrepreneurs ought to possess to become entrepreneurs.

In view of the above, it is concerning for a country such as this one that is looking to entrepreneurship to grow the economy and create jobs to find that these results that have shown that the majority of the surveyed group think that the government has not created a supportive environment that is conducive for entrepreneurship. It is equally concerning as the majority of the same respondents indicated that they are not aware of government schemes that motivate entrepreneurship.

6.3.3.2 Question CD 39/CD58 - What type of assistance do you expect from Government for entrepreneurs?

The chi-square results presented in chapter 5 showed that there was statistical significant difference between the two groups in terms what their expectations about the type of government assistance that is required. Although these two

groups were statistically different in their responses, it is noted that the majority and almost half of group's respondents indicated the need for financial assistance from government. This is in line with the response that specifies financial assistance as one of the leading resources that entrepreneurs need assistance with (Maas & Harrington, 2008).

6.3.4 Cooperative Environment Themed Situational Factors

Cooperative environment refers to institutions actively involved in promoting entrepreneurship such as financial and academic institutions (Norman & Nieuwenhuizen, 2009). In line with the situational factor questions included in the questionnaire, two cooperative environment themes, namely education and financial institutions' contribution to entrepreneurship will be discussed.

6.3.4.1 Education

6.3.4.1.1 Question CD 31/D52 - Do you think your engineering qualification provided you with a competitive edge over formal entrepreneurship to become an entrepreneur.

6.3.4.1.2 Question CD 32/CD53 - Did your engineering degree develop entrepreneurial skills in you?

6.3.4.1.3 Question CD 33/CD54 - Do you feel that a management programme like MBA is necessary before venturing into Entrepreneurship?

6.3.4.1.4 Question CD 41/CD60 - What Support do you require from Educational Institutions to enable you to be a successful entrepreneur?

The chi-square tests results presented in Chapter 5 indicated that there was no statistically significant difference between the two groups view about whether engineering has developed entrepreneurial skills in them and about the support that is required from academic institutions. To recap, the majority within both groups indicated that engineering did not develop entrepreneurial skills in them and that academic institutions should include a module in entrepreneurship in engineering qualification to enable entrepreneurship. Considering that, Baron and Ward's (2004) findings that knowledge is a key contributing factor towards entrepreneurial opportunity identification, the findings of this research suggests that low entrepreneurial activity amongst engineers in South Africa can be attributed to lack of exposure to entrepreneurial knowledge. The above claim is also made on the basis that West III *et al* (2008) citing Green and Brown (1997) have also stated that knowledge a component of human capital has been identified as the most critical for new entrepreneurial venture creation compared to other resources such as financial, social, physical and organisational. This finding is disheartening considering that considering that this era is considered to be a knowledge

economy where individuals use a variety of combinations of knowledge both technical and business related to compete and innovate (Carlaw *et al*, 2006).

The above findings echoes the sentiments contained in the GEM report that has generally identified education and training as the most crucial factor that hinders entrepreneurship in South Africa (Mass & Harrington, 2009). Esbach *et al* (2009) citing GEM report 2006 also advocated that generally potential entrepreneurs in South Africa lack the mindset and skills to become true entrepreneurs. Furthermore, Esbach *et al* (2009) found engineering student is South Africa to be lacking these skills as well.

The majority of both groups of engineers indicated that engineering has provided them with a competitive edge over formal entrepreneurship courses to be entrepreneurs and the chi-square test results have shown no statistically significant difference between the two engineer groups' scores in relation to this matter. The majority of both groups also think that entrepreneurship modules should be included in the engineering curriculum. Should inclusion of entrepreneurship education into engineering be achieved, it will contribute positively towards entrepreneurship amongst graduate engineers as Norman & Nieuwenhuizen (2009) have advocated that entrepreneurship can be developed by education and it can be learnt. The majority of non-entrepreneurs indicated that it is necessary to study business management related courses prior to venturing into entrepreneurship whereas their non-entrepreneurial indicated not.

The complementary results in which the respondents value both their technical background and entrepreneurship is positive for advancement of entrepreneurship

considering Carlaw et al's (2006) assertion that economic growth within the knowledge economy is fuelled by technological change in which individual pieces of technical knowledge is combined with other kinds of knowledge to form innovative ideas.

The realisation by all surveyed individuals that both management related studies and entrepreneurship are important for entrepreneurship is also supported by Magnanti (2005) cited in Esbach (2009) who concluded that together the combination of management and engineering provide an ideal underpinning for technology innovation and entrepreneurship.

6.3.4.2 Financial Themed Situational Factors

6.3.4.2.1 Question CD 40/CD59 - What type of Financial help did you get (entrepreneurs) or would you require (non-entrepreneurial) from Financial Institutions to start a business?

Entrepreneurs were asked about what financial assistance they have received from financial institutions and non-entrepreneurs were asked what financial assistance they would require from financial institutions. The results revealed that the majority of entrepreneurial (63%) engineers stated that they did not get any assistance from financial institutions. On the same note, the majority (92%) of non-entrepreneurial engineers indicated that they would require assistance from financial institutions to

start an entrepreneurial venture. The majority of non-entrepreneurs indicated that the reason they currently do not own a business is because of finances (39%) followed by risk (32%).

Considering Minniti and Levesque (2008) citing Evans and Jovanovic's (1989) findings that low-wealth potential entrepreneurs may not be unable to start an entrepreneurial venture due to lack of financial resources, it is concerning that some of the 78% of the non-entrepreneurial engineers may not be able to start an entrepreneurial venture. This concern is raised on a backdrop of the GEM report that records that access to finance remains one the factors that hampers entrepreneurship in South Africa (Mass & Harrington, 2008).

6.3.5 Opportunity Recognition

6.3.5.1 Question CD 42/CD61 - Do you think there are opportunities for entrepreneurship in the business environment?

The majority of non-entrepreneurs (95%) have indicated that they think there are ample opportunities in the business environment. The perception of business opportunities as perceived by non-entrepreneurs was not statistically different from their entrepreneurial counterparts as confirmed by the chi-square tests presented in results section of this research.

In view of the results that showed that 78% of non-entrepreneurs intend to become entrepreneurs it is not surprising that their perception of business opportunities is not statistically different from their non-entrepreneurial counterparts. The above claim is made in view of Pownall and Lawson (2005) who argued that individuals will become entrepreneurial should they recognise the desirability and feasibility of a new entrepreneurial venture.

Additionally, since the dawn of entrepreneurship studies it has been propounded that entrepreneurship entails opportunity searching and recognition (Madsen, 2007), as this result showed the evidence that even the non-entrepreneurial engineers have recognised the available opportunities. This sends a positive message about the possibility of these individuals entering entrepreneurship provided other situational factors are met.

6.4 Concluding Remarks

6.4.1 Entrepreneurial Orientation Conclusion

With the exception of the competitive aggressiveness dimension and innovativeness, the rest of research propositions that proposed that entrepreneurial engineers will measure significantly higher score than non-entrepreneurial counterparts on each individual EO dimension (autonomy, risk taking, autonomy and proactiveness) were supported. Additionally, the 18 item five dimensions EO was found to be uni-dimensional.

As highlighted in the body of this report, various studies have found evidence that support a uni-dimensional whereas others a multi-dimensional EO construct. These contradictory findings highlight that there are factors that moderate the EO construct and that further research ought to be carried out to identify the various contexts in which dimensionality is evident and relevant.

6.4.2 Entrepreneurial Orientation Conclusion

Chi-square tests results showed that two groups of engineers were not statistically different when relating to situational factors. Based on literature discussed in chapter 2 it was expected that the entrepreneurial engineers would have different and more favourable situational factors which would have shaped their entrepreneurial behaviour.

However at the backdrop of the idea that 78% of non-entrepreneurial engineers intend to become entrepreneurs, considering that they may enter entrepreneurship, this result may not be considered

6.4.3 Integrated view on entrepreneurial orientation and situational factors

Although it was expected that the entrepreneurial engineers would have more favourable situational factors compared to their non-entrepreneurial counterparts, the findings of this research did not confirm that expectation; instead there was more in common than different. Apart from having similar situational factors, the majority of the non-entrepreneurial had a strong indication that they have entrepreneurial intent.

As these two groups were found to be similar in their entrepreneurial intent and situational factors, the fact that some are already entrepreneurs and while others are not, may be attributed to just a matter of time or EO difference. The possible explanatory factors for the difference in entrepreneurial status between the two groups could be attributed to differences in EO or entrepreneurial entry timing.

Entrepreneurial entry timing merely means that they will probably become entrepreneurial in the future. The majority of the non-entrepreneurial engineers have indicated that given the required assistance such as financial (biggest need), legal and educational resources, they will become entrepreneurs.

The need for resources to becoming an entrepreneur cannot be undermined in view of Domke-Damonte *et al* (2008) who advocate that the availability of financial resources and government agencies within a social setting are contributing factors towards an individual's decision to become an entrepreneur.

It is considered to have serious implications for entrepreneurship considering that low-wealth potential entrepreneurs may be unable to start an entrepreneurial venture due to lack of finances (Minniti & Levesque, 2008 citing Evans & Jovanovic,1989).

The Chapter 5 results that showed that entrepreneurial engineers measured a statistically significantly higher EO score than non-entrepreneurs. This may explain why some of the engineers are currently entrepreneurs whereas others regardless of the findings that they are similar in terms of intent and situational factor are still employees. This view is supported by West III *et al* (2008) who found that although knowledge resource (both groups have same engineering qualification) may be a

contributing factor towards entrepreneurship, it is only effective in the presence of an entrepreneurial orientation. Knowledge resource is not only limited to academic qualification and experience but extends to include “know-how” and “know-what” related to specific skills to identify opportunities, which the results of this research have shown that both groups have.

The view that EO has been found to be a differentiating factor between entrepreneurs and non-entrepreneurs was not only confirmed by the results of the EO t-testing for difference, the situational factors also highlighted the matter.

To illustrate the difference, the results presented in Chapter 5 showed that 92% non-entrepreneurs have indicated that they require financial assistance to start a business whereas 63% of the entrepreneurs who started a business did not get financial assistance.

It is inferred that latter group may have also required financial assistance but the fact that a business was started even though 63% of them did not get financial assistance highlights the difference between the two groups given the same entrepreneurship cooperative environmental constraint.

Carlaw *et al* (2006) has highlighted that the current era denotes a knowledge economy in which knowledge is the basis of innovation and competitiveness. The need to invest in human capital particularly entrepreneurship education cannot be over-emphasised considering that human capital creates economic growth through knowledge spill overs (Acs et al, 2004&2005 cited in Minniti & Levesque, 2008).

Chapter 6: Discussion Of Results

One of the key findings was that the majority of all respondents indicated that engineering qualifications do not impart entrepreneurial skills and that entrepreneurship modules should be introduced to the curriculum. The above findings echoes the sentiments contained in the GEM report that has generally identified education and training as the most crucial factor that hinders entrepreneurship in South Africa (Mass & Harrington, 2009).

Esbach *et al* (2009) citing GEM report 2006 also advocated that generally potential entrepreneurs in South Africa lack the mindset and skills to become true entrepreneurs. Furthermore, Esbach *et al* (2009) found engineering students in South Africa to be lacking these skills as well. In order to improve entrepreneurial activity amongst engineering graduates, various global universities have already incorporated entrepreneurial education into engineering curriculum (Wang & Klepper, 2001; Wood et al, 2004) and (Justa, Nogueira, Rodrigues, & Pacheco, 2006)

Overall the situational factors highlighted the need for institutions and government agencies to play a more active role in motivating entry into entrepreneurship. The following section presents the conclusion and recommendation of this study.

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

In recognition that success or failure of economies such as South Africa has been attributed by in large to the performance of entrepreneurs (McMillan & Woodruff, 2002 cited in Minniti & Levesque, 2008), the idea to conduct a study in entrepreneurship within South Africa was born. The EO of engineers is the main focus of the research as it is known to be a personal trait that represents a promising area of study for building a relevant body of knowledge about entrepreneurship (Rauch *et al*, 2009). Entrepreneurship studies in South Africa are necessary, considering that the country is now focused on enterprise development as a solution to social issues such as the high unemployment rate of 26% (Sasix, 2009). The study is focused on engineers as literature supported the view that engineering entrepreneurship could help in creating the engine that drives the South African economy (Coetzer, 2006 cited in Esbach, 2009).

This chapter consists of seven sections namely, *the overview of literature review, research objectives, research propositions and results, limitations of study, conclusion, recommendations and suggestion for future research*.

7.2 Overview of literature review

Success or failure of transition economies such as South Africa has been attributed by a large proportion to the performance of entrepreneurs (McMillan & Woodruff, 2002 cited in Minniti & Levesque, 2008). An entrepreneur is defined as one who organises, manages and assumes the risks and reaps the benefits of starting a new entrepreneurial venture (Wood *et al*, 2004). New entrepreneurial ventures have been found to be instruments of change and growth for economies (Aloulou and Fayolle, 2005).Currently the entrepreneurship levels in South Africa are low compared to other developing nations, for example entrepreneurs only contribute 35% gross domestic product (GDP) compared with 60% in devloping economies comparable to South Africa - namely India and Brazil (Mass & Harrington, 2008). The individual entrepreneur is an essential part of the process through which these new ventures are created (Baron, 2007), hence the study was focused on studying entrepreneurship on an individual level.

Krauss *et al* (2005) suggested that the EO behaviour trait is expected to be found to be common in entrepreneurs and higher in entrepreneurs than in non-entrepreneurs. Krauss *et al* (2005) is supported by Domke-Damonte *et al* (2008) who cited Grant & Bush (1995) by saying that EO provides an insight into the predispositions that an individual may carry with him or her into a business setting. Additionally, these authors citing Lumpkin and Des (1996) suggested that EO provides an indicator of the requisite behavioural initiatives that are conducive to new venture development. The previous paragraph identified that in order to understand entrepreneurship on a national level, a study focused on an individual

entrepreneur is important. This paragraph identified that in order to understand an individuals' propensity for entrepreneurial activities, understanding the individuals' EO is important.

Miller (1983) cited in Li, Zhao, Tan and Liu (2008) originally characterised EO by three dimensions namely innovativeness, risk taking and proactiveness. Lumpkin and Des (1996) cited in Rauch *et al* (2009) suggested that two additional dimensions namely competitive aggressiveness and autonomy be added to the EO construct, hence the study focused on a five dimensions of EO.

Linking EO to entrepreneurial entry, Pownall and Lawson (2005) state that an individual is to possess the necessary EO before developing an entrepreneurial intention to be an entrepreneur. Domke-Damonte *et al* (2008) citing Bird (1988) supported the view that entrepreneurial intention is the precursor to entrepreneurial activity as entrepreneurial interest must exist before a business can be started.

This section highlights that both EO and EI are behavioural phenomenon. Baron (2007) stated that some aspects of their behaviour and cognition play a role in their entrepreneurial abilities. The social environment which individuals are part of shapes behaviours and cognition that either promote or hinder entrepreneurial activity (Domke-Damonte, Faulstich& Woodsen III, 2008). Furthermore, Domke-Damonte *et al* (2008) citing Peterson advocate that the social setting as a whole - such as community, government agencies, financial resources, and family issues - form part of the integral national culture which is an environment that contributes towards individuals' likelihood of entering entrepreneurship. Additionally, West III *et al* (2008) found evidence that knowledge which is acquired through education and

working experience amongst other sources is an important resource that is required for gestating entrepreneurship.

The previous paragraphs amongst many other factors identified knowledge to be a key contributor to entrepreneurship. This is ever so important considering Carlaw, Oxley and Walker's (2006) view that the world has become a knowledge economy in which knowledge is a basis of competing, innovation and thus contributing to economic growth. In view of Baron's (2007) findings that certain people recognize opportunities that others may not be able to due to better access to information associated with factors such as being in that particular market, the study focused on engineers was established. This study is relevant considering Baron's (2007) statement above and in recognition of Magnanti (2005) cited in Esbach (2009) who concluded that together the combination of management and engineering provide an ideal underpinning for technology innovation and entrepreneurship.

7.3 Research Objectives

The study's aim was to achieve the three objectives summarised below:

- The main objective is to study the EO of engineers in South Africa and to perform a comparison of EO scores of two groups of engineers' namely entrepreneurial and non-entrepreneurial engineers.
- The first secondary objective was to establish the entrepreneurial intention of the non-entrepreneurial engineers.

- The second secondary objective was to study the situational factors that have contributed towards entrepreneurship entry amongst engineers.

7.4 Research Proposition and Results Revisited

7.4.1 Entrepreneurial Orientation

There are eight research propositions related to the main objective of the study and they are listed below:

7.4.1.1 Entrepreneurial Orientation Proposition and Result Revisited

Research Proposition 1 - Entrepreneurial engineers will measure significantly higher innovative orientation score than the non-entrepreneurial engineers. On the basis of T-test results, this proposition was rejected as there was no statistical significant difference between the mean scores of two engineers' groups on the EO innovativeness orientation.

Research Proposition 2 - Entrepreneurial engineers will measure significantly higher risk-taking orientation score than non-entrepreneurial engineers. On the basis of T-test results, this proposition was not rejected as there was statistical significant difference between the mean scores of two engineers' groups on the EO risk taking orientation.

Research Proposition 3 - Entrepreneurial engineers will measure significantly higher proactiveness orientation score than non-entrepreneurial engineers. On the basis of T-test results, this proposition was not rejected as there was statistical

significant difference between the mean scores of two engineers' groups on the EO proactiveness orientation.

Research Proposition 4 - Entrepreneurial engineers will measure significantly higher competitive aggressiveness orientation score than their non-entrepreneurial engineers. On the basis of T-test results, this proposition was rejected as there was no statistical significant difference between the mean scores of two engineers' groups on the EO competitive aggressiveness orientation.

Research Proposition 5 - Entrepreneurial engineers will measure significantly higher autonomy orientation score than the non-entrepreneurial engineers. On the basis of T-test results, this proposition was not rejected as there was statistical significant difference between the mean scores of two engineers' groups on the EO competitive aggressiveness orientation.

Research Proposition 6 - The seven dimensions of EO combine to make a uni-dimensional construct. This proposition was not rejected as factor analysis provided evidence that EO is a uni-dimensional construct in this context.

Research Proposition 7 - The uni-dimensional EO construct of engineers who are entrepreneurs will measure significantly higher than of non-entrepreneurial engineers. On the basis of T-test results, this proposition was not rejected as there was statistical significant difference between the mean scores of two engineers' groups on the overall EO construct as shown by t-test results.

Research Proposition 8 - The EO construct is multi-dimensional with the each dimension not interrelated with one another. As alluded to above, there was evidence that EO is a uni-dimensional construct hence this proposition is rejected.

7.4.1.2 Entrepreneurial Orientation Reflection on Literature

Krauss *et al* (2005) suggested that EO the behaviour pattern is expected to be common in entrepreneurs and it will be higher in entrepreneurs than in non-entrepreneurs. Findings on proactiveness, autonomy, risk taking and overall EO construct are supportive of literature.

7.4.2 Situational factors

There were no research questions, propositions or hypothesis to tests for the difference in situational factors between the two engineers groups. Instead a wealth of literature about situational factors was covered and a pre-structured questionnaire with situational factors was used. Chi-square tests enabled the comparison of two groups of engineers' responses on specifically eleven situational factors and the literature formed the basis of comparison and discussion of results.

7.4.2.1 Entrepreneurial Orientation Themed Situational Factors

Chi-square test showed that there is no statistically significant difference between the two groups' responses in terms presence of entrepreneurial role models within their networks. Although it was expected to have entrepreneurs with more entrepreneurial role model than non-entrepreneurs the overall result is positive in view of Pownall and Lawson (2005), and Domke-Damonte *et al* (2008) who

advocates that the availability of entrepreneurial role models in an environment contributes positively towards individuals making entrepreneurial decisions

7.4.2.2 Supportive Environment Themed Situational Factors

The chi-square tests showed that there was no statistically significant difference of opinion between the two groups of engineers with regards to government's motivating role, awareness of government entrepreneurship schemes, and expected and required assistance from the government. Both groups indicated that government is not playing a key role in motivating entrepreneurship, half of all sampled engineers are aware of government entrepreneurship initiatives and majority require financial assistance from government. The results indicated on role of government is negative considering that governments contribute towards or lack entrepreneurial culture in a society (Domke-Damonte et al, 2008) (Lumpkin & Dess, 1996) cited in (Fulford & Rizzo, 2009).

7.4.2.3 Cooperative Environment Themed Situational Factors

7.4.2.3.1 Education Themed Situational Factors

Chi-square results showed no statistical significant difference between the two groups as they indicated that engineering does not provide the necessary entrepreneurial skills and that entrepreneurship module should be incorporated into the engineering curriculum.

Considering that engineers indicated that engineering qualification does not impart entrepreneurial skills and in view of Baron and Ward (2004) findings that knowledge is a key contributor to entrepreneurial opportunity identification, it can

be inferred that the lack of entrepreneurial education within an engineering curriculum has hindered entrepreneurship amongst engineers.

Findings support Esbach *et al* (2009) who found evidence that engineering student in South Africa lack entrepreneurial skills, which contributes towards the overall lack of entrepreneurial skills in SA identified by GEM report (Maas & Harrington, 2008).

7.4.2.3.2 Financial Themed Situational Factors

The majority of entrepreneurial engineers indicated that they did not receive financial assistance from financial institutions. The majority of non-entrepreneurial engineers indicated a need for financial assistance in order to become entrepreneurs.

Considering Minniti and Levesque (2008) citing Evans and Jovanovic's (1989) findings that low-wealth potential entrepreneurs may not be able to start an entrepreneurial venture due to lack of financial resources. This concern is raised on a backdrop of the GEM report that records that access to finance remains one the factors that hampers entrepreneurship in South Africa (Mass & Harrington, 2008).

7.4.3 Opportunity Recognition/ Entrepreneurial Intention

Chi-square tests revealed that the perception of business opportunities in SA by both groups is not statistically different as they both indicated that opportunities are abundant. 78% of non-entrepreneurs indicated that they intent being entrepreneurs in the future. This result is positive and indicates that individuals

have recognised the desirability and feasibility of a new entrepreneurial venture (Pownall and Lawson, 2005).

7.5 Limitations of Study

The following were the limitations of the study:

- The sample was not representative as it was sourced by employing non-probability sampling techniques and hence the findings cannot be generalised to the population of engineers in SA.
- The majority of entrepreneurial engineers had entrepreneurial ventures of 0 to 2 years operating life. The narrow sampling band in terms of business operating life and size in terms of the number of employees presents another sampling bias that suggests that the results cannot be generalised to population of engineers.
- There was limited research or literature available for entrepreneurial studies conducted on engineers.
- A non-response bias is reported as not everyone who received the questionnaire responded and it is not possible to estimate the non-response rate because of the non-probability sampling technique “snowball” that was employed.
- Self-selection bias is acknowledged as it was introduced by the snowballing technique in addition to the fact the engineering associations with voluntary member affiliations were asked to distribute the questionnaire.

7.6 Conclusion

The objectives of this study were achieved. The following subsections records the essence of the findings in relation to the objectives.

7.6.1 Entrepreneurial Orientation

Overall the 18 item five dimensions entrepreneurial orientation scale is reliable and appropriate for use in the SA context. It is however noted that the autonomy dimension was unreliable.

The EO scale was developed to measure EO on a firm level however studies including this one has used it to measure EO at individual level with minor adaptations. The scale proved to be appropriate for use on individual level.

Factor analysis provided support to entrepreneurship scholars who have found EO to be a uni-dimensional construct.

Results showed that entrepreneurs have a higher EO on all dimensions with the exception of innovativeness and competitive aggressiveness. Statistical testing confirmed that, overall; EO of entrepreneurs is statistically significantly higher than that of non-entrepreneurs

7.6.2 Situational Factors

The existence of role models amongst the sampled engineers has positively contributed towards their ability to recognise the feasibility of an entrepreneurial venture and opportunity recognition.

The engineering curriculum lacks entrepreneurial education which engineers have indicated that they require and which is key to a success of an entrepreneur.

In addition to the need for entrepreneurial education, the need for financial assistance from both government and financial institutions to start entrepreneurial ventures was highlighted.

Government's role is not perceived to be motivating individuals to become entrepreneurs and only half are aware of government schemes.

7.6.3 Contributions of study

As it was highlighted in the limitations section, there are limited studies that focus on entrepreneurship amongst engineers in SA. This study has therefore added to entrepreneurship body of knowledge. This is particularly important because it was highlighted in the literature review that entrepreneurship is a behavioural phenomenon that is context specific and hence the study in this context is valuable.

7.7 Recommendations

The 18 item five dimensions EO scale require further testing considering that the autonomy dimension was unreliable and to further tests it for validity to use for individual level analysis.

In recognition of Magnanti (2005) cited in Esbach (2009) who concluded that together the combination of management and engineering provide an ideal

underpinning for technology innovation and entrepreneurship, it is recommended that engineering schools incorporate entrepreneurial modules within the core engineering curriculum. On the same note, although contraindicated by sampled engineers, it is recommended that engineering graduates undertake postgraduate studies that incorporate entrepreneurship. This supports Drucker (1985) cited in Justa *et al* (2006) who stated that systematic innovation is an entrepreneurs' tool and the innovation process should be taught and learnt in a pedagogic and didactic way.

The government agencies and financial institutions are to review the effectiveness of their schemes for motivating entrepreneurship as the results indicate that these two stakeholders are not perceived to be contributing to an environment that is conducive for entrepreneurship. Financial assistance remains the greatest need.

It is recommended that both entrepreneurs and non-entrepreneurs consider other ways of raising seed capital for their new entrepreneurial ventures as the results indicated that financial institutions may not provide the necessary finance.

7.8 Suggestions for Future Research

One of the major highlights of this study is that it supported previous studies such as Esbach *et al* (2009) and GEM report (Mass & Harrington, 2008) that entrepreneurial education is generally lacking in South Africa. Entrepreneurship scholars support the view that although entrepreneurial behaviour may be an inherent quality, it can also be acquired through receiving knowledge via formal

education and experience (Norman & Nieuwenhuizen,2009), (West III et al, 2008) and (Baron & Ward, 2004). As a result certain universities have already introduced entrepreneurial education into the engineering curriculum (Justa et al, 2006). In view of the above, the following is proposed as potential area of future research:

- A study research should be conducted to assess entrepreneurial activity of individuals who have graduated from an engineering school that has already introduced entrepreneurial studies in the engineering curriculum. This would entail assessing the significant difference in entrepreneurial activity of engineering graduates who graduated prior to and after that specific school introduced entrepreneurship studies in the curriculum

"Most of what you hear about entrepreneurship is all wrong.

It's not magic; it's not mysterious; and it has nothing to do with genes.

It's a discipline and, like any discipline, it can be learned."

Peter F. Drucker

"What lies behind us and what lies before us are tiny matters compared to what lies within us."

William Morrow

REFERENCE LIST

Aloulou, W., & Fayolle, A. (2005). A conceptual approach of entrepreneurial orientation within small business context. *Journal of Enterprising culture, 13* (1), 21-45.

Baker, W. E., & Sinkula, J. M. (2009). The complementary effects of market orientation and entrepreneurial orientation on profitability in small business. *Journal of Small Business Management, 47* (4), 443-464.

Baron, R. A. (2007). Behavioral and cognitive factors in Entrepreneurship: Entrepreneurs as the Active element in new venture creation. *Strategic Entrepreneurship Journal* , 167-182.

Baron, R. A., & Ward, T. B. (2004). Expanding entrepreneurial cognition's toolbox: Potential contributions from the field of cognitive s6cience. *Entrepreneurship theory and practice* , 553-573.

Blaikie, N. (2003). *Analyzing Qualitative Data.* London: SAGE Publications Ltd.

Reference List

Carlaw, K., Oxley, L., & Walker, P. (2006). Beyond the hype: Intellectual property and the knowledge society/knowledge economy. *Journal of Economic Surveys, 20* (4), 634 - 689.

Chadwick, K., Barnett, T., & Dwyer, S. (2008). An empirical analysis of the entrepreneurial orientation scale. *Journal of Applied Management and Entrepreneurship, 13* (4), 64.

Domke-Damonte, D., Faulstich, J. A., & Woodsen III, W. (2008). Entrepreneurial orientation in a situational context: Comparisons between Germany and United States. *Journal of Business Strategies, 25* (1), 16-30.

Dutiro, G. (2009). *The benefits of collaboration in the entrepreneurship incubation environment in South Africa.* Johannesburg: Gordon Institute of Business Science, Pretoria University.

Duygulu, E. (2008). *Institutional profiles and entrepreneurship orientation: a case of turkish graduate student.* Munich Personal RePEc Archive: Dokuz Eylul University.

ECSA. (2010). Retrieved February 2010, from http://www.ecsa.co.za/documents/list_of_AccrUniv_E-20_PE_2010.pdf

Esbach, J. (2009). Relevance of engineering entrepreneurship. *A Study at CPUT. Journal of Asia Entrepreneurship and Sustainability,, V* (3), 108-123.

Reference List

Foo, M. D., & Lee, S. F. (2005, May). Entrepreneurial orientation (EO) & opportunity evaluation: The moderating effects of EO on cognitive factors & business size. 1-25. Singapore, Singapore: NUS Entrepreneurship Centre.

Frishammar, J., & Horte, S. (2007). The role of market orientation and entrepreneurial orientation for new product development performance in manufacturing firms. *Technology Analysis & Strategic Management, 19* (6), 765-788.

Fulford, H., & Rizzo, A. (2009). A conceptual model for the strategic orientation of small firms. *Journal of Enterprising Culture, 17* (1), 25-54.

Kondrateiff Wave. (2010). *Wall Street Survivor University*. Retrieved November 04, 2010, from (http://education.wallstreetsurvivor.com/images_articles/kondratieff_wave.png).

Hamel, G. (2007). *The Future of Management.* Harvard Business Press

Herrington, M., Kew, J., & Kew, P. (2009). *Global Entrepreurship Monitor, South African Report 2009, Tracking Entrepreneurship in South Africa: A GEM Perspective.* Global Entrepreneurship Monitor (GEM). GEM.

Reference List

Justa, R. P., Nogueira, M. D., Rodrigues, E. F., & Pacheco, M. D. (2006). Entrepreneurship and Engineering. *9th International Conference on Engineering Education*, pp. 19-21.

Kreiser, P. M., Marino, L. D., & Weaver, K. M. (2002). Assessing the psychometric properties of entrepreneurial orienation scale: A multi-country analysis. *Entrepreneurship Theory and Practice* , 71 - 94.

Krauss, S. I., Frese, M., Friedrich, C., & Unger, J. M. (2005). Entrepreneurial orientation: A psychological model of success among southern African small business owners. *European Journal Of Work And Organizational Psychology, 14* (3), 315-344.

Li, Y., Guo, H., Liu, Y., & Li, M. (2008). Incentive mechanisms, entrepreneurial orientation, and technology commercialization: evidence from china's transitional economy. *The Journal Product Innovation Management* , 63-78.

Li, Y., Zhao, Y., Tan, J., & Liu, Y. (2008). Moderating effects of entrepreneurial orientation on market orientation-perfomance linkage: Evidence from small chinese firms. *Journal of Small Business Management, 46* (1), 113-133.

Litan, R. E., & Song, M. (2008). From the special issue editors: Technology commercialization and entrepreneurship. *Journal of Product Innovation Management, 25*, 2 -6.

Reference List

Lumpkin, G. T., & Dess, G. G. (1996). Clarifying the entrepreneurial orientation construct and linking it to performance. *Academy of Management Review, 21* (1), 135-172.

Lumpkin, G. T., Wales, W. J., & Ensley, M. D. (2006). Entrepreneurial orientation effects on new venture performance: The moderating role of venture age. *Academy of Best Management Conference Paper*, pp. N1 - N6.

Lumpkin, G., Cogliser, C. C., & Schneider, D. R. (2009). Understanding and measuring autonomy: An entrepreneurial orientation perspective. *Entrepreneurship Theory and Practice* , 49-69.

Madsen, L. E. (2007). The significance of sustained entrepreneurial orientation on performance of firms - longitudinal analysis. *Entrepreneurship and regional development* , 185 - 204.

Mass, G., & Harrington, M. (2008). *Global Entrepreneurship Monitor, South Africa.* Retrieved November 2009, from www.gsb.uct.ac.za/gsbwebb/default.asp?intpageNR=228

Minniti, M., & Levesque, M. (2008). Recent Developments in the economies of entrepreneurship. *Journal of Business Venturing, 23*, 603-612.

Reference List

Norman, G., & Nieuwenhuizen, C. (2009). *Entrepreneurship -A south African perspective.* Pretoria: Van Schaik Publishers.

Popli, G., & Rao, D. (2010). *A study of entrepreneurial orientation & inclination for entrepreneurial career of engineering students.* Retrieved February 23, 2010, from http://ssrn.com/abstract=1530288

Pownall, I., & Lawson, V. (2005). A regional entrepreneurial orientation (REO): Model for a Northen English town. *Journal of Enterprising Culture, 13* (4), 295-331.

Rauch, A., Wiklund, J., Lumpkin, G., & Frese, M. (2009). 1. Entrepreneurial orientation and business performance:An assessment of past research and suggestions for the future. 761-787.

Sasix. (2009). From http://www.sasix.co.za/news/2009/02/05/creating_a_generation_of_south_african_entrepreneurs/

Shane, S., & Venkataraman, S. (2001). Entrepreneurship as a field of research: A response to Zahra and Dess, Singh, and Erikson. *The Academy of Management Review, 26* (1), 13-16.

Reference List

Tang, J., Tang, Z., Marino, L. D., Zhang, Y., & Li, Q. (2008). Exploring an inverted u-shape relationship between entrepreneurial orientation and performance in chinese ventures. *Entrepreneurship Theory and Practice*, 219-239.

Tang, J., Tang, Z., Zhang , Y., & Li, Q. (2007). Journal of Developmental Entrepreneurship , 12 (4), 383–397.

Urban, B. (2008). The prevalence of entrepreneurial orientation in a developing country: Juxtapositions with firm success and south africa's innovation index. *Journal of Developmental Entrepreneurship, 13* (4), 425-443.

Wang, C. L. (2008). Entrepreneurial orientation, learning orientation, and firm performance. *Entrepreneurship Theory and Practice* , 635-657.

West III, P. G., Bamford, C. E., & Marsden, J. W. (2008). Contrasting entrepreneurial economic development in emerging Latin American economies: Application and extensions of resource-based theory. *Entrepreneurshop Theory and Practice* , 15-36.

Wood, M. T., Gadd, K., & Falkenburg, D. (2004). Entrepreneurship for Engineers. *Education that Works: The NCIIA 8th Annual Meeting*, pp. 131-135.

Reference List

Wu, W.Y., Chang, M.L., & Chen, C.W. (2008). Promoting innovation through the accumulation of intellectual capital, social capital, and entrepreneurial orientation. *R&D Management, 38* (3), 265-277.

Zhou, K. Z., Yim, C. K., & Tse, D. K. (2005). The effects of strategic orientations on technology and market-based breakthrough innovations. *Journal of Marketing, 69*, 42-60.

Zikmund, W. G. (2003). *Business Research Methods.* Ohio: South-Western Cengage Learning.

APPENDINCES

Appendix A – Questionnaire –

THE QUESTIONNAIRE WAS ADMINISTERED ELECTRONICALLY FEATURING QUESTIONS WHICH HAD ANSWERS ON A DROP DOWN LIST. THE ELECTRONIC COPY OF THE QUESTIONNAIRE SHOWING ALL VARIABLES (OPTIONAL ANSWERS) IS AVAILABLE. ADDITIONALLY, THE DESCRIPTIVE STATISTICS PRESENTED IN CHAPTER 5 DETAILS THE OPTIONAL VARIABLES ON THE FIGURES.

Respondent Number	

CONSENT FOR PARTICIPATING IN AN ACADEMIC RESEARCH STUDY

RESEARCH TITLE: Engineers as Entrepreneurs: Entrepreneurial Orientation of Engineers in South Africa

Dear Respondent

The purpose of this study is to understand the entrepreneurial orientation of engineers within the South African context. The research is for academic purposes ONLY, in partial fulfilment of the requirements of a Masters in Business Administration (MBA) degree.

You are Kindly requested to participate in this academic research conducted by Beauhania Nonyane-Mathebula, an MBA student at the Gordon Institute of Business Science.

Please take note of the following:

1. The responses will be kept confidential, however the outcomes of this research may be published in the media.

2. Respondents will NOT be asked to provide identity and hence the survey is anonymous.

3. By proceeding to answer questions you voluntarily agree to participate in this research however at any stage you are allowed to withdraw from answering. We would however appreciate if you can complete all questions.

4. By completing this survey you consent that the data can be used for the purposes of this research.

5. Kindly save your answers and e-mail responses to beau@drasa.co.za or beauhania@gmail.com or fax to 0866932135

6. Should you require clarity on this survey, contacts are provided below:
Beau Nonyane-Mathebula (Researcher) - 082 771 0418 - beauhania@gmail.com
Alex Antonites (Supervisor) - +27 12 420 3119 - alex.antonites1@up.ac.za

Thank you for taking the time to complete this questionnaire.

A: DEMOGRAPHIC INFORMATION

Instruction for completing this section: Please select an answer from the drop-down list provided or write your answer in the box corresponding to a question.

CODING

a). What is your Gender? **CD2**

Select

b). How old are you? **CD3**

Select

c). What is your home language? **CD4**

Select

d). What is your race? **CD5**

Select

e). Are you are employed? **CD6**

Select

f). Do you currently own a business? **CD7**

Select

g). What Engineering Qualification(s) do you possess? **CD8**

h). From which academic institution was your Engineering Qualification(s) obtained? **CD9**

i). Which year was your Engineering Qualification(s) obtained? **CD10**

j). Do you have any business management related education (e.g. certificate, diploma, degree)? **CD11**

Select

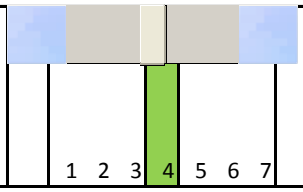
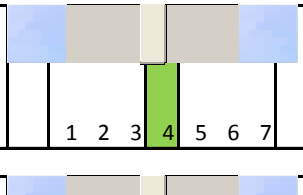
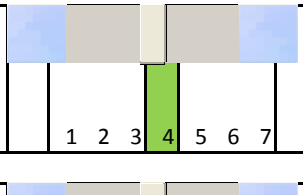
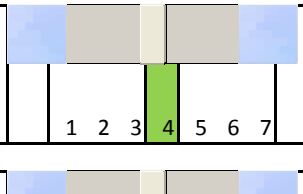
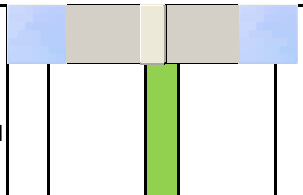
B: ENTREPRENEURIAL ORIENTATION INFORMATION

Instructions for completing this section: *Please select your answer using the scroll-bar provided to indicate which statement is true for yourself. Selecting seven (7) indicates a strong agreement with the statement on the right of the likert scale. Selecting one (1) indicates strong agreement with the statement the statement on the left of the likert scale. The numbers in between represent the degree of agreement with the statement one of the two statements.*

Proactiveness Items			
In dealing with competition I would…….			**CODING**
1. Most likely respond to actions which competitors initiated	1 2 3 4 5 6 7	Most likely initiate actions that competitors will respond to	**CD12**
2. Very seldom to introduce new products/services, administrative techniques and operating technologies.	1 2 3 4 5 6 7	Very often to introduce new products/services, administrative techniques and operating technologies.	**CD13**
3. Typically seek to avoid competition clashes, preferring a "live and let-live" posture	1 2 3 4 5 6 7	Typically rather undo-the-competitors posture	**CD14**
I am likely to have……			
4. A strong tendency to "follow the leader" in introducing new products or services	1 2 3 4 5 6 7	A strong tendency to be ahead of competition in introducing novel ideas or practices	**CD15**
Risk Taking Items			
5. I have a strong proclivity for low risk projects (with normal and certain rate of return)	1 2 3 4 5 6 7	I have a strong proclivity for high risk projects (with chances of very high return)	**CD16**
6. I believe that owing to the nature of environment, it is best to explore the environment gradually via a careful, incremental behaviour	1 2 3 4 5 6 7	I believe that owing to the nature of environment, it is best to explore the environment boldly with wide ranging acts necessary to achieve my objectives	**CD17**

7. When confronted with decision making situations involving uncertainty, I typically adopt a cautions "wait and see" posture in order to minimise the probability of making costly decisions	1 2 3 4 5 6 7	7. When confronted with decision making situations involving uncertainty, I typically adopt a bold, aggressive posture to maximise the probability of exploiting potential opportunities.	**CD18**
8. I prefer to study a problem thoroughly before deploying resources to solve it	1 2 3 4 5 6 7	I prefer to quickly spend money on potential solutions if problems are holding me back	**CD19**
Competitive Aggressiveness Items			
In dealing with competition I would likely…….			
9. Make no special effort to take the business from competition	1 2 3 4 5 6 7	Be aggressive and intensely competitive	**CD20**
Autonomy Items			
10. I prefer to working in teams with guidance from seniors	1 2 3 4 5 6 7	I prefer to work autonomously with no reliance on teamwork and guidance from seniors	**CD21**
11. I believe that best results occur when top managers provide primary impetus for pursuing business opportunities	1 2 3 4 5 6 7	I believe that best results occur when individuals and teams provide primary impetus for pursuing business opportunities	**CD22**
12. When pursuing business opportunities I prefer obtaining approval from supervisors and superiors before making the decision	1 2 3 4 5 6 7	When pursuing business opportunities I make decisions without obtaining approval from supervisors and superiors	**CD23**
13. My seniors/partners/role models/others play a major role in identifying and selecting the entrepreneurial opportunities that I pursue or may pursue in future	1 2 3 4 5 6 7	I play major role in identifying and selecting the entrepreneurial opportunities that I pursue or may pursue in future	**CD24**

Appendices

Innovativeness Items			
14. I favour a strong emphasis on marketing of tried and true products and services		I favour a strong emphasis on R&D, technological leadership and innovations	**CD25**
15. In the last five years I have marketed no new lines of products or services		In the last five years I have marketed many new lines of products or services	**CD26**
16. My changes in product or service lines or processes have been mostly of a minor nature		My changes in product or service lines or processes have been mostly quite dramatic	**CD27**
17. I favour imitating methods that other people or firms have used for problem solving		I favour experimentation and original approaches to problem solving	**CD28**
18. I prefer to adapt to processes and methods of production and techniques that others have developed and proven.		I prefer to design my own unique new processes and methods of production rather than adapting method and techniques that others have developed.	**CD29**

C: SITUATIONAL INFORMATION

Instructions :

a) Each question comprise of a choice of answers, varying from two to eleven optional answers per question.

a) **Please select your answer from the drop down list**

b) If you are a BUSINESS OWNER/ENTREPRENEUR PLEASE ANSWER SECTION C.1 ONLY

c) If you are NOT a business owner/entrepreneur PLEASE ANSWER SECTION C.2 ONLY

C.1 TO BE COMPLETED BY ENTREPRENEURS/BUSINESS OWNERS ONLY, if NOT an Entrepreneur please SKIP this section and complete Section C.2.

Instructions : *Each question comprise of a choice of answers.* ***Please select your answer from the drop down list.***

Questions	Answer	CODING
1. Does technical education play a role in deciding a career path?	Select	CD30
2. Do you think your engineering qualification provided you with a competitive edge over formal entrepreneurship courses to be an entrepreneur?	Select	CD31
3. Did your engineering degree develop entrepreneurial skills in you?	Select	CD32
4. Do you feel that a management programme like MBA is necessary before venturing into Entrepreneurship?	Select	CD33
5. If you have completed a business/management related course before venturing into entrepreneurship, please indicate whether or not this course has motivated you to become an entrepreneur? ***A not applicable choice is to be selected if you have not completed a business related course.***	Select	CD34

6. Do you have family, friends, mentor and people in your networks who are entrepreneurs/business owners?	Select	CD35	
7. Which social group motivated or inspired you to start your own business?	select	***If selected other networks, please use this cell to provide your explanation***	CD36
8. Did the government entrepreneurship supportive environment play a role in motivating you to become an entrepreneur?	Select	CD37	
9. Are you aware of various Government schemes for motivating entrepreneurship?	Select	CD38	
10. What type of assistance do you expect from Government for entrepreneurs?	Select	***If selected OTHER, please use this cell to provide your explanation***	CD39
11. What type of Financial help did you get from Financial Institutions to start a business?	Select	***If selected OTHER, please use this cell to provide your explanation***	CD40
12. What Support do you require from Educational Institutions to enable you to be a successful entrepreneur ?	Select	CD41	
13. Do you think there are opportunities for entrepreneurship in the new business environment?	Select	CD42	

14. In which one of the following branches of industry would you classify your business?	Select	CD43
15. Why did you choose to start a business in the industry you specified in question 13?	*State your reason in this box*	CD44
16. For how long has your business been in operation?	Select	CD45
17. How many people do you employ?	Select	CD46
18. How many years were you employed before you started your own business?	*State the number of years in this box*	CD47

C.2 TO BE COMPLETED BY NON-ENTREPRENEURS/ NON-BUSINESS OWNERS ONLY

Instructions : *Each question comprise of a choice of answers.* ***Please select your answer from the drop down list.***

Questions	Answer	CODING	
1. What is the main motivational factor to stay employed?	Select	CD48	
2. What prevents you from owning your business?	Select	***If selected OTHER, please use this cell to provide your explanation***	CD49
3. Do you have any future plans of starting your own business?	Select	CD50	
4. Does technical education play a role in deciding a career path?	Select	CD51	
5. Do you think your engineering qualification provided you with a competitive edge over formal entrepreneurship courses to be an entrepreneur?	Select	CD52	
6. Did your engineering degree develop entrepreneurial skills in you?	Select	CD53	
7. Do you feel that a management programme like MBA is necessary before venturing into Entrepreneurship?	Select	CD54	
8. Do you have family, friends, mentor and people in your networks who are entrepreneurs/business owners?	Select	CD55	
9. Does the government entrepreneurship supportive environment play a role in motivating you to become an entrepreneur?	Select	CD56	

10. Are you aware of various Government schemes for motivating entrepreneurship?	Select	CD57	
11. What type of assistance you expect from Government for entrepreneurs?	Select	***If selected OTHER, please use this cell to provide your explanation***	CD58
12. What type of Financial help will you require from Financial Institutions to become an entrepreneur?	Select	***If selected OTHER, please use this cell to provide your explanation***	CD59
13. What Support do you require from Educational Institutions to enable you to become entrepreneur?	Select	CD60	
14. Do you think there are opportunities for entrepreneurship in the new business environment?	Select	CD61	
15. In which one of the following branches of industry are you currently employed/engaged in?	Select	CD62	
16. If you are provided the required assistance, would you prefer being entrepreneur?	Select	CD63	
If you have selected YES in question 16 above, please proceed to answer the last three questions			
17. Would you prefer to start a business in the industry that you are currently employed or engaged in?	Select	CD64	

Appendices

18. In which one of the following branches of industry would you prefer to start your own business?	Select	CD65
19. Why do you want to start a business in the industry that you have indicated in question 18?	*State your reason in this box*	CD66
20. Please stated the total number of years you have been in employment	*State number of years in employment in this box*	CD67

END OF QUESTIONNAIRE: Thank you for participating in this research. Kindly save your answers and e-mail responses to beau@drasa.co.za or beauhania@gmail.com or fax to 0866932135