A framework for the enhancement of postgraduate engineering student supervision at universities of technology: perspectives from the faculty of engineering

by

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DECLARATION

This study has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

This thesis is being submitted in fulfilment of the requirements for Philosophiae Doctor (Ph.D.): in Higher Education Studies at University of the Free State.

This thesis is the result of my own independent investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references. A list of references is appended.

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DEDICATION

This research study is dedicated to:

My family, friends and my late parents,

I would like to thank you all for the support and encouragement you gave me during this journey. From the bottom of my heart, I really appreciate everyone who has contributed towards the success of this study.

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ABSTRACT

There have been several concerns that were raised about the quality of postgraduate research supervision in South Africa particularly at Universities of Technology (UoTs). One of the primary challenges relating to postgraduate supervision at UoTs in the faculty of engineering, is the shortage of academics with doctoral qualifications to supervise postgraduate engineering students. UoTs' which were formerly known as technikon's, are faced with many challenges when it comes to postgraduate supervision. There are not enough academic staff with doctoral qualifications to supervise postgraduate engineering students and that these universities lack facilities and infrastructure needed for research to thrive. It has been more than a decade since universities merged in South Africa and it is taking a longer time for research to thrive at UoTs, due to the fact that these universities were known for their production of industry related skills or technical qualifications rather than postgraduate qualifications. One of the major problems that is affecting postgraduate engineering throughputs for many UoTs is students not having quality supervision or qualified/trained supervisors. However, the tendency to use structure (Institutional history, rules, regulations policies and procedures) to address the challenges related to postgraduate studies has resulted in policy makers (government) ignoring the role that UoTs' play in higher education not only in perpetuating some of these challenges, but also in understanding and resolving them. Despite the significant push by the government for more knowledge and innovative workforce, the success rate of UoTs leaves much to be desired. One of the reasons cited for low throughputs in engineering faculty has been postgraduate supervision capacity challenge. Therefore, this study seeks to propose a tailored supervision framework for engineering faculty at UoTs. This research study included 52 postgraduate engineering students and 11 engineering supervisors from two South African UoTs. Data was collected by questionnaires, semi-structured interviews and focused group discussions. Based on the data generated from the study, the researcher proposes a framework for postgraduate supervision based on the principles of academic writing where quality supervision should be at the centre of learning.

Keywords: Universities of Technology, Postgraduate Supervision, Postgraduate Engineering Students, Postgraduate Throughputs and Research Outputs.

ACRONYMS AND ABBREVIATIONS

ASSAf	Academy of Science of South Africa
CATE	Colleges of Advanced Technical Education
CHE	Council on Higher Education
CSD	Centre for Science Development
DHET	Department of Higher Education and Training
DoE	Department of Education
FRD	Foundation for Research Development
HEI	Higher Education Institution
HEMIS	Higher Education Management Information System
HEQC	Higher Education Quality Council
HSRC	Human Sciences Research Council
IRDP	Institutional Research Development Programme
NATED	National Association for Tertiary Education
NCHE	National Commission of Higher Education
NDP	National Development Plan
NEPI	National Education Policy Initiative
NPC	National Planning Commission
NPHE	National Plan for Higher Education
NRF	National Research Foundation
SAPSE	South African Post-Secondary Education
SASCO	South African Students' Congress
SATN	South African Technology Network
SCT	Social Cognitive Theory
TRDP	Technikon Research Development Programme
UDUSA	Union of Democratic University Staff Associations
UFE	Utilisation Focused Evaluation
UoTs	Universities of Technology

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1.1 Introduction to the study

The creation, transferring and management of postgraduate student supervision and research competencies at universities has become a critical issue in the knowledge economy with its research competitive environment. There is intensive pressure on South African higher education institutions to increase postgraduate throughputs which impact on research outputs needed for generating funding for university sustainability that affects postgraduate supervision. This study investigated the nature of supervision in postgraduate studies and the relationship between postgraduate engineering students and supervisors that seeks to enhances and stimulates quality postgraduate supervision practices and research performance within the context of South African Universities of Technology (UoTs) in the faculty of engineering. The South African National Development Plan (NDP) 2030 Chapter 9 on Higher Education is aimed at increasing the number of doctoral graduates by 5000 annually in the year 2030 (NDP, 2012). Looking at the current production of Ph.D. which is just over 2000 graduates per year (DHET, 2018:14) this target seems unlikely to be achieved. The researcher learned of challenges with supervision of postgraduate engineering students at UoTs through South African Technology Network (SATN), National Research Funding (NRF) and Higher Education Management Information System (HEMIS) reports and were concerned about supervision capacity challenge and non-completion rate which impacted negatively on postgraduate throughputs and research outputs at UoTs which led to this research study (Kagisano, 2010:46-136; SATN, 2007; HEMIS, 2012). Abiddin, Ismail and Ismail (2011:206), describe postgraduate supervision as an intensive, interpersonally centred one-to-one relationship between the supervisor and postgraduate student. Supervision is detailed in accordance with a guidance of the postgraduate student's educational development either among phrases regarding coursework or research project (Abiddin, Ismail & Ismail, 2011:206). The study focused on postgraduate supervision and postgraduate engineering student research skills at UoTs as a process that influences non-completion of research projects in the faculty of engineering. The study analysed

supervisor/student relationship and the expertise required for effective supervision in the faculty of engineering.

According to Ibrahim, Yunus, and Khairi (2017:160) there are three aspects that students who study engineering face difficulties with when writing academic articles which are content, structure and language related. These authors further argue that in order to enhance the quality of academic writing among engineering students, these aspects must be critically taken into consideration. This research study proposes a tailored supervision framework that is writing-centred led by a content supervisor and a student both located within the faculty of engineering. The proposed supervision framework will allow academic writing to provide a conducive research learning environment in postgraduate supervision process. Notably the subject of power relations between the student and a supervisor remain inherent in the traditional one-on-one (face to face) supervision practice hence academic writing to a large extent exist on the margins of academic work. Central to this research study is the essence of written feedback by supervisors to postgraduate engineering students. Supervisors' written feedback practices are critical to development of student progress. It is hoped that the proposed framework minimises any barriers and enhances communication between postgraduate engineering students and supervisors by ensuring that feedback is conveyed accurately, clearly and as intended. The differing feedback practices of supervisors are discovered by using various analytic feedback framework in demonstrating a continuation of traditional supervision practices. A further finding make connection to academic writing challenges identified by supervisors and postgraduate engineering students mainly linked to higher education structures.

1.2. Background to the study

The South African NDP for 2030 is aimed at the socio-economic developmental approach that stipulates the necessity for increased quality and quantity in research, technology and innovation. An intended strategy to rectify challenges in postgraduate studies was to require Higher Education Institutions (HEIs) to identify strategies aimed at increasing throughputs and research outputs to produce more Ph.D.'s, which will in turn address the supervision capacity challenge at universities (NDP, 2012:78).

According to Abiddin, Ismail and Ismail (2011:206), postgraduate supervision is described as a rigorous, mutually centred one-on-one relationship between a supervisor and a student. Supervision is detailed in accordance with a facilitation of the postgraduate student's educational development, either among phases regarding coursework or full research projects (Abiddin, Ismail & Ismail, 2011:206). This research seeks to focus on the contribution of postgraduate supervision processes that influences postgraduate engineering student throughputs, research outputs, quality of supervision and students research skills, the relationship that is formed between the two, the expertise required for supervision and problems encountered by postgraduate engineering students at UoTs.

Supervision challenges and conflict experiences have a direct impact on postgraduate engineering students' non-completion of a research project. Supervisors are accountable because of the leadership role and maintaining educational environments that should be conducive for the research project to thrive in accordance with the instruction and in ensuring that postgraduate engineering students finish their research studies within a required duration of study (Maasdorp & Holtzhausen 2011:38). It, therefore, is essential to HEIs, including UoTs, to explore and address the context-specific challenges related to supervision in accordance with the conclusion regarding postgraduate engineering students at these institutions.

SATN, NRF and HEMIS reports (SATN, 2008a; HEMIS, 2012) outlined concerns about the supervision capacity challenge, dropout and non-completion rate, which impacted on the throughputs and research outputs at UoTs. These resources suggest that postgraduate supervision training and support programmes were proposed to assist with creating a more conducive environment to enhance postgraduate studies at UoTs. Benshoff, Cashwell and Rowell, (2015:83) further argues that it is critical to create enabling research environment that provide support where postgraduate engineering students could flourish and challenges such as supervision capacity should be urgently addressed.

According to Lues and Lategan (2006b:109), former technikons (currently UoTs) had to diverge from teaching and learning to focus more on research after South African universities merged in 2004 and, as a result, had to make some adjustments within the structures of these universities.

According to SATN 2016 annual report, five out of six UoTs experience limitations in the number of staff with postgraduate qualifications (Ph.D.'s) and students who register for postgraduate studies (masters and doctoral) including the resources and funding, which are required as part of the essential infrastructure for postgraduate research studies to thrive. Critical components are required for research to thrive, for example staff profiles (supervision), although changing gradually at UoTs, is suited more to teaching than to research (SATN, 2016). The existence or non-existence of a clear research policy on supervision and percentage of staff with postgraduate qualifications (Ph.D.'s) and its impact on the throughputs were investigated by the researcher. All these demands can be reduced to one important challenge, namely postgraduate supervision capacity (Mutula, 2009:1).

According to Mouton (2007:1078), quality of postgraduate students and supervision has become the main focal point for many universities in South Africa, as echoed in institutional reports that constitute two key elements: "the quality of the supervision process (by supervisors) and the quality of the research outputs (by students)" (Lessing & Schulze, 2003:161). Accompanied by the demands of making sure that increased throughputs and research outputs transform universities into businesses where the subsidy formulas have changed and more emphasis is placed on student throughputs, which should lead to increased research outputs by both students and staff (Lessing & Schulze, 2003:161; Lessing & Lessing, 2004:73). However, universities, particularly UoTs, are faced with difficulties in producing the number of postgraduates in line with the NDP annual throughputs, for example the 2030 NDP target. Supervisors should give all the support and access for students who might not have basic research skills that are needed for postgraduate studies due to lack of knowledge in essential academic writing, especially those who come from previously disadvantaged backgrounds (Cloete, Mouton, & Sheppard, 2015:2). At UoTs, increasing the number of postgraduate engineering student enrolment to continue with masters and doctoral studies is affecting the supervisor-student ratio, because of limited supervision capacity, which is affecting student support and quality supervision. Although this has become a common problem for many universities in South Africa, Speckman and Mandew (2014:10) argue that this is an indication of change in higher education access, from a group of a few to a larger population. Diversity of postgraduate engineering students also plays a critical role with regard to culture, age,

language, socio-economic level and educational background. This present major obstacle for effective student-supervisor relationship. Alternative methods need to be explored to enhance support for supervision capacity (Pillay & Balfour, 2011;358). The use of innovative methods and technology should preferably replace traditional, one-on-one postgraduate supervision process (Winberg, 2014:2).

According to ASSAf (2010:77), postgraduate supervision is a challenging assignment for academic staff with a lot of responsibility in leading and guiding students to completion of postgraduate studies. Due to capacity challenge which affect quality supervision, this indicates a need for well-established postgraduate training, mentoring, coaching and leadership skills necessary for supervision (Bitzer, 2010:32). Considering the necessity for UoTs to develop, in accordance with masters or doctoral graduates at postgraduate level, capacity-building is crucial in equipping supervisors with expertise and skills required to guide postgraduate engineering students to timely completion. This entails supervisors acting as mentors with the determination to review and accept their own capacity challenges of guiding students in a manner that enables them to reach their full research abilities, since such skills do not come naturally, they have to be developed through continuous learning. Postgraduate research studies at UoTs, formerly known as technikons, are taking place in conditions where there is an ongoing transformation, increasing number of student enrolments while the capacity of the supervision is a challenge, which impacts on postgraduate throughput rates and research outputs. Thus, there is a serious concern for the quality of the postgraduate supervision at UoTs (Government Gazette, 2011:14).

According to O'Brien (2015:36), research culture is the extent to which research activity is integrated into the shared vision, mission and values, and communicated within the university structures. It has been more than a decade since university mergers in South Africa and it is taking a long time to establish a research culture at many UoTs since these universities were known for their production of industry-related skills or qualifications, rather than focussing on postgraduate studies. The launch of the first programme dedicated to supporting the research activities and research training for technikons in 1990 witnessed the foundation of research development at UoTs. This combination of planned programmes eventually fell under the umbrella of National Research Foundation's (NRFs) Technikon Research Development Programme (TRDP) in 1995, now known as the Institutional Research Development

Programme (IRDP). Research (or the idea of research) clearly separated the new technikon people from the ‘old guard'. At the time, with few resources, deficient limit and a background marked by disregard, technikons had been battling for many years to react to expanding requests, including the lack of capacity up to date (Luruli, 2014:23).

The NDP 2030 on higher education sets out an advancing approach, which stipulates the necessity to increase research outputs and production of Ph.D.’s as a critical human development strategy for social redress in South Africa. Teaching and learning is also equally essential and it becomes vital that all South African universities provide high quality postgraduate studies through quality teaching at undergraduate level. UoTs are faced with many challenges when it comes to postgraduate research studies. Kagisano (2010:42) highlights the lack of academic staff with doctoral qualifications to conduct supervision for their master and doctoral students and that these universities lack facilities or infrastructure for conducting postgraduate research studies, as the critical contributing factor to the low research throughputs and outputs at UoTs.

Internationally, in countries like Australia, Canada, as well as some European countries, there were concerns raised previously in conference proceedings and accredited journals regarding poor completion and dropout rates for masters and doctoral students at universities and supervision challenges (Cranfield & Taylor, 2008:86). Technology models in supervision from the Queensland University of Technology in Australia are specifically aimed at creating awareness of postgraduate supervision as a teaching and learning model in technology for engineering departments. This model is aimed at raising awareness of postgraduate supervision capacity challenge as an alternative tool or framework that can be used to deal with capacity. It also encourages the sharing of best practices amongst supervisors and enhances postgraduate throughputs (Bruce & Stoodley, 2009:5).

The effectiveness and efficiency of research supervision is attracting increased international scrutiny as the quality of research writing is of critical importance for higher institutions. As increasing emphasis is placed on the general nature of supervision practices internationally (McCallin & Nayar, 2012:63), a critical area of postgraduate pedagogy is that of academic writing, that has increasingly become

essential for postgraduate studies. In South Africa, in the last decade, the numbers of postgraduate engineering students have increased exponentially, and the development of research and academic writing has become critical (DHET, 2013). Globally the profile of postgraduate engineering students is changing, there are more postgraduate engineering students with diverse cultural background and some study part-time or at a distance while others are full-time registered. Postgraduate engineering students from other African countries are increasingly enrolling in many South African universities and there is an increasing global flow of postgraduate engineering students at UoTs (Tremblay, Lalancette, & Roseveare, 2012:16). Postgraduate engineering students come with a range of academic experiences, cultural and language backgrounds. The culture, norms and values of these diverse postgraduate engineering student populations increases the challenges for supervisors in coping with the diversifying groups in language for academic writing skills. Internationally, countries such as Australia and the United Kingdom, there is increasing pressure to improve the rate of postgraduate throughputs (Kamler & Thomson, 2006:192). This pressure also exists in the South African UoTs context where there is low postgraduate engineering student retention rate, less postgraduate success and low research outputs which are now seen as a priority.

1.3 Rationale of the study

Emphasis on the postgraduate supervision role has begun to acknowledge the work of academic writing (Lee & Murray, 2015:558). According to Aitchison, Catterall, Ross, & Burgin, (2012:435) recognising that academic writing remains significantly under theorised. This research study offers some new insights into academic writing pedagogy that may be applied by postgraduate supervisors. Additionally, this research study, located in South Africa, in the context of a developing country by taking into consideration the South African NDP 2030 on higher education, provides a local perspective on postgraduate supervision and academic writing pedagogy within engineering faculty at two UoTs. The dynamics of academic writing has become a major interest for both the engineering postgraduate students and supervisors. According to Kamler and Thomson (2001:192) academic writing is considered ‘marginal or ancillary’ to the real work of research, they indicated that there is very little research that “opens out the complexity of Ph.D. writing practice”. This is still currently the case

at a local UoT engineering faculty. Some UoTs in South Africa have recently shifted their focus to become more research-intensive institutions and with this change came increased pressure to enrol more postgraduate engineering students whilst retaining quality supervision remain a concern. Quality postgraduate supervision is thus of critical importance, particularly since it has the potential to address the concerns of low postgraduate throughputs and research outputs at South African universities in general (NDP, 2012).

The rationale of this study was to investigate postgraduate supervision capacity challenges at UoTs in faculties of engineering. The research focuses on the supervisor-student relationship, postgraduate throughputs and the impact on research outputs. These characteristics are common in engineering postgraduate supervision and recognises that academic writing remains significantly under theorised (Aitchison et al.; 2012:436), this research study proposes a supervision framework that offers new insights into academic writing pedagogy that should be employed by supervisors in engineering faculties at UoTs.

The proposed framework demonstrates close synergies between academic writing, postgraduate supervision and postgraduate throughput. The proposed framework suggests that research supervision at engineering faculties is knowledge conversion process that can also be seen as one of knowledge creation, skills transfer, and a process of knowledge access improvement as well in which postgraduate engineering students can develop new knowledge through integrating, synthesizing and valuing existing research skills. This process requires research skills-oriented individuals and environment that is conducive for research to thrive. The outputs of the research supervision from knowledge creation, transfer and embedding processes are qualified researchers who successfully complete their research degrees by producing and presenting research outcomes with potential value to our knowledge-based society.

The research study suggests a new, innovative and non-conventional approach to research supervision as a framework, that is transformative in approach and seeks to address capacity challenge for research supervision at UoTs in the engineering faculty. This is different from the exiting studies that concentrate on changes in supervisory structures of learning and teaching patterns (Evans & Person, 1999).

However, this supervision framework approach has several implications for postgraduate engineering student supervision. Firstly, knowledge is regarded as an intellectual asset. Postgraduate supervision framework is aimed at stimulate the acquisition of academic writing skills for postgraduate engineering students. The successful supervision framework is measured not only by the completion rate of research students within a set timeline but also by the economic value that postgraduate throughputs and research outputs are able to generate additional funding for university sustainability, such as intellectual property. In this regard, a framework clarifies the goals of transformative supervision for postgraduate engineering students and supervisors in recognising the value of knowledge transfers from academia to industry and the community at large (triple helix).

Another element of the proposed supervision framework is related to effective and efficient application of technology and human resources. The supervision framework includes tacit and explicit knowledge (Duffy, 2000:64). The rationale for a proposed supervision framework is also to facilitate postgraduate engineering students' access to resources and guide them in optimising the application of ICT resources that could enhance reliability and validity of their research projects. This will be in a form of knowledge conversion, transfer and embedding, where students apply tacit knowledge to their exiting explicit knowledge through expert supervision.

The application of a proposed supervision framework to postgraduate studies implies that several changes may be an attempt to create and make adequate use of knowledge assets at UoTs. One of the key knowledge assets for UoTs is qualified supervisors who are knowledge creators. The theoretical and practical perspective of a rationale for this study accommodated the purpose and coherence of the research plan. This provided an overview of the intended postgraduate research process and the importance of quality supervision in enhancing postgraduate studies at UoTs.

This chapter provides the background to this research, situating it within the South African UoTs context. More importantly it has provided rationale for the study. The aims of the research have been placed within the local and global perspectives.

1.3.1 Literature review

History provides significance and reflective roles that universities play in modern era of globalisation. Emerging states and religious institutions building up the units of

government happen to appreciate the refinement of Roman law in regulation and promotion of the emerging trade economy. These revolutions had different aims and objective for state modernisation. They also intended to put restrictions on the influence of political rulers; to institute the jurisdiction of law in its capacity to restrain and influence the conduct of private authority and public officials behaviour; to ensure rights to private property extra secured; and to supply mechanisms for compliance and promote coordination between political and economic powers in Europe. Many of these states emanated from the German terrain of the Holy Roman Empire (Archer, 2017:3).

According to Neave (1989:211), since the mid-nineteenth century, the European countries have taken upon themselves the administrative and supporting duties concerning postgraduate studies. The model derived that the state dealt with the general populace excitement for postgraduate studies. It masterminded and routinely adjusted the definitive structures for the advancement of higher education system and it was crucial as a sole funder of higher education. Hence, in various countries, including South Africa, up until now the general populace for postgraduate studies development estimation is weak.

Germany is broadly viewed as having the best vocational education (artisan) system as compared to other countries, as indicated by the audit in nature (Cyranoski, Gilbert, Ledford, Nayar & Yahia, 2011:276). Germany is Europe's best producers of doctoral graduates, as well as gained huge ground in taking care of the oversupply issue through a noteworthy overhaul of its doctoral training programmes in previous years (Cyranoski et.al, 2011:276).

In South Africa, Lewanika and Archer (2011:147) introduce the idea of shifting the lens from students to consultants in a reflective exploration of academic writing as a practice that works towards shaping and even transforming the academic identities of masters and doctoral students. According to Grobler (2013:1), in a rapidly changing world that is increasingly dominated by technological innovation, Information and Communication Technology (ICT), universities such as UoTs are contemplating transformation to take advantage of established and emerging technologies to enhance postgraduate studies and improve their throughput rates at postgraduate

level. Providing access to many students previously denied access to quality postgraduate supervision continues to be a priority for many UoTs.

The impact of globalisation on universities in general has also increased the flow of international students enrolling in postgraduate research degree programmes outside their own countries (Marginson & Van der Wende, 2009:17). As a result, significantly more academics are now engaged in intercultural supervision or supervising students who comes from different cultural background (Manathunga, 2014:1)

The demand for dedication and investment on postgraduate studies has left a void in which former technikons (UoTs), which are committed to applied research by advantage of their strong alliance with industry, should be enhanced. However, postgraduate supervision capacity at UoTs mainly in the faculty of engineering remains a huge challenge. The change in the higher education scenery and the formation of the new type of a university, comprehensive university, has called for more discussion on roles and functions of these bodies and their expectations on postgraduate supervision, student throughputs and research outputs. A comprehensive university is a mixture of both technikon and university resemblance and it is expected in its newly established role to comprise of basic and applied research. The new perspective calls for reconsideration on allocation of research funding formula, allocation of resources and infrastructure for universities. UoTs needs to carry a balance in connecting basic and applied research by ensuring that they address industry needs and at the same time increase masters and doctoral throughputs (Fisher, 2011:119)

Undertaking research at UoTs is integral to have Academic Writing Centres, Academic Development Units, Educational Technology Centres, Quality Assurance Units and several other structures to lead research and postgraduate supervision in the right direction. It is of essential and critical for universities to give educational support that gives an individual and sensible approach to manage research studies that open entryways for postgraduate engineering students to develop and enhance their research skills. Postgraduate engineering students require different types of support and bearing from their specific university or resources keeping in mind the end goal to increase postgraduate throughputs and research outputs. Unfortunately, the opening of access to higher education has not resulted in a change in institutional structures to

accommodate some of these students and to ensure their academic success (Mouton, 2016:34).

According to Bunting (2002:81) the establishments of institutions into eight classifications that point to the type of information generation (traditional universities versus universities of technology), racialised power, structure and body electorate. Across South Africa, the higher education scene contained a divided arrangement of the fragmented system of unequally-planned, governed and funded institutions.

The classifications of three HEIs, which become prominent from this exercise, were traditional universities, that offered mainly conventional white-collar qualifications for professional careers (such as law and medicine); universities of technology, that provided mainly vocational (engineering) diplomas and comprehensive universities, that provided a mixture of the two qualifications. The distinction among universities congregated near the variety of qualifications and reasons for distinct universities expected to meet unprecedented requirements for knowledge. Hence, very little interest was given to the relationship between distinct knowledge demand of independent universities and their effects on postgraduate research studies specifically supervision (academic staff with doctoral qualifications), postgraduate engineering student throughputs and research outputs at UoTs (Motshoane & McKenna, 2014). Consequently, distinctions focused on dealing with imbalances of apartheid, the way it crisscrossed with other influences, which may have caused divergences, such as the history of an institution, circumstances in which it can be fully understood and the effects these have on postgraduate supervision, academic staff profiles, postgraduate throughputs and research outputs regarding quantity and quality that needs to be strongly taken in consideration.

Postgraduate research studies at several UoTs in South Africa are not well structured for research to thrive, while there is regularly extensive variety in methodology and even in satisfaction of the necessities for postgraduate supervision (Mutula, 2011:184). Subsequently, there are some difficulties confronting postgraduate studies in Africa generally.

According to Lues and Lategan (2006b:109), former technikons (currently UoTs) had to diverge from teaching and learning to focus more on research after South African universities merged in 2004 and, as a result, had to make some adjustments within

the structures of these universities. Many of the UoTs experience limitations in the number of academic staff with postgraduate qualifications (Ph.D.'s) to supervise students who register for postgraduate studies mainly in the faculty of engineering (masters and doctoral) including the resources and funding, which are required as part of the essential infrastructure for postgraduate research studies to thrive. Critical components are required for research to thrive, for example staff profiles (supervision), although changing gradually, is suited more to teaching than to research.

Postgraduate supervision is "an extremely specific and complex model for research learning transmission (teaching and learning). On the off chance that you are new to supervision then you should be prepared". The second perspective is that although a postgraduate supervisor has "helped number of students to finish their postgraduate studies effectively despite everything he/she needs continuous supervision training to be very much updated with research developments and new practices associated with supervision" (Lategan 2009:161).

According to Lessing and Lessing (2004:74), who argued that guidance, change and development are critical, keeping in mind the end goal to keep up the quality of postgraduate supervision in the evolving environment. The difficulties confronting UoTs is the greater heterogeneous the postgraduate engineering student populace, jointly with few facilities or infrastructures and the nature of supervision qualities, that implies students have different aspirations, needs and demands for postgraduate studies, (Lessing & Lessing, 2004:74).

Archer has argued that effective academic writing pedagogy involves dialogue between the culture and discourses of academia and those of students, 'offering students from disadvantaged backgrounds an empowering and critical experience, not just bridges to established norms' (Archer, 2010b:508).

The theoretical contribution in this research sees academic writing as a contextualised social practice (Lea, 2005). Supervision of postgraduate engineering students needs to be individualised to suit each postgraduate engineering student who comes with a distinct background and set of research skills. The supervision process is always a diverse one since it should be tailored to meet specific complex needs and context of postgraduate engineering student. Thus there are two sides to the contextualised nature of academic writing, firstly from the perspective of the student, it is critical to

ensure the way in which postgraduate engineering student writers are able to engage with and be accommodated within specific discipline in academia; and secondly, from the supervisory point of view, the development of the postgraduate engineering student's academic writing needs to be approach in a sensitive manner. At the same time academic writing skills for postgraduate engineering student needs to be nurtured and encouraged by the supervisor. According to Lillis (2001:2) who suggest that it is important to consider "specific issues" regarding student academic writing because they provide valuable information into writing practices. This research study, together with supervisors and postgraduate engineering students including feedback given to students with regard to their academic writing is a way of identifying possible academic writing-centred supervision approach within UoTs in the faculty of engineering.

Academic writing is seen as critical element of thinking and organisational skills for second language writers, as well as assisting postgraduate engineering students to test hypotheses about the new language by providing a time to process meaning in a less stressful way compared to oral production. Writing in general is a multifaceted skill which involves different complex elements that impinge on each other. This aspect of writing has been presented by Raimes (1983:6), who suggests that producing a written product is not a simple skill but a rather difficult and complex skill, which forces the postgraduate engineering students to simultaneously consider numerous factors such as content, word choice, audience and grammar, among others.

Using this theoretical approach by Raimes (1983:6) in which academic writing is regarded as a multifaceted practice, this research study provides an opportunity to add value in enhancing postgraduate research pedagogy that is linked to quality supervision (Raimes,1983:6). Postgraduate studies and academic writing has become a critical element to postgraduate supervision in South Africa and globally (Marginson & Van der Wende, 2009:17). Hence, this research study aims to fill the gap that exist in increasing postgraduate throughputs and research outputs at UoTs by developing a tailor-made supervision framework for engineering students. The theoretical contribution of the study seeks to construct a research approach that is beneficial to engineering faculties at UoTs by developing a supervision framework that stimulate and enhance postgraduate supervision, increase throughputs and outputs at these institutions. In considering whether to implement the proposed recommendations, the researcher make judgments about the importance of the knowledge that is likely to

result from this research studies. The importance of the knowledge to be gained may increase when significant new findings are expected; it may result in a development of a supervision framework that is specific and applicable to engineering students at UoTs. Targeting specific institutions such as UoTs with supervision capacity to produce more masters and doctoral graduates and advocating for public support amongst government and industry for a better understanding of the value of the postgraduate qualifications. It is also about creating an institutional culture that values the development of all human capacities within the institution, embedding a lifelong learning organisation and promoting a quality supervision not only limited to research but also to teaching, learning and community service learning activities. This study also investigated the contribution of supervision at UoTs with specific focus on the faculty of engineering as a process that influences many factors, including settings, the personalities of the supervisor and postgraduate engineering student, the relationship that develops between them, the expertise of the supervisor, and the problems varied among postgraduate engineering students.

1.4 Problem statement

Postgraduate supervision at UoT engineering faculties are characterised by low postgraduate throughput and research output rate. The data suggest that academic writing and postgraduate supervision contribute significantly to this result at South African UoT engineering faculties in particular.

This research explored the nature of postgraduate supervision practices with a specific focus on academic writing, and the possibilities for the development of tailored postgraduate supervision framework that support and enhance academic writing for engineering faculty at UoTs. Traditional supervision with regard to academic writing, as well as practices provided by a writing supervision model in engineering discipline was investigated.

The aim of the study was to cultivate research knowledge that is favorable for South African UoTs in engineering faculty by developing a supervision framework that seeks to stimulate and enhance postgraduate supervision, increase postgraduate engineering throughputs and institutional outputs. This was done with the aim of addressing three key interrelated issues that might affect UoTs in the faculty of

engineering, namely supervision capacity challenges, low postgraduate throughputs and research outputs. The study propose a supervision framework tailored for postgraduate engineering faculty at UoTs while taking into consideration the NDP 2030 goals of producing 5 000 Ph.D.'s per annum. The researcher argue that UoTs need an incubation phase where a sustainable research environment can be entrenched for these institutions of higher learning can contribute meaningfully in postgraduate research studies especially in the faculty of engineering. This phase should include effective and efficient research management, nurturing research environment, resources, infrastructure, strong quality research development and quality postgraduate supervision.

The proposed supervisory framework for engineering faculty at UoTs seek to construct possible supervision solutions based on recommendations drawn from the literature reviewed and the empirical data generated through this research project. These recommendations assisted the researcher to answer the research question more accurately. The process was interactive and inclusive. In this sense, the recommendations do not imply explanations for explicit facts and challenges in postgraduate studies, only to manage the research study (Bless, Higson-Smith Kagee, 2007:38). To deal with the research problem, the relevant literature was in the form of books, journals/ articles, the Internet and some newspaper reports as an ongoing process. For students, research skills in the sense of postgraduate studies are an important indicator of quality (Maharasoa & Hay, 2001:9). A local South African UoT for example, encourages postgraduate engineering students to continue with their postgraduate studies after they have completed a Bachelor of Technology (B-Tech) qualification through Undergraduate to Graduate Student's Programme. The programme was initiated to increase postgraduate enrolment and institutional development at a UoT faculty of engineering.

This study explored the shortage of academic staff, particularly supervisors as critical contributing factor in the faculty of engineering which impacts on postgraduate throughputs and research outputs at UoTs.

1.5 Research question

The main question posed in this research is:

- To what extent does research supervision capacity challenges and postgraduate engineering student experiences impact on postgraduate throughputs and research outputs at UoTs in the faculty of engineering?

The subsequent research objectives were developed:

- To investigate how postgraduate supervisors at two South Africa UoTs consider their roles and responsibilities as academic leaders in the supervision process and their relationship with students they are supervising.
- To investigate postgraduate supervision challenges that both postgraduate engineering students and supervisors at two UoT engineering faculties experience and the reasons for such challenges; and
- To identify through literature, questionnaires, interviews and focus group discussions a suitable postgraduate supervisory framework that is aimed at enhancing postgraduate engineering student advancement at UoTs in engineering faculty.

The contention is up to the expectations of UoTs, which requires an incubation duration for a sustainable research environment to be mounted on the mission and vision of its structures in accordance with meaningfully research capacity development. This incubation period must integrate constructive management tools, resources, infrastructure and most importantly uncompromising quality supervision.

This research study aims to contribute to engineering faculty role players at UoTs, industry and government, be it in policy or at intervention levels aimed at enhancing postgraduate studies at these universities.

The study seeks to contributes towards the following:

- The enhancement of research supervisory framework for postgraduate engineering students at UoTs, which would lead to increased postgraduate throughputs and research outputs;

- A supervisory practice for the development of effective and efficient student-supervisor relationship, which serve as a foundation for successful masters and doctoral research studies at UoTs in the faculty of engineering;
- Providing policy guidelines that ensure high levels of postgraduate research supervision dissemination and value addition at UoTs; and
- Promoting the development of postgraduate engineering student welfare systems for the attainment of research excellence.

1.6 Clarification of key concepts

1.6.1 Postgraduate supervision framework

Postgraduate supervision framework in this study refers to the proposed supervision framework that seeks to guide research supervision for postgraduate engineering students at UoTs; its strength resides in its integrative and systemic perspective with student experience of academic writing at its core. The framework integrates the range of factors influencing postgraduate engineering student's supervision experience so that it can respond to this issue in a coherent and effective manner and potentially enhance postgraduate engineering student throughputs and research outputs at UoTs in engineering faculty. This refers to a basic guidance of postgraduate engineering students and a conceptual structure for leading a postgraduate supervision process.

1.6.1.1 Tailored supervision framework

Tailored supervision framework means specific, exactly right or suitable for someone or something and it is specific for engineering faculties at UoTs. In this study tailored supervision framework is in the form of customisation for postgraduate engineering student academic writing skills. Chapter six in this study refers to a proposed supervision framework that will guide postgraduate engineering student academic and technical research skills. The proposed tailored supervisory framework aims to guide postgraduate supervision, which focuses on the strength that resides in its integrative and systemic approach with supervisor and postgraduate engineering student academic writing at the core. The framework aims to integrate various factors that influence postgraduate students experience so that they can envision response to this

issue in a coherent and effective approach and potentially increase postgraduate engineering student's throughput and research output rates.

1.6.2 Technical writing

Technical writing is one of the most difficult writing tasks that postgraduate engineering student can undertake. According to Mills and Walter (1980), technical writing is the art of informally establishing a meaningful pattern of relationships among a group of facts. It is especially useful in formal reports such as theses and dissertations. Technical writing is replete with technical terms that need to be defined. It is a must to define scientific terms to allow for better comprehension. These difficult words may come in the form of known words used in a differently new sense. New words do not necessarily mean newly-coined words; they are new in the sense that they are encountered by the reader for the first time so they have to be defined. When one defines, he gives the meaning of a certain term. The writer may define a word in any of the three ways: informal (word or phrase) definition, formal (sentence) definition, and amplified (extended or expanded) definition.

The Society for Technical Communication (STC) define technical writing as a specialised form of exposition: that is, written communication done on the job, especially in fields with specialised vocabularies, such as engineering, technology, and the sciences.

Technical writing, just as any other form of writing, has certain characteristics which distinguish it from other types of writing. It is very different from writing opinion pieces, essays, prose, non-fiction or fiction.

- It is clear and straight forward;
- The language is very direct and straight to the point. The writing will avoid words that people do not understand and will avoid an eloquent writing style;
- It is very detailed and informative. The perfect example of technical writing is a textbook; and
- It is very structured. Solid structure is needed with technical writing as it allows the audience to easily access the information as needed.

In this study technical writing focuses on postgraduate engineering students' research skills to supplement academic writing. Technical writing for postgraduate engineering students is a type of writing where postgraduate student is writing about a particular subject that requires specific instruction, or explanation. This style of writing has a very different purpose and different characteristics than other writing styles such as academic writing. Regardless of the type of document which is written, technical writing requires postgraduate engineering students to do extensive research on engineering topics. By including these element, postgraduate engineering students can create clear instructions and explanations for a research topic.

In general, a good dictionary may provide all the definitions many words need. Several respected dictionaries are listed in the text, such as the Oxford English Dictionary, the American Heritage Dictionary, Webster's New World Dictionary, and the Random House Dictionary. These are all general dictionaries, in that they are not limited to and may not contain the operational definitions of terms used in technical writing.

Successful writers employ a variety of techniques in their writing. However, the kind of writing dictates the techniques to be employed by postgraduate engineering student. In this study technical writing, the techniques basically employed are classification, analysis, causation (causal analysis), comparison, and interpretation.

1.6.3 Academic writing

According to Hartley, (2008:37) academic writing refers to a style of expression that researchers use to define the intellectual boundaries of their disciplines and their specific areas of expertise.

Characteristics of academic writing

- Deductive reasoning and an analytical approach are important in academic writing for engineering postgraduate students.
- Academic writing refers to a style of expression that postgraduate engineering students use to define the intellectual skills and specific areas of expertise in postgraduate supervision.
- Academic writing is planned, focused, structured, evidenced and demonstrates knowledge of the subject area that supports opinions and arguments with evidence, and is referenced accurately.

In this study, academic writing skills demand more than language vocabulary instruction for postgraduate engineering students; these writing skills are more associated with student thoughts and coherence processes. Although the supervisor guides in developing postgraduate engineering students to acquire academic writing skills, the challenge is that the supervisor must not be a proof-reader where he has to check grammar, spelling and help the student to develop ideas (Lee & Murray, 2013:558).

According to Lee and Murray (2013:558), a framework of supervising postgraduate engineering students should first aim at understanding the principles of writing academically and gain skills through uncomplicated tasks and events before engaging in scientific writing. Research writing creates serious anxiety amongst students. Some students are not able to conceptualise and write simultaneously, to structure their own writing appropriately. Writing academically, especially for postgraduate engineering students whose first language is not English, is challenging. Academic writing skills demand more than language vocabulary instruction; these writing skills are more associated with student thoughts and coherence processes. Although the supervisor guides in developing the students to acquire academic writing skills, the challenge is that the supervisor must not be a proof-reader where he has to check grammar, spelling and help students to develop ideas (Lee & Murray, 2013:558).

1.6.4 Academic writing pedagogy

Pedagogy refers more broadly to the theory and practice of education, and how this influences the growth of learners. Theories of pedagogy increasingly identify the student as an agent, and the teacher as a facilitator. Within higher education and even among teachers, where the term pedagogy is under-defined, often referring to no more than a teaching style, a matter of personality and temperament, the mechanics of securing control to encourage learning, a cosmetic bandage on the hard body of classroom contact (Lusted, 1986: 2). Simon (1992: 55) similarly describes pedagogy as a term fraught with difficulty. Pedagogy is critical in this study since, as a concept, it draws attention to postgraduate supervision process through which knowledge is produced. Pedagogy addresses the ‘how’ questions involved not only in the transmission of knowledge but also in its production. It enables postgraduate engineering students to question the validity of separating research activities by asking

under what conditions and through what means they have to learn writing academic (Lusted, 1986: 2).

Academic writing pedagogy in this study refers to attention in developing research skills for postgraduate engineering students that focuses on basic elements of scientific writing, characteristics of writing genres across engineering faculty at UoTs by developing a tailored postgraduate supervision framework in which expert and practical knowledge is internally transferred. Using this pedagogy in which academic writing is seen as a contextualised practice, this study offers the opportunity to add and enhance knowledge of the pedagogy associated with academic writing and effective postgraduate engineering supervision. Thus this research study fills a much-needed gap as there is a need to increase research skills for a tailored supervision framework, practices and interactions in academic writing for postgraduate engineering students at South African UoTs.

1.6.5 Pragmatic approach

The pragmatic paradigm has what Tashakkori and Teddlie (1998:126) and Creswell (2003:8) refer to as intuitive appeal, permission to study areas that are of interest, embracing methods that are appropriate and using findings in a positive manner in harmony with the value system held by the researcher (Creswell, 2003:8). For these reasons it can be argued that the pragmatic paradigm was adopted for this study as an approach of mixing quantitative and qualitative research methods. Pragmatic approach in this study refers to solving problems in a sensible way that suits the conditions that really exist now, rather than obeying fixed theories, ideas, or rules.

1.7 Theoretical framework of the study

This study draws on the social cognitive theory (SCT), as theoretical lenses to underpin the research construct that began as a social learning theory (SLT). SLT was developed by Albert Bandura in the mid-1960s. It was later developed into SCT in 1986 with an emphasis that learning takes place in a social setting with active and shared activities of people and how they behave towards their environment. The unique characteristics of SCT are its influence on social behaviour and the emphasis on external and internal social support. The SCT examines the nature in which individuals achieve and sustain behaviour, while taking into consideration the social

environment in which they perform. The theory considers people's past experiences, which determine whether behavioural response will transpire. Past experiences often influence actions and the expectations, which outline whether a person will behave in a particular way and the reasons they react in that way. SCT argues that individuals learn from each other through observing, imitating and modelling. The theory has been characterised as a method of connecting behavioural and cognitive learning theories because it focuses on motivation and attention.

Using this theoretical framework in which academic writing is seen as a contextualised social practice, this research offers the opportunity to add to and enhance knowledge of the pedagogy associated with postgraduate research-writing and supervision. Thus, this research study filled a much-needed gap in postgraduate studies as there is a need to increase research knowledge of supervision models, practices and interactions concerning academic writing for engineering students at South African UoTs (Lillis, 2003:192).

The aim of SCT is to give reasons in order to justify how individuals control or manage their behaviour through monitoring and support to bring about a particular behaviour that can be retained over a period of time. The first six establishments, namely reciprocal, determinism, behavioural, capability, observational, reinforcements and expectations were constructed as elements of SLT; the development of self-efficacy was later included when the theory progressed into SCT.

There are some disadvantages in using SCT, which must be taken into consideration when applying this theory for specific target audience. These disadvantages include the following:

- The theory presumes that changes in the environment eventually lead to changes in the behaviour of people, whereas this might not necessarily true.
- The theory is generally applied and is based mainly on the potent interplay between people, behaviour and the environment they live in. It is not clear to what extent these factor into real behaviour and if the one is more influential than the other.

- The theory's main focal point is on learning and in the process ignores biological and hormonal inclination that could influence behaviours, irrespective of one's previous experience and his or her expectations.
- The theory focuses less on emotions or motivation, other than referencing past experience. There is little focus on these factors.
- The theory is broad; it is often difficult to apply it in its entirety.

SCT examines different levels of social ecological framework when addressing people's behaviour change. It has been broadly used in health campaigns taking into consideration the link between people and the environment (Reyneke, Meyer & Nel, 2010:277).

The conceptual framework also draws from Vygotsky's Social Constructivism and the systems approach. Social Constructivism focuses on social interaction in gaining knowledge and new meaning (Bergh & Theron, 2009). Vygotsky believes that learning is a social and collaborative activity wherein people create meaning through their interactions with one another (Schreiber & Valle, 2013: 395). Furthermore, Social Constructivism views learning as a social process which occurs when an individual is engaged in social activities (Kim, 2001). The social constructivism approach view supervisor's working experience as playing a crucial role towards the professional development of postgraduate engineering students. This view is supported by Burton (2011) who contends that social constructivism approach to supervision provide an advantage that supervisor's working experience assist the supervisees within the context of learning and professional development. The researcher is of the opinion that supervisors, using the social constructionist perspective, involve postgraduate engineering students in a collaborative relationship that stimulates exploration and exchange ideas, opinions and information sharing.

1.8 Paradigmatic perspectives

The research design for this study was pragmatic in nature. Existing single paradigm, does not provide adequate rationale for mixed methods research. Both transformative and pragmatic paradigms had several limitations. A realist perspective, it is argued, overcome some of the study limitations and provided a much more satisfactory paradigm for mixed methods research. The study also included some elements of

realism paradigm. The study followed a multi-strand sequential design with various data-collection phases, including a mono-strand approach during the first empirical phase of inference, with data collected by means of a developmental question followed by a questionnaire consisting of both closed and open-ended questions. The researcher adopted a realist approach due to its ability to capture the fuller picture when studying a phenomenon and appreciate the influence of interrelationship between the individual, the group and the organisation.

In evaluating realism, Vasquez makes 'the ability to produce knowledge' the ultimate criterion for judging a theory's truth or utility. This ability to produce knowledge is dependent upon the 'empirical content of its theories, that is, the number of theories that have failed to be falsified' (Vasquez, 1998:122). However, one of the most important attempts to critique realism from a scientific perspective is Keohane's 'Theory of World Politics' in 1986. According to Keohane, (1986:164) although invaluable as a sophisticated framework of questions and initial hypotheses, 'realism does not provide a satisfactory theory of world politics, if we require of an adequate theory that it provide a set of plausible and testable answers to questions about state behaviour under specified conditions' (1986:159). Keohane further outlines three fundamental assumptions of realism; state-centrism; that states are rational actors; and that power is the aim of states (Keohane, 1986:164). For Keohane, realism lacks an adequate basis in scientific terms, its vagueness and ambivalence leading to a lack of clarity that is unacceptable according to his Lakatosian definition of theoretical purity.

1.8.1 Epistemological perspectives

Many mixed methods recent publications advocate for researchers' explicit discussion of their paradigmatic foundations, more guidance is needed regarding how these paradigms should be applied. This research study comparatively analyses three major paradigmatic perspectives discussed in mixed methods approach; pragmatism, transformative, and critical realism. It offers a discussion of each perspective's implications for mixed methods and how they can be used to influence research studies. While there are several similarities, such as emphasising divergent results and by allowing choices for the researcher in selection of method, each perspective offers a unique set of advantages and disadvantages. Emphasising how paradigms can be used then promotes more explicit engagement with them in future research.

Teddlie and Tashakkori (2003:4) identified the ‘‘paradigmatic foundations as a major issue for mixed methods research. This issue is critical in terms of how to conceptualise, address, and move beyond the former ‘‘paradigm wars’’ that have characterized social science research for the past few decades. Discussions around the paradigmatic foundations for mixed methods research can be characterised in several ways. First, there has been much discussion on what constitutes a paradigm (Freshwater & Cahill, 2013). How academics use the term paradigm has changed considerably from the original Kuhnian perspective as ‘‘a way to summarise researchers’ beliefs about their efforts to create new knowledge’’ (Morgan, 2007:50). According to Biesta (2010) who argues that paradigms should be considered as ‘‘tools’’ useful to the research process but not intending to be exclusionary. Freshwater and Cahill (2013) also argue that conceptualising paradigms are not static but should be considered as ‘‘constructed entities’’ that are more fluid.

1.8.2 Methodological paradigm

According to McMillan and Schumacher (2010:6) pragmatic approach to research allows for “common sense and practical thinking” in the selection of the research methods used to explore issues at hand. The research methodology is the systematic, theoretical evaluation concerning the strategies applied to a subject of study. It consists of the theoretical evaluation of the strategies and ideas related to the body of knowledge (Myers, 2009:8). Even though there are several contrasts in the research modes, the most generally utilised are qualitative and quantitative methods. At a specific level, the concept of qualitative and quantitative methods alludes to qualifications about the way of learning: how one comprehends the world and a definitive motivation behind the research. On the other hand, the terms allude to research strategies, that is, the path in which the information was gathered and broken down in this study and the kind of speculations and representations that aroused from the dissected information (Myers (2009:8).

It is important to consider the research issue and the idea of the information gathered before choosing the methodology. Since mix method did not really constitute a solitary research worldview, it can be viewed as rising above the worldview wars (Teddlie & Tashakkori 2009). In any case, a mixed method considers the most part connected with a pragmatic approach, as it does not really concentrate on one philosophical way

to deal with investigating the research problem and the research questions (Teddlie & Tashakkori 2009:270). Following a pragmatic approach which increased the meta-point of view inside the pragmatic perspective, enabling the researcher to address the foreordained research inquiries by applying strategies that yield/give both quantitative and qualitative information; the length of these yielded significant information.

Both quantitative and qualitative research techniques were applied by the researcher in this study. Neither one of these techniques were considered by the researcher as superior to the other; the propriety of which were chosen by the connection, reason and nature of the research study being referred to; on occasion the one interchanged with the other, relying upon the course of the study. Most researchers ordinarily prefer to utilise a blended techniques approach by exploiting the contrasts between quantitative and qualitative strategies, blending the two strategies and use in a solitary exploration venture contingent upon the type of study and its methodological establishment (Brysman & Burgess, 1999:45).

1.9 Research overview

Postgraduate research supervision is one of the core components of academic work. In light of the changing higher education environment in South Africa, with its increased teaching loads, drive for more postgraduate throughputs and research outputs, increased focus on enhancing the quality of teaching and learning, and increased administrative tasks, supervision has become challenging (Olivier, 2007). This research study was based on an auto ethnographic reflection searching for a more constructive supervision practice. More specifically, it describes academic writing and quality supervision approach to enhance postgraduate engineering student throughputs and research outputs at UoTs. Although the literature available on alternative forms of supervision is increasing, it remains broad, and where its practices are documented, it lacks specifications and clear guidelines on how to implement it to specific students such as engineering at UoTs (Buttery, Richter & Filho, 2005:7). Furthermore, most of the research focussing on group supervision practices uses structured, faculty-wide implementation mostly using postgraduate engineering student cohorts (De Lange, Pillay & Chikoko, 2011:15). The group supervision practices described in this research study are implemented on a supervisory level, and include a multi-voiced approach (Samara, 2006:115).

The researcher presents an incisive overview of the impact on postgraduate supervision at two South African UoTs in the faculty of engineering. This was done with the aim of directing the reader to the background of the data that were analysed and interpreted. The purpose of this research study was also to analyse data collected to reach deductions and inferences that are reliable and based on experiences of respondent's viewpoints about postgraduate studies at UoTs in the faculty of engineering and to instigate the establishment of a supervisory framework that is appropriate for postgraduate supervisors and students within the context of South African UoTs in order to enhance postgraduate throughputs and research outputs. In outlining the recommended models, it is critical to explore student-supervisor relationship at UoTs from previously conducted research, students and supervisor's points of view.

The impact of postgraduate supervision and the relationship between the student and the supervisor were examined through the literature review. The applications, aspects, considerations and perspectives of postgraduate supervisors and postgraduate engineering students assisted in providing independent data that is valid and reliable. The data was collected during different phases in the research study. The researcher considered it essential to first manage a theoretical question to assess the suitability and the mental role that supervision plays and its impact on throughputs and outputs in the postgraduate supervision process. Secondly, questionnaires were designed based on the growth and expansion of postgraduate enrolment and supervision capacity at two South Africa UoTs with specific focus in the faculty of engineering.

Although, the findings of this research study were not generated for the purpose of being generalised to all South African universities, but preferably with specific focus aimed at contributing to the development of UoTs in the faculty of engineering, which will hopefully impact positively on postgraduate throughputs and research outputs at these universities.

1.9.1 Research design

The study followed a multi-strand sequential design with various data-collection phases, including a mono-strand approach during the first empirical phase of inference, with data collected by means of a developmental question followed by a questionnaire consisting of both closed and open-ended questions.

The research methodology for this study was a mixture of qualitative and quantitative methods. Mixed methods research has been practiced since the 1950s but officially introduced in the late 1980s and is progressively used by large number of academic scholars (Creswell & Plano Clark, 2011; Dunning, Williams, Abonyi, & Crooks, 2008:145). The growth in use of mixed methods substantiates the question of ascertaining the appreciation of using mixed methods as compared with solely quantitative or just qualitative study. It is essential to recognise the importance of mixing the two differing methods, primarily given the resources advantages, time and knowledge needed to apply a mixed methods study. Mixed methods approach requires more time due to the demand to collect and analyse the two distinct types of data (Creswell & Plano Clark, 2011:69).

Another significance of mixed methods is that the combination of two allows readers more assurance in the outcomes and the conclusions they may gain from the study (O'Cathain, Murphy, & Nicholl, 2010:341). Mixed methods can also assist researchers develop suggestions for future research (O'Cathain et al., 2010). Furthermore, many researchers argue that mixed methods application for research is the most effective way to be sure of findings and results interpretations (Tashakkori & Teddlie, 2008:101).

It is important to consider the research issue and the idea of the information to be gathered before choosing the methodology. Since mix method does not really constitute a solitary research worldview, it can be viewed as rising above the worldview wars (Teddlie & Tashakkori 2009:270). In any case, a mixed method considers the most part connected with a pragmatic approach, as it does not really concentrate on one philosophical way to deal with investigating the research problem and the research questions (Teddlie & Tashakkori 2009:270). Following a pragmatic approach increased the meta-point of view inside the pragmatic perspective, enabling the researcher to address the foreordained research inquiries by applying strategies that yield/give both quantitative and qualitative information; the length of these yielded significant information.

The research design for this study tried to portray and be interpretive in nature in that information was broken down precisely and completely. Questionnaires and surveys were utilised to assess participant's abilities and knowledge to determine their levels

of fulfilment during the course and toward the end of the contextual analysis. An engaging measurable technique likewise were utilised to dissect staff and student fulfilment views. Member perception, face-to-face interviews, questionnaires and focus group discussions was utilised as information accumulation strategies. Besides, the avocation for each of the information accumulation strategies utilised as a part of the study was described. With a specific goal to guarantee dependability of the exploration, suitable criteria for qualitative research we talked about and a few techniques that incorporate peer reviews and scholarly articles were later employed.

1.9.2 Selection of participants

According to Parahoo (1997:218), populace is the entire number of participants from which information can be gathered, for example, people, antiques, exercises or associations in a particular area. Burns and Grove (2003:213) portray populace as every one of the variables that meet the principles for incorporation in a study.

Burns and Grove (2003:234) describe qualification models as "a posting of characteristics that are required for the participation in the objective populace".

The criteria for inclusion of participants in this research study included:

- Registered masters and doctoral students in the faculty of engineering at two UoTs; and
- Supervisors and academic staff in the faculty of engineering at two UoTs.

This research generated empirical data from 52 postgraduate engineering students and 10 engineering faculty supervisors from two South African UoTs. The researcher used randomly selected sampling size that was representative of the sampling population of postgraduate engineering students and supervisors since this methodology focused on a specific group of the population (masters and doctoral students as well as supervisors in the faculty of engineering at two UoTs). Empirical data for this study was collected by means of questionnaires, several interviews and focus group discussions. The first phase was a developmental phase consisting of randomly selected sample size from each UoT, with postgraduate supervisors being invited (via an e-mail sent to the research units of the two UoTs) to participate in the qualitative developmental process. The second evaluation process consisted of an e-mailed invitation to postgraduate supervisors. This sample size in all phases was

randomly selected sample of possible participants corresponding with the topic of research (Leedy & Ormrod 2010:212–213).

The study followed a multi-strand sequential design with various data-collection phases, including a mono-strand approach during the first empirical phase of inference, with data collected by means of literature review followed by a questionnaires consisting of both closed and open-ended questions. Second phase focused on individual interviews and the third phase was completed through focus group discussions as a follow up on questionnaires and interviews.

Saunders et al. (2012:150) explain sampling as strategies that empower the researcher to decrease the measure of information that he or she has to gather by considering just information from a subgroup instead of all conceivable cases or components". According to Fischer (2004:159), a sampling size "is to get an outcome that is illustrative of the entire populace without heading off to the inconvenience of asking everybody". Strydom (2005a:193) characterised a sampling as any divide of a populace that is illustrative of that group. Respondents/participants for the exploration procedure comprised of postgraduate engineering students, supervisors and research managers/ administrators working at two UoTs. Jankowicz (2005:209) proposes that one needs to ask what number of individuals a study ought to have in its example and that the response will shift contingent upon the exploration questions inquired. There were more than 60 participants in this research study from two UoTs as has been indicated earlier.

1.9.3 Data documentation and analysis strategy

Amid the interview that were conducted and recorded on audiotape, notes were taken at the same time with permission to enhance the taped discussions. According to Holloway and Wheeler (2002:237), note-taking is an important action, but can be time consuming and uncomfortable to both the interviewer and interviewee. To minimise this, the researcher informed participants before the interview that notes would be taken during the interview in order to know if they will be comfortable or not. A non-participant may take notes so that non-verbal conduct of the participants and the researcher's responses and remarks may be recorded (Holloway & Wheeler, 2002:237). Note taking was refined cautiously to refrain from manipulating data.

Questionnaires usually appear to be a logical and easier choice as a form of gathering information from participants. They are sometimes strenuous to design because of the frequency of their use in all contexts in the modern world. The response rate is sometimes problematic (low response) unless the researcher creates a manner that make participants to complete them and submit at the same time (sometimes this may reduce a sample size, the length of questionnaire and the type of questions asked). As with interviews, the researcher may opt to use closed or open questions and can give participants multiple-choice questions to choose from. Questionnaires' layout should be well designed because when they are poorly structured questionnaires participants tend to repeat their ticking of boxes in the same way. When given a choice of response on a scale of 1-5, participants might opt for the middle point and often tend to miss out subsections to questions. The researcher took expert advice in setting up a questionnaire, ensure that all the information about the respondents is included and filled in and ensure that they are returned. Expecting people to pay to for participating is a financial burden to participants and drawing up a lengthy questionnaire will inhibit response rates. The researcher ensured that questions were clear and that there are cost effective ways of collecting and managing the data. The researcher incurs cost for distribution of questionnaires, interviews and focus group discussions, those who wanted to be reimbursed for incurring cost were refunded.

The researcher utilised the accompanying strategy for discussion:

- The researcher conducted individual interviews and arrange meetings with the participants by scheduling a meeting guide with semi-structured questions.
- The interview strategies of testing (verbal and non-verbal) were utilised. These included probing or "investigating". The researcher endeavoured to encourage more participation by emphasising the importance of this research study (Holloway & Wheeler, 2002:84).
- The researcher utilised a semi-structured meeting guide, for adaptability and consistency.
- The participants were informed with respect to the requirement for subsequent meetings for questionnaires that were not clearly answered.

1.9.3.1 Data generation and analysis

Empirical data for this study was collected by means of questionnaires and several interviews. First, questionnaires that were used to gather information from participants during the data-collection process in the form of closed-ended and open-ended questions to 52 postgraduate engineering students from two UoTs and the anonymity of the participants were guaranteed. Secondly, the researcher conducted a semi-structured interview with about 10 experienced postgraduate engineering supervisors at two UoTs. Thirdly, the researcher conducted focus group discussions with postgraduate engineering students. To ascertain the validity of the data-collection instruments, the first phase was a developmental phase consisting of a randomly selected sample size (postgraduate engineering students and academic staff) from each UoT, with postgraduate engineering supervisors being invited (via an e-mail sent to the research units of the two UoTs) to participate in the qualitative developmental process. The second evaluation process consisted of an e-mailed invitation to postgraduate supervisors. This sample size in all phases were randomly selected sampling of participants corresponding with the topic of research study (Leedy & Ormrod, 2010:212–213).

There researcher was an observer in this research study, as a faculty research officer at one of the UoT, the researcher was known and recognised by the participants at that UoT. The participants knew the researcher’s aim for being an observer. There was little interaction with the participants, but the interaction was limited since interviews were conducted. The researcher played a neutral role as much as possible.

Questionnaires, interviews and focus group discussions were utilised to assess participant's abilities and knowledge to determine their levels of fulfilment during the course and toward the end of this research study. Data for this research was collected using qualitative as well as quantitative methods of study. The researcher collected and analysed both quantitative (closed-ended) and qualitative (open-ended) data using rigorous procedures that were appropriate to each method’s tradition, such as ensuring the appropriate sample size for quantitative and qualitative analysis.

1.9.3.2 Data structuring, analyzing and interpretation

The researcher presented data analysed and collected for this research study through questionnaires and interviews, which focused on both quantitative and qualitative methods as well as procedures that were used to try to answer the research questions. This was done with the aim of directing the reader to the background of the data that was collected, analysed and the interpreted. The purpose of this research study was also to analyse data collected to reach deductions and inferences that are reliable and based on experiences of participant's viewpoint about postgraduate supervision at UoTs and to instigate the establishment of supervisory framework that is appropriate for supervisors and postgraduate engineering students within South African UoTs context aimed at improving postgraduate throughputs and research outputs in the faculty of engineering. However, it is important to remember that the strategies for analysing data might differ depending on the strategy and information gathering techniques. Once the information is gathered, the researcher continued to seek to describe different aspects of the study in a depiction. In the second stage of data analysis, the researcher tried to depict the different application components of this study, which incorporated people being studied (participants); the motivation behind data analysis; the perspectives of participants and the impacts of any exercises on them. Patton (2002:434) explain that the third stage of data analysis, interpretation of results, including explanation and clarification of the findings, answering questions, connects essentialness to specific outcomes and placing data into a systematic structure. The analysis of data concentrated on coding, examining, explaining, elaborating and formalising.

When taking part in qualitative data analysis, the researcher wishes to highlight recurring features, as well as various strides, methods and procedures that were at the disposal of a researcher. In such manner, the initial phase in breaking down qualitative data, as indicated by Best and Khan (2006:270), included gathering information. However, it is important to remember that the strategies for analysing data might differ depending on the strategy and information gathering techniques. Amid the second stage of data analysis, the researcher tried to depict the different application components of this study, which incorporated people being studied (participants); the motivation behind any exercises inspected; the perspectives of participants and the impacts of any exercises on them. Patton (2002:434) portrays the third and last stage

of data analysis, interpretation of results, as including explanation and clarification of the findings, answering questions, connecting essentialness to specific outcomes and placing designs into a systematic structure. The analysis concentrated on coding, examining, explaining, elaborating and formalising.

1.10 Value of the research

The researcher seeks to contribute towards the development and implementation of a tailor-made supervisory framework that will enhance student-supervisor relationship with the aim of increasing postgraduate engineering student throughputs and research outputs at UoTs. It is also hoped that this study would contribute to new knowledge by assisting policymakers as well as relevant stakeholders in higher education to understanding how reconciliation can be made between the old problem of ex-technikons and UoTs (qualifications vs industry demands) in that, they will have more understanding of how the postgraduate studies can best work at UoTs and how this will benefit industry as well as the higher education sector in advancing postgraduate studies and contribute towards NDP 2030 goal of increased production of Ph.D.'s. Local and international researchers may find the findings of this study useful, as it is the intention of the study to highlight the reasons for low postgraduate throughputs and outputs and recommend probable solutions for supervision capacity development at UoTs.

1.11 Ethical considerations

Efforts have been made to safeguard the privacy of the supervision process so that personal issues remained anonymous and the wishes of the participants were respected. All names were omitted from the research study. In view of this, ethical considerations have constrained explicit discussion regarding power relations between the student and a supervision.

This identifies with good guidelines that the researcher has to consider in all data collection process at all levels. After permission (ethical clearance) granted from the University of the Free State (UFS) Ethical Clearance number: UFS-HSD2018/0012, to conduct the study from the ethics committee. The researcher applied for permission with ethical clearance from UFS to two UoTs engineering faculties to distribute

questionnaires, conduct interviews and focus group discussions. The standard of value signified "most importantly do no harm when conducting this research study was adhered to".

Consideration of morals in research and in life is of basic significance. It is critical to consider internal and external elements amid the procedure of information accumulation and research various vital viewpoints with respect to morality was adhered to by the researcher. These incorporated planning ahead of time, successful utilisation of time, rights to security and giving an itemised clarification of the thought processes behind conducting this research and the advantages of the study. Participants' consent was of high priority and adequate time was given to participants.

The inclusion of respondents was on a voluntary basis and there were no coercion or deception. Informed consent, another basic issue in the investigation was to ensure that the people who are going to take part in the study totally understand what they are being asked to do and that they are all aware of potential dangers that may arise. Finally, the researcher was as objective as possible by avoiding being conflicted.

1.12 Demarcation of the study

The study was conducted at two South African UoTs context and included perspectives from the faculty of engineering. UoTs in South Africa, particularly those previously disadvantaged universities such as UoTs, have a long history of challenging infrastructural and institutional structures of the post-apartheid.

1.13 Outline of the chapters

Chapter 1: Introduction

The context, purpose and problem area of the research will be defined, followed by a description of the chosen site of study, research objectives, research questions and significance of the study.

Chapter 2: Historical perspective

This chapter aims to describe the international and the South African history in the application of postgraduate to address issues related to research studies.

Chapter 3: Review of postgraduate studies and its effect at UoTs

This chapter aims to structure the rationale for the use of research at UoTs in relation to a critical analysis of the South African situation regarding postgraduate research studies.

Chapter 4: Research methodology

This chapter will outline the methods employed by the study to address the main research question.

Chapter 5: Data collection and analysis

The chapter will critically outline and examine the study findings in line with the main research questions.

Chapter 6: Supervision framework

This chapter outlined the proposed supervision framework for postgraduate engineering students at UoTs that is specific for the faculty of engineering.

Chapter 7: Conclusions and recommendations

This chapter will make deductions about the overall findings of the study. The findings from previous chapters are broken down into main sub-headings and are critically examined in relation to the key issues highlighted in the literature review and provide recommendations

1.14 Conclusion

The supervisor plays a critical role in assisting postgraduate engineering students to plan for their academic writing. Supervisors often complain that students do not plan their writing and thus writing skills are usually lacking a coherent sequence or connection and students are not clear on what they write (Comley-White & Potterton, 2018:450).

Two main components that are critical elements in the process of postgraduate supervision, which are writing and managing a research project, by which an experience for postgraduate supervision must provide knowledge, wisdom and student success through guidance in a research project. The elements of leadership

should involve safety, assurance, correct planning and organising of research management to accomplish the aims and objectives of postgraduate engineering student supervision.

The current review on postgraduate studies aims to extend historical and international viewpoints on this matter. In this regard, it could involve local and global dialogue that seems to be increasingly focused solely on the issue, for example, universities in South Africa are aiming to balance the legacy of apartheid with policies solution. For example, renowned research universities in America and Europe, like the Oxbridge and Sorbonne universities, have been deliberately criticised as ill-suited benchmarking by academics for South African context. Their vision and mission are pronounced undesirable as models to be pursued by the universities in developing countries, such as South African UoTs. This has been argued, especially when academic staff redress is debated and it tends to be tackled as the primary objective of reforming South African universities (Archer, 2017:3).

The primary aim of this research study was to design and develop an institutional supervision framework to support postgraduate supervisors and candidates undertaking a higher research degree in the faculty of engineering. This study has reported on the processes adopted to design and develop the postgraduate supervision framework. The construction of a framework that meets the needs of postgraduate engineering students, supervisors and the institution is critical, especially in the context of significant change in the higher education sector and the need to demonstrate the quality and impact of research at UoTs. The design of the framework should be developed in consultation with academic staff and postgraduate engineering students with international expert-collaborators using a Utilisation Focused Evaluation method. This approach facilitated the concept that supervision should be viewed as a unique pedagogy. Feedback from those involved in this research study enabled the development of a framework that reflected issues that were viewed as important to its users, as well as issues that were viewed as valuable from a panel of experts who possessed wide-ranging views. While this study concentrated on the construction of a supervision framework to support supervisors and students, issues associated with the implementation of such a framework need to be seriously considered to ensure the future evolution of this type of guiding resource. A key challenge for higher education institutions is to ensure that academics are

supported and a culture of research, including supervisory skills and support systems, is developed institutionally. Similarly, the varied needs of students at different stages in their candidature also require integration into the institution's research culture. In the future, these challenges need to be balanced against academic autonomy and the issues associated with limitations of the framework, including the degree to which supervisors are required to implement all elements of the framework and the degree to which their students are expected to engage in using its components, online or otherwise. A more prescriptive approach may require a regulatory arm to examine compliance. Rigid regulatory processes that focused on compliance with a supervision framework may divert resources away from essential components of postgraduate studies.

Chapter 2: History and Ideology on postgraduate research studies at universities in South Africa and the global perspective

2. Introduction

History provides significance and roles that universities play in modern era of globalisation. Effective postgraduate supervision of postgraduate engineering students is a complex multi-facets process that is confined with issues at various forms being that of postgraduate students'/supervisors' relationship, to infrastructural support, institutional structures, policies, rules and regulations. Various components have been discovered in literature as critical predictor for successful postgraduate studies completion of a research project. For a development of a tailored supervision framework in this study, these various factors include studying part-time or full-time, academic writing, funding, age, gender, discipline (engineering), topic of research, environment in the faculty, access to adequate resources and infrastructure plays a critical role (Rodwell & Neumann, 2007)

According to Lin and Cranton (2005) who outline the process of postgraduate student supervision as widening from postgraduate student becoming an independent researcher, in which Lovitts (2005) refer to it as an important research learning transition. This process is usually a challenging and difficult transition. This process takes place through what Malfroy (2005) refer to as unavoidable tension, that could lead to critical thinking and independence (Lin & Cranton, 2005). Lin and Cranton (2005) further argues that postgraduate engineering students require specific support in their development for individual research identity.

With regard to postgraduate supervision as a process, most literature pay particular attention to leading and guiding, with very little attention being directed towards the importance of academic and technical writing for postgraduate engineering students at UoTs. Hence the need for a development of a tailored supervision framework for this research study, as it necessitates for postgraduate engineering students to be developed in the habit of academic writing practice and for supervisors in becoming competent for leading such processes (Lategan 2009:161).

According to Ngcongo (2001:53) who state that leading in the process of postgraduate supervision is essential for empowering postgraduate students. The process should

embrace pragmatic and continuous mentoring, coaching, guiding, regular monitoring and evaluation throughout the entire postgraduate supervision. Manathunga (2007:207) further state that “postgraduate supervisors guide and facilitate postgraduate students' gradual development into independent researchers through empathetic communication and resembling appropriate disciplinary research behaviour”.

This chapter provides an overview of the foundation of postgraduate supervision history and the need for a tailored supervision framework at UoTs in the faculty of engineering. The main focus in this chapter, refers to attributes and characteristics that are required for effective supervision of postgraduate engineering students and the course of action needed at UoTs in postgraduate supervision as a process.

According to Abiddin, Hassan & Ahmad (2009:13) the primary function of any type of supervision include leading and guiding towards achieving specific goals. While Maxwell and Smyth (2011:222) support the notion of leading and guiding as critical because it allows the leading to take precedent and that functions often differs during the process, which is similar in postgraduate supervision process. In this context, academic writing primarily resides with postgraduate engineering students for a proposed tailored supervision framework. Abiddin et al. (2009:13) define quality supervisor as a person that is committed to postgraduate student research project, and who is involved in all his or her research activities (Maxwell & Smyth 2001:222).

2.1 Historical perspective on universities

The doctoral study as a qualification, was first awarded in Germany by Friedrich Wilhelm University in Berlin during the nineteenth century. Since the eighteen sixties onward the United States of America started initiating research universities and doctoral degrees through Yale University in 1861 (Park, 2005). By the twentieth century research studies spread throughout Canada in 1910, Britain in 1917, and then onwards to several English-speaking countries such as Australia in 1948 (Park, 2005). Interestingly, the introduction of doctoral qualifications in Britain was driven less by academic considerations for political and economic aspirations to deflect American and colonial postgraduate students away from German universities (Simpson, 1983).

Based on the British supervisor model approach, the Irish doctorate has conservatively been approached using an entrepreneurship framework of postgraduate training.

Within the framework, postgraduate student registered to study independently under the supervision and guidance of experienced academic researcher by advising postgraduate students on how to conduct research and publication. As different to the US, where many first year of study is focused on coursework, Irish postgraduate students hardly attended formal classes during their doctoral studies. However, many countries, most notably the United Kingdom and Australia, have moved towards an intermediate doctoral approach, where postgraduate students register for coursework and training in key interdisciplinary skills together with their research, and it was proposed that Ireland move towards the same direction (IUQB, 2003). In responding to these trends, within the sciences, universities in Ireland has introduced structured multidisciplinary qualifications with a coursework component in the first year.

Historically, regardless of the significance and influential role for postgraduate supervision, formal research on attributes aspects for advanced supervision training only started during the nineteen seventies. During the year 1975 Ernest Rudd published conducted A Study of Graduate Education in Britain, where an analysis of postgraduate student experiences unearthed different aspects in postgraduate student supervision process. Mainly, it was highlighted that supervisors that are not motivated had a negative effect on postgraduate students' progress and it was recommended that Graduate Schools be established as an institutional mechanism for enhancing quality of postgraduate supervision.

This approach seems to be falling out of favour and training methods on postgraduate supervision have progressively been replaced, especially in the United Kingdom, some European countries, including Australasia, with comprehensive and compulsory research supervision training programmes (Manathunga, 2005). Around Europe this trend forms part of European Union drive to integrate academic standards and quality assurance across Europe, as agreed in 1999 by Bologna Accords (European Commission, 2008).

It has been argued by Green and Lee that rather than encouraging research on pedagogical elements associated with postgraduate supervision, increasing pressure compel universities to be more accountable for ethical conducts "policy issues and on the organisation and administration of the postgraduate research degree" (Green & Lee, 1995).

According to Grobler (2013:1), in a rapidly changing world that is increasingly dominated by technological innovation, Information and Communication Technology (ICT), universities such as UoTs are contemplating transformation to take advantage of established and emerging technologies to enhance postgraduate studies and improve their throughput rates at postgraduate level.

Providing access to many students previously denied access to higher education continues to be a priority for many UoTs. Consequently, many students enrolled for postgraduate studies are from disadvantaged family backgrounds. This impacts on admission requirements at the undergraduate level, capacity, quality, throughput, access to resources and the ability to write academically, for those enrolling for postgraduate studies (Grobler, 2013:1).

Developing and enhancing the research profile for a university is a critical objective of South African UoTs, increasing postgraduate supervision capacity, improving throughputs and research outputs. Related to this is research outputs and managing socially relevant research of required quality, which also focuses on innovation and technology. South African universities structure used to be in the form of two organisations for higher education prospects, one as universities and the other as technikons. Conventionally, broader academia and society generally recognise research as characterised by applied research at technikons and basic research at traditional universities. Of these two institutions, universities that produced more student throughputs and research outputs receive the bulk of research funding and resources from the National Research Fund (NRF), government and other external funding agencies. Regardless of the proportion used for research projects at universities, they are perceived as being unable to tackle the critical issue of low throughputs for doctoral graduates. The demand for dedication and investment on basic research has left a void in which technikons, as universities committed to applied research by advantage of their strong alliance with industry, should be enhanced. The change in the higher education scenery and the formation of the new type of a university, comprehensive university, has called for more discussion on roles and functions of these bodies and their expectations on postgraduate supervision, student throughputs and research outputs. A comprehensive university is a mixture of both technikon and university resemblance and it is expected in its newly established role

to comprise of basic and applied research. The new perspective calls for reconsideration on allocation of research funding formula, allocation of resources and infrastructure for universities. UoTs needs to carry a balance in connecting basic and applied research by ensuring that they address industry needs and at the same time increase masters and doctoral throughputs (Fisher, 2011:119). Historically, postgraduate studies and research did not feature much in the institutional structures of technikon (UoTs) curriculum nor amongst its academic staff. The culture of a postgraduate research at these institutions was unheard of and postgraduate engineering student supervision capacity was not advanced in pursuit of increasing throughputs and outputs. After the promulgation of the Technikon Act (125 of 1993), technikons were licensed to offer postgraduate qualifications up to doctorate degrees. After this, technikons were faced with capacity challenge of academic staff with Ph.D. qualifications to supervise masters and doctoral students as a result the Certification Council of Technikon Education then decided to revoke awarding postgraduate qualifications of institutions whose research track record and infrastructure were poor. The problem was compounded further with the release of the Higher Education Act of 1997, which also redefined technikons as tertiary providers of education making the former an equal partner with universities. The then proposed mechanism of funding universities further compounded problems technikons were faced with regarding throughputs and outputs.

Another problem that could be traced to low research throughputs of technikons is policy guidelines before the year 1990. The philosophy of technikon education was too narrowly focused and concentrated mainly on vocational and career-oriented features of the programmes offered by technikons due to industry demands for skilled labour. After 1990 and with the promulgation of the Technikon Act (125 of 1993), there was a dramatic shift to include research as a mainstream academic activity.

Consequently, the document entitled A Research Philosophy and Strategy for technikons was released in 1998 to meet new challenges underpinning the research dimension, but most importantly, technikons were now approved to offer masters and doctoral degrees. Adding to this challenge was the threat of sanctions being imposed by the Certification Council for Technikon Education (SERTEC) if Technikon staff qualifications were deemed inadequate. The role of SERTEC hinges on its integration

into the Higher Education Quality Council (HEQC), which is seen to play a significant advisory role.

The impetus of the changing philosophy for technikons was remodelled to redefine their locus to include the following:

- Research at technikons should form a critical component of the higher education system as key performance indicator.
- Research at technikons should be learner focused from undergraduate and postgraduate levels aimed at collaborating with industry, business, government and the community at large.

The then proposed funding framework had dire consequences for subsidising technikons when measured in terms of postgraduate throughputs and research outputs. The guiding formula for state funding is focused on postgraduate throughputs and research outputs, which further adding pressure on these universities to register more postgraduate engineering students and simultaneously increase throughput rates. This implied that technikons with more infrastructure and resources might have to focus on registering more postgraduate engineering students hoping for increased throughputs and research outputs to receive more subsidies. Most significantly, funding formula for research and development placed technikons at a disadvantage when compared to historically white institutions whose track record for research throughputs was and still is high. The funding formula although promoting a new trajectory towards research development, paradoxically appears to lead technikons towards negative entropy. This research study also explored the implications of this proposed subsidy formula on former technikons throughputs and research outputs and in the process highlight the historical background of the vision and mission of technikon (UoTs) education (CHE, 2004).

From a technikon perspective, two main challenges in research and development are compounded by first, a stronger focus towards applied and development research including process related innovations, secondly, the practice of technology and its implementation. The proliferation of technology is particularly important in the face of e-commerce activities and globalisation issues. However, the practice of technology spans not only the hard sciences and engineering fields, but also the humanities and social sciences in the practice of management.

According to the NPHE (2001:5), the challenges facing higher education as highlighted in the White Paper on Higher Education Transformation, underpin, amongst other issues, production, acquisition and application of new knowledge, national growth and competitiveness that is dependent on continuous technological improvement and innovation, driven by a well organised, vibrant research and development system, which integrates the research and training capacity of postgraduate supervision with the needs of industry and social reconstruction (White Paper:1.12).

According to the NPHE (2001:70), the strategic objective for sustaining and promoting research is outlined as sustaining existing research vigour and promoting innovative forms of research and research outputs needed to meet national development goals, which will empower the country in becoming competitive globally.

The priorities listed include:

- to increase the capacity of academic staff to supervise postgraduate engineering students;
- increasing throughputs of postgraduates, particularly masters and doctoral graduates;
- increasing research outputs to sustain existing research capacity and funding needed for sustainability,
- by creating new centres of excellence and niche areas in institutions where there is demonstrable research capacity or potential;
- to facilitate collaboration and partnerships with business, industry and government, especially at the regional and national level, in research and postgraduate training; and
- to promote articulation between different elements of the research system with a view to developing a national research strategy linked to the national system of innovation.

The role of UoTs as engines of technology and innovation transfer cannot be realised with low-capacity supervision, low postgraduate throughputs and low research outputs. The underlying assumption is that universities can provide an adequate foundation for the complexities of the expected knowledge economy through

postgraduate degree programmes in which research is central (Kagisano, 2010:169). It is clear from the literature that the nature and role of UoTs on postgraduate studies have not been implemented adequately to impact positively to the development of research. However, the quality of higher education and research dimension at universities presents a concern especially at UoTs when it comes to postgraduate supervision. Research shows that Africa is not producing enough doctoral graduates for the labour market and the higher education system. The current academic workforce is aging and only about a third of permanent academic staff members have a doctoral degree. According to the Inter-University Council for East Africa, council's executive secretary, Mayunga Nkunya, the biggest concern is the scarcity of Ph.D. qualified academics in Africa. In the short term, the situation will worsen because when the current generation of academics retire, the higher education sector will continue to expand in terms of postgraduate enrolment (Nkunya, 2013:1).

According to Swanepoel (2010:132), the pressure to increase the throughput rates of postgraduate students and supervision capacity challenge is not unique to South Africa but is common at most universities around the world. In addition, more postgraduate engineering students with diverse cultural backgrounds are now registered masters and doctoral students at many South African universities (Letseka & Pitsoe, 2014:1942). Most of these students are registered at UoTs and are from previously disadvantaged majority groups. Since these groups are increasingly introduced into postgraduate studies and most of them lack research writing skills, supervisors' work increasingly becomes difficult (Mouton, 2011:13). Unfortunately, the opening of access to higher education has not resulted in a change in institutional research culture to accommodate these students and to ensure their academic success (Mouton, 2011). Some academics who are appointed to supervise these students often lack the necessary human management skills and knowledge to work with students from diverse cultural backgrounds (Malan, Erwee, Van Rensburg & Danaher, 2012:1). As a result, the supervisors, as well as the students, bring different expectations to the student-supervisor relationship, which impacts negatively on the throughputs, which also affects research outputs. These different expectations often create conflict, because supervision revolves around the relationship between a supervisor and supervisee. Supervision has retained its historical patronage culture,

as developed in face-to-face by traditional institutions and the supervisors rely on their own experience of supervision to supervise their students (Lessing, 2011:921).

Historically, the doctoral qualification was used to prepare graduates for academia, but studies in the last few decades have revealed a declining proportion of Ph.D. graduates entering academia. Instead, a growing proportion of Ph.D. graduates is also entering careers in government and non-governmental organisations, business and industry. Researchers and academics are concerned that current doctoral training programmes are not necessarily preparing graduates well for academia especially with skill to supervise postgraduate engineering students.

The impact of globalisation by universities has also increased the flow of international students enrolling in postgraduate research degree programmes outside their own countries. As a result, significantly more academics are now engaged in intercultural supervision or supervising students who are culturally different. Manathunga (2014:1) describes supervision as an activity that is conducted within a certain area, between supervisors and postgraduate students and bringing one's individual intellectual capacity and academic experience to the process. It means that supervision may not be conducted in some sort of vacuum, but is rather a consequence of ideologies, values and conceptions in a discourse practice.

Transforming universities to transform society requires changes in curriculum, quality and standards that meet new external demands or standards, particularly at UoTs. Quality assessment and accreditation should respond to the local drivers. Many universities in South Africa, mostly UoTs, are faced with poor quality postgraduate engineering students in most disciplines, low graduate throughputs and low research outputs, low investment in postgraduate supervision (research and development) and less interest from business and industry in research development. The South African government needs to put in place a conducive/ favourable environment for supervision and research to thrive, especially at UoTs. The founding document of the CHE (2000:29) states that “high level research requires academic staff with Ph.D. qualification and expertise in the field of study”. The ability of institutions to conduct high level research is usually measured by the number of staff possessing doctorates, which serves as an indicator of being able to conduct independent research and capacity to supervise postgraduate engineering students at high level". The guidelines

also propose the bench marking of institutions by measuring refereed research throughputs of students and outputs of its academic staff members. Historically disadvantaged technikons tended to falter in the new higher education landscape, since institutions have their own respective identities and mission mandates that consider the issue of differentiation and diversity. The inherent danger is one based on perception about the research culture, which has long stigmatised these institutions as being inferior as compared to traditional universities. In addition, technikons with poor research track profiles will continue to lose a major portion of the research subsidy, which is output driven.

Change, considering the estimations of postgraduate supervision, should be upheld by the UoTs for research that focuses on innovation and technology to thrive. This study along these lines asks, how might we utilise instructive hypothesis to change our practices for postgraduate studies in higher education, particularly from UoTs perspective? In this research study, the researcher endeavoured to show how value-based, research capacity (supervision) and curriculum development can encourage or give answers to the impact this has on throughput and output rates.

2.2 Global overview of the development of postgraduate studies

South African universities, particularly UoTs, are not the only institutions in the world that are reflected on its postgraduate studies. Since the beginning of the 1990s, countries around the globe have been expanding doctoral degree creation and acquainting activities with changing their masters and doctoral studies. Countries as little as Iceland or as big as China, with a long history of doctoral training, for example, Germany, Australia, Brazil or Malaysia are also reflecting on research studies at their respective universities because of globalisation. Why are such activities happening in the meantime around the globe?

Globally, universities have three missions, research, teaching and learning; universities play an essential part as pioneers in teaching and learning, in training and in research, innovation and technology. In showing practicalities, universities give the expert preparations for students and training that is essential for the improvement of the identified problems. Universities are imperative to all segments from social to economic perspectives. Universities around the world are considered to have been viewed as key institutions in procedures of social change and transformation. The

most critical part they have been doled out is the creation of exceptionally skilled labour and research intended to meet identified problems. Another role of universities is in the working of new foundations of common society, in growing new social qualities and in preparing and mingling individuals through research that matters.

It appears that the historical background of the postgraduate studies may have, turned up at ground zero. For the first six centuries, taking after its origination at the University of Paris amidst the twelfth century, postgraduate degrees were coordinated toward preparing for professionals and doctorates in philosophy, law and medicine. It was just toward the end of the eighteenth century that a renewal of the university's framework was started first in Germany and Sweden, from there on spreading to different parts of Europe and the USA (Cloete, Maassen, Fehnelm, Moja, Perold & Gibbon, 2002:10). The nineteenth century denoted the ascent of the present-day research universities prevalently attributed to the changes of Wilhelm von Humboldt. The eighteenth-century concern was the readiness of a regulatory structure and specifically the improvement of professionals. Contrary to this, in Germany, the Humboldt changes visualised another type of university learning, established on illumination standards and reflecting a desire by the universities to take part in a quest for a type of well-known fact that set it apart from society and put itself in a position of power with respect to the production of knowledge.

According to Cloete et al. (2002:196), nineteenth-century shifts in European knowledge production had underlined the improvement of disciplinary learning. The part of postgraduate studies (around the world) was changed to "permit scholars to proclaim a control, to recharge groups of scholars inside universities and to progress disciplinary knowledge production". The modern-day Ph.D. discovered structure at the University of Berlin in the nineteenth century, from where it spread crosswise over German universities and drew in many foreign students, mostly from the USA. By 1861, the main Ph.D. was honoured at Yale University and not until 1920 was a Ph.D. granted in England (Oxford University). Ensuing decades have seen recharged interest and investigation into the capacity of academic staff and objective of higher education in postgraduate studies hence this research study also focuses on the global history in the development of postgraduate studies and the impact it had at that time (Cloete et al., 2002).

Postgraduate studies and academic research are worldwide phenomena, thus countries, as well as world organisations such as (OECD, EU, UNESCO, the World Bank), are creating platforms to upgrade the commitment of postgraduate training to national and international monetary development. While there are varieties between nations in the necessities for accomplishing a doctoral capability, a focal component is dependably the requirement for research that makes a noteworthy commitment to new knowledge. The centre for postgraduate supervision training remains an exploration venture that will make a huge commitment to supervision and the changing demands put on supervisors and researchers. It is critical to ask whether this ought to keep on being the situation and whether there is a need to go past this conventional model to consolidate distinctive postgraduate programmes at UoTs (UNESCO, 2008:8).

Regarding funding availability, national limit building and global participation and rivalry, governments around the world including South Africa, are dispensing significant university funds to expand the innovative work limits of their countries. Postgraduate studies are incorporated into these funding designations. The training of supervisors and researchers who can convey creative changes to their working environments – be these in business, government, academia or non-profit organisations – is progressively considered a portion of innovative work exercises and incorporated into national development approaches. It is accepted and observational proof now proposes, that the supply of exceptionally gifted individuals, as well as how broadly scholarly learning is scattered, has an impact on the financial and social advancement of a country (CHE, 2009:5). In an unexpected way, new learning must be viably dispersed and retained if advancements and monetary development are to continue from it. What's more, keeping in mind the end goal to draw in speculation and create employment opportunities and markets, governments need their countries to be known for having world-class research facilities and infrastructures for research to thrive, which is not the case for many UoTs in South Africa given the historical background of these institutions.

According to the South African commission of inquiry into higher education and training, which was held at Mbombela stadium in Nelspruit, 22 August 2016, substantial scale development in the number of postgraduate students entering higher education masters and doctoral studies, combined with diminishing open consumption

on higher education, has put a strain upon the flexibility and self-governance already experienced by universities. Increased postgraduate engineering student mobility has additionally required more prominent institutionalisation between different establishments in different areas.

Collaborations may help to extend the importance of research at UoTs to cultivate the commercialisation of their innovative work results and this may expand the versatility of work amongst public and private sectors. The advantages of university-industry coordinated efforts are additionally obvious in creating employment opportunities. For instance, a review in Chile and Colombia demonstrates that coordinated effort with universities significantly expanded collaboration with industry Marotta, Blom, & Thorn, 2007:14).

Africa is surely not doing well enough for the civil argument about the significance of the masters and doctoral studies. In 2012 alone, research on doctoral instruction occurred through an International Association of Universities (IAU) and Catalan Association of Public Universities (CPU) global workshop entitled Creative ways to deal with doctoral instruction and research-preparing in sub-Saharan Africa, which was facilitated by the Southern African Regional Universities Association (SARUA) authority. A dreary picture of doctoral instruction rose up out of an 11-year study on eight sub-Saharan African universities completed by the Higher Education Research and Advocacy Network in Africa (HERANA) at the Center for Higher Education Trust (CHET) (Bunting, Cloete & Van Schalkwyk, 2014:25).

Evidence about Africa's execution on the worldwide research and science stage is not empowering. According to Zeleza (2014:1), in an expansive extending audit of Africa's execution in innovation, maths and science demonstrates that Africa stays at the base of the worldwide research, science, innovation and technology lingers behind on key pointers, for example, the gross local use on innovative work, number of researchers and share of logical distributions and licenses. While Africa is at the base of each pointer, a positive is that the development of distributions in Africa expanded from 11 776 in 2002 to 19 650 in 2008, a development rate of sixty percent in contrast to the world development of thirty-five percent. Africa's reality share of distributions expanded from one and half percent to two percent. Latin America from four percent to five percent and Asia from twenty-five percent to thirty percent (Zeleza, 2014:1). Be

that as it may, as far as share of researchers by area, near 2002 and 2007, the US shares tumbled from twenty-five percent to twenty-two percent, Asia's expanded from thirty-five percent to thirty-eight percent and Latin America from three percent to four percent, while Africa's moved from two and half percent to two percent. A somewhat better picture rises out of the most recent evaluation of the condition of science in the African Union. Utilising the Scopus database for companion assessed productions, the African Observatory for Science, Technology and Innovation (2014) reports that over the period 2008–2012, African Union distribution yield developed by forty-three percent which contrasted with the world normal eighteen percent. On the off chance that the African Union were viewed as an organisation, it would, in the BRICS setting, be recently behind India, China and Brazil, however, in front of Russia in production yield (Zeleza, 2014:2).

According to the Department of Education (DoE, 2001), government allocations for higher training in the Republic of South Africa extended from R1.161-million in 1986 to R3.227-million in 1994 (DoE, 2001). By 1994, unmistakably a procedure grasped during the 1980s through the Republic of South Africa at black universities had certified implications for their funding related prosperity. This used to be the arrangement of the use of the extension of the funding situation for white universities to all parts as a method for extending their stages of institutional freedom. In the mid-1990s, the unique non-authoritative appraisal has been dispatched into future improved higher education strategies for a post-politically-endorsed racial isolation in South Africa. Amid these debates the SAPSE financing formulation used to be taken to be an insufficient report and robust dissents have been conveyed to its necessary suppositions and measures (Bunting, 2002:141-149).

By the beginning of 1998, state-supported universities and technikons in South Africa were unmistakably gone up against with strong signs that radical changes would be made to the financing framework under which they had laboured for a couple of years. Meanwhile, it was clear a couple of years would go by before the radical new structure and its running with frameworks would be set up. In the budgetary year of 1995, the majority of the universities and technikons in South Africa were passed on toward the SAPSE subsidising condition.

Bunting (2002:81-84) characterises the establishments of institutions into eight classifications that point to the type of information generation (universities versus technikons), racialised power and body electorate. Across South Africa, the higher education scene contained a divided arrangement of the fragmented system of unequally-planned, governed and funded institutions. This scene, which constitutes a "result of social procedure and institutional guided activities of researchers" (Van Buuren & Edelenbos, 2004:289), yielded an uneven and topographically divided creation of postgraduate evaluation, which is clear from the Project on Postgraduate Education Research (PPER) overview of postgraduate instruction research (Karlsson, Balfour, Moletsane & Pillay, 2009:1086).

After 1994, the arranged desire for higher education in South African incorporated the mix or merger of organisations as a chance to reorient and rejuvenate the sector, in the quest for vital social and instructive objectives (CHE, 2004:55). Along these lines research, covering the procedures required in reshaping higher education envelops the basic political rebuilding and the conceptualisation of learning era itself (Jansen, 2003; Cloete et al., 2002).

Pedagogy of Postgraduate Supervision

Over the last few decades there has been a considerable increase in research which centres on postgraduate supervision often referred doctoral pedagogy (Grant, 2010). Postgraduate pedagogy had for some time played a less important role in supervision practices when the notion of supervisor as researcher took precedence (Pearson & Brew, 2002:135). However, supervision training in higher education is now becoming more widespread with changes in the nature of what supervisors do (Thomson & Walker, 2012). There has been a significant shift in doctoral training, particularly in Australia, Britain and the USA from seeing the PhD as a process of producing research (the thesis as product) to a pedagogy of training researchers in order to develop their research skills and expertise i.e. a movement from scholarship to training (McCallin & Nayar, 2012:63).

Some evidence suggests that supervisors frequently base their practice on their own, often unscrutinised, experiences as postgraduates (Trivett, Skillen, & James, 2001), and there is pressure for supervisors to benefit from more formal training (McCallin & Nayar, 2012:63). The traditional view of supervision focused strongly on issues of process

and methodology, whereas currently supervision is seen to be a pedagogic process. McCallin and Nayar (2012:66) suggest that “when supervision pedagogy is emphasized, it is assumed that research students need to be taught how to research, how to write a grant proposal, how to prepare an ethics proposal, how to review the literature, how to write, how to analyse data and how to manage a research project” A useful distinction is between what graduates learn (the doctoral curriculum) and the pedagogy of how that supports their learning (Gilbert, 2004:299).

Anderson, Day and McLaughlin (2006:149) investigated dissertation work in a British Masters by coursework focusing on the supervisory relationship, student agency and student and supervisory responsibilities. In this study supervisors saw themselves as having a gate-keeping role whilst their personal commitment to the students both supported and shaped the efforts of their students. More recently models of supervision have been examined critically as the issues of completion time and the introduction of pedagogic input become of greater importance. McCallin and Nayar (2012:63) suggest that there are possibly three types of supervision: the traditional model; group supervision; and a mixed model. The first model assumes the ‘expert/apprentice’ roles of the supervisor and the student. In this structured model, students may be excluded from wider interactions with other researchers and the isolation may limit the student’s research development (Walker, 2010). In the second model (group supervision), there is a supervisor/student relationship as well as a student/student relationship. In this model the role of the supervisor is supported by informal peer support (McCallin & Nayar, 2012:63). Whilst this model may offer social and emotional support, it is also suggested that ‘scholarly writing groups may improve writing outputs (Aitchison and Lee, 2006:265). The third model is a mixed model which adopts a blended learning approach. This blended learning model utilises individual face-to-face supervisor /student sessions as well as the environment of the student comprising infrastructural resources, communities of researchers, and a virtual classroom with online learning (McCallin & Nayar, 2012:63).

A further conceptual frame for theorizing doctoral education which has emerged recently is that of identity. McAlpine and Amundsen (2009:109) investigated how doctoral students develop their academic identities from the perspective of agency. McAlpine and Amundsen (2012:683) argues for an identity–trajectory view where

individual agency is linked to the past and imagined future of the student, and where this is linked to increasing student independence.

The generic conception of postgraduate supervision was understood as a clearly identifiable form of teaching research skills (Wisker & Sutcliffe, 1999:444). This generic conception outlines two trends: the expansion of the postgraduate research sector in higher education, which has led to an increased attention on the supervision process; and recent quality assurance and accountability requirements which have led to attempts to standardise and monitor supervision. Recent critique of the generic conception of supervision has focused firstly on the way 'quality' has been defined and practised in higher education and secondly on the lack of concern for the character of the university context. This signals a move away from the notion of the 'generic student' to 'specific students' in specific situations. Thus there was a trend towards encouraging the diversity of research supervision and a contextualised conception of supervision processes (Wisker & Sutcliffe, 1999:444).

This contextualised conception of research supervision ties in with the work of Lillis (2003:193) that research writing is a contextualised social practice in that supervision and writing practices have implications for the development of individual research writers. This thinking forms the framework for this research. My standpoint is that within the institution there is little discussion between supervisors or between supervisors and postgraduate students around postgraduate writing. There also needs to be sensitivity to the disparate needs of individual students in the context of their research writing.

In reality, many students of all backgrounds and language persuasion may require assistance with the development of their writing. Historically, in my institution, this related to opening up academic literacy practices to historically disadvantaged undergraduate students. More recently this needs to widen to include all students, including postgraduate students as students coming into the university at this level are all in need of assistance with their academic writing. This has led to the development of a new tailored postgraduate supervision framework at UoTs for engineering postgraduate students (See Chapter 6).

2.3 Postgraduate supervision: A theoretical basis

There are several specific characteristics that are required in postgraduate engineering supervision, indicating the need for effective postgraduate supervision (Dubrin, 2004:3). According to Schermerhorn, Hunt and Osborn (2008:243) who argued that supervisors should have special research attributes that distinguishes them from teaching and learning, like the ability to develop an effective student/supervisor relationship, effective planning, and guiding decision-making process, effective communication and the ability to motivate postgraduate students (Dyason, Lategan, & Mpako-Ntusi ,2010:45).

Effective postgraduate supervision can be in different forms or combination of various elements. According to Van Rensburg (2007:2) emphasises that these elements can relate to research and serves as foundation for improving the different stages of a research project. Canfield (2005:29) argue that effective postgraduate supervision enables postgraduate engineering student to take charge of his/her own research and develop skills needed to achieve specific research goals. The author further emphasises that the need for postgraduate supervisors to develop their own supervision framework approach is critical in leading postgraduate students achieving specific goals. Supervision as concept has moved beyond the historical institutional context in which a supervisor has to be effective in leading and guiding a research project. As a result, this research study employ concept of "postgraduate supervision" as discussed by Gardner (2000:3), such as "process of persuasion or example" to inspire postgraduate engineering students in achieving their research objectives. It is clear that supervisors play critical role in the process of postgraduate supervision, as they have to execute tasks that are key in accomplishing student research goals. Not only does supervision imply particular tasks, but it refers to tasks that have the potential to move postgraduate engineering students towards achieving their research objectives. This notion is supported by Zenger, Ulrich and Smallwood (2002:23) who also referred to the process of providing support to deliver quality postgraduate supervision.

The term "postgraduate supervision" is also associated with concepts such as leading, guiding, coaching and mentoring (Brewster, Carey, Grobler, Holland, & Wärnich, 2011:48) also emphasised that postgraduate supervision is related to a process and

not a position, which involves a relationship between a student and a supervisor within a research process. This relationship requires commitment and enthusiasm from the both individuals to allow a leading to influence postgraduate supervision.

Managing and leading is complementary yet distinctive concepts, each with its own functions and characteristics. They are not mutually exclusive and are both essential for successful postgraduate supervision.

According to the existing literature on postgraduate supervision, a number of theories have emerged over time, touching on how supervisors approach their task in terms of moving, developing and supporting postgraduate students to achieve their research goals, through particular research skills and behaving in a specific way. The supervision approach to be discussed is the trait approach or theory, which proposes that leaders are born, not made. This leadership approach focuses on the identification of the qualities and characteristics possessed by a great leader (Van Zyl 2009:205).

The behavioural approach of postgraduate supervision focuses on the differences in the actions of effective supervision across, what effective supervisors do, how they are delegated with tasks to supervise postgraduate engineering students, and how they perform their roles and responsibilities within supervision process (Amos, Ristow, Ristow, & Pearse, 2011:201).

The contingency approaches demonstrate the importance of situational factors and individual characteristics. Effective supervisors are adept at recognising the requirements for supervision, the needs of postgraduate students and will then tailor their own supervision style accordingly. This approach implies that supervisors should be able to adapt to the different conditions they may encounter (Hellriegel, Jackson, Slocum, Staude, Amos, Klopper, Louw, & Oosthuizen, 2004:300).

Postgraduate supervision is the process according to which a supervisor exerts influence by inspiring postgraduate students, motivating them and guide their research project to assist them in achieving specific research goals and objectives (De Beer & Rossouw 2012:38). The need for effective supervision in postgraduate studies has becomes more important due to the rapid changes that are continuously taking place in most fields (De Beer & Rossouw 2012:47). In order to influence postgraduate engineering students to achieve specific goals, supervisors should understand what

motivates these postgraduate students' behaviour and should create a conducive research environment where they are motivated to work effectively (Du Toit, Erasmus, & Strydom, 2010:185).

The theoretical perspective on postgraduate supervision provides many requirements and attributes for the creation of a leadership foundation within the postgraduate supervision environment of UoTs in the faculty of engineering. It is important that supervisors employ a framework approach that will enable postgraduate engineering students to deal with challenges such as academic writing in the process of postgraduate supervision. Guiding and leading are critical functions that postgraduate supervisors must have to execute in the process of supervision. In considering the various supervision frameworks, some attributes emerge in relation to the social, personal, emotional and managerial requirements of a supervisor. Although it is not possible to cluster these attributes rigidly because they overlap, they have been categorised to prevent student/supervisor conflict in the development of a supervision framework for postgraduate engineering students at UoTs.

According to Dinham and Scott (1999); "the student-supervisor relationship has the potential to be wonderfully enriching and productive, but it can also be extremely difficult and personally devastating". Edwards (2002) further argues that main challenges in postgraduate student experience and supervisors should focus on finding few supporting structures, availability of funding and resources. Powles (1989) reported that 25% of postgraduate research students surveyed were either "dissatisfied" or "very dissatisfied" with their experience. Problems with the supervisory relationship were cited by 31% (i.e. 8% of the total) of that group. Other research suggests that, within a discipline such as engineering, the quality of supervision is the key factor determining the successful and timely completion of a Ph.D. (Knowles, 1999). At a basic level Woodward (1993) has noted that academic writing is strongly correlated with successful completion.

Major differences in doctoral completion time and successful completion is also related to academic disciplines (for example, engineering as compared to humanities). Specifically, postgraduate engineering students are more unlikely to successfully finish their Ph.D. as compared to those in human sciences (Rodwell & Neumann, 2007). Wright and Cochrane in (2000) surveyed submission rate of 3579 postgraduate

students at one university to identify various characteristics of postgraduate student who are most likely to succeed. They discovered that only reliable predictor of successful submission was based on whether a postgraduate student was conducting research in science-based or humanities-based research. Similar discipline-specific trends have been found in Australia, (Martin et al., 2001), the US (Bowen & Rudenstine, 1992), and Canada (Seagram et al., 1998). The faster times to completion and higher completion rates associated with the sciences appear to arise from the fact that science students appear to meet more frequently with their supervisors, make an early start on their research projects compared to humanities, and have generally higher levels of financial support (Seagram et al., 1998)

Interestingly, in a small (n=30) study at Exeter university, UK, Abdelhafez (2007) found a significant positive correlation between postgraduate student knowledge of the university's code of supervisory practice and their attitudes towards their supervisor. Supervisor attitudes were not found to be predicted by gender or year of study.

The Swedish National Agency for Higher Education (2006) published a comparative review of postgraduate student's attitudes in four geographically peripheral European countries: Sweden, Finland, and Ireland (the International Postgraduate Mirror report). The report compares postgraduate student responses to questions on seven areas of postgraduate life, two of which focused on supervision: 'dialogue with supervisors' and 'supervision in action'.

In 'dialogue with supervisors' postgraduate student views generated on perceived levels of supervisor interest, high levels on constructive criticism, degree to which supervisors engaged with postgraduate student in discussions on methodological, theoretical, general subject area issues, and the student's future career plans. Overall Irish postgraduate students appear to fare much better than the sampled European average. For example, about one third of Irish postgraduate students reported that they received less constructive criticism from their supervisors as compared to approximately 35% of Catalonian postgraduate students and over 50% for postgraduate students at Finnish. Additionally, the sample of Irish postgraduate students were mostly satisfied with their supervisors and indicated interest in their postgraduate studies (Swedish Coordinating Centre, 2006).

Even though much of literature on postgraduate studies and supervision has focused on the impact of postgraduate student variables such as age, gender, nationality and language and cultural backgrounds on experience of postgraduate students, Cullen et al. (1994:148) discovered that demographics of supervisor population such as age, gender, educational background, teaching and learning responsibilities had an impact on how they supervise their own postgraduate students.

2.4 Frameworks for supervision

According to Pearson and Kayrooz (2005:297) who argues that the development of supervisors as academics has been limited by lack of robust discussion and understanding of what supervision entails. In an attempt to answer this, the multi-faceted nature in effective supervision, many supervisors have applied different approaches which are various and sophisticated from multi-dimensional analogy, to unstructured desirable attributes, to complex uni-dimensionally driven supervision frameworks. According Grant (1999:87) who argues that majority of these framework approaches for understanding and practicing effective supervision emerged from general human views on social relations which supervision is regarded as essentially rational for engagement between individuals. She further argues that additional useful insights into complexities of supervision can be gained from considering postgraduate supervision within it research context.

Even though there is still a tendency to compare postgraduate supervision frameworks to research training and part of responsibilities for academic staff (Johnston, 1999), a popular view on postgraduate supervision constitutes advanced teaching in the form of learning (Taylor, 2006:156). According to Knowles (1999:123) who argues that postgraduate supervision as a critical element proposes that it forms part of mentoring students and it is just more than an instruction. Green and Lee (1995:25) argues that the role of supervision still remains unclear as they advise replacing the notion of learning with a much broader concept of supervision as pedagogy. According to Connell (1985:230) a more unique approach should outline postgraduate supervision at advanced level of teaching and complex learning task. Whilst Green and Lee (1999:26) argue that this view is prejudicial for modern universities which prioritise research over teaching and learning. A somewhat refined dualistic view is suggested by Zuber-Skerrit and Ryan

(1994) that postgraduate supervision is novel as academic responsibility and must provide a direct link between research activities, teaching and learning.

According to Grant (1999:88), who also argue that postgraduate supervision is multi-facets and complex process that requires awareness of current research activities and adaptability through a clear and specific supervision framework.

According to Cullen et al. (1994:148), as part of a major study carried out at the Australian National University, Canberra, produced a list of the characteristics of a 'good supervisor' (which they noted is very similar to lists of what undergraduates hold as desirable features of a good lecturer):

- approachable and friendly;
- supportive, positive attitude;
- open minded, prepared to acknowledge error;
- organised and thorough; and
- stimulating and conveys enthusiasm for research.

A more structured list of supervisory framework, roles and attitudes is provided by Brown and Atkins (1989:86):

- Director (determining topic and method, providing ideas);
- Facilitator (providing access to resources or expertise, arranging field-work);
- Adviser (helping to resolve technical problems, suggesting alternatives);
- Teacher (of research techniques);
- Guide (giving feedback on progress, identifying critical path for data collection);
- Critic (of design of enquiry, of draft chapters, of interpretations or data);
- Freedom giver (authorises student to make decisions);
- Supporter (gives encouragement, discusses postgraduate student's ideas);
- Friend (extends interest to non-academic aspects of postgraduate student's life);
- Manager (checks progress regularly, gives systematic feedback)

Although enumerating lists of missing skills is a common approach to addressing the problem of creating employable and well-rounded postgraduates (Taylor & Beasley, 2005:11) a potential pitfall with such lists, identified by Pearson (2004), is the lack of an integrating conceptual framework of what constitutes effective supervision and research training. According to Pearson, this means that it is difficult to identify priorities, to identify appropriate training strategies, and to determine the distribution of responsibility for different aspects of a training programme. Furthermore, it implicitly facilitates a modular, fragmented approach to designing postgraduate training programs with such desirable generic skills, such as time or project management, treated as 'add-ons'. Pearson and Krayooz (2004:148) argue that what is "needed is a complex outcome; a skilful performer rather than someone who can list their skills". An advance on the list approach is specific framework for postgraduate supervision. Several researchers have formulated empirically-driven supervision frameworks within which to place and assess the manifold characteristics of supervisory practices. Gurr (2001:82) elaborated Grant's (1999) 'rackety bridge' metaphor and devised a dynamic framework for aligning supervisory style with the development of postgraduate students possessing 'competent research skills and autonomy'. Gurr's framework is define by two key dimensions: a 'direct'/'indirect' and an 'active'/'passive' dimension which form a graph with four categories of behaviour:

- direct active, characterised by initiating, criticising, telling and directing the student;
- indirect active, characterised by asking for opinions and suggestions, accepting and expanding postgraduate students' ideas, or asking for explanations and justifications of supervisee's statements
- indirect passive, characterised by listening and waiting for the student to process ideas and problem solve; and,
- passive, characterised by having no input and not responding to student's input

A central point is that the effective supervisor moves flexibly between the various modes. Most notably as the candidate progresses away from dependence and towards competent autonomy. This adaptive mode-switching can occur even within the space of a single meeting.

Gurr (2001:82) tested the efficacy of this Supervisor/Student Alignment framework as a supervisory tool by separately interviewing four pairs of postgraduate students and supervisors in the University of Sydney. In interviews postgraduate students were asked to mark on a graph where they felt their supervisor's approach fell. The supervisors were similarly asked to classify their own supervisory behaviour and the results were then compared in a joint meeting. The author found that, especially in cases where there was a marked discrepancy between the student and supervisor perceptions of supervision, the neutral graphical approach facilitated open dialogue on the state and appropriateness of the prevailing supervisory practices. The tool continues to be used to fine tune the supervisory relationships.

An alternative framework is advanced by Fraser and Mathews (1999:5) who performed an empirical analysis of the desirable characteristics of a supervisor from a postgraduate student perspective or point of view. They argue that a traditional emphasis on expertise as the salient dimension of supervisorship is too limited and augment it with support and creative/critical dimensions. When Fraser and Mathews surveyed postgraduate students on the desirability of an array of specific supervisor characteristics encompassed by these three dimensions they found that non-expertise-related characteristics which provide support, and which balance creativity with criticism, emerged as more important overall than expertise-related characteristics.

A perceived need to devise a “new supervisory framework approach drawn from a wider literature then traditional supervision pedagogy” (Pearson, 2004:211) has motivated several researchers to explore the potential for applying business frameworks into postgraduate supervision process.

Vilikas (2002:148), for example, suggests that the role of a supervisor is strongly analogous to that of a business manager and consequently models supervision using an integrated version of Quinn's Competing Values Framework (CVF) of managerial roles. The CVF model identifies operational supervisory roles within a two-dimensional surface formed by an internal-external focus dimension and a flexibility-stability dimension. The original CVF model identified eight operational roles (innovator, broker, producer, director, coordinator, monitor, facilitator, and mentor) within four quadrants: 'expansion, adaptation'; 'maximisation of output'; 'consolidation, continuity';

and 'human commitment'. The modified version adds a ninth 'process' role of 'integrator' (Vilikas & Cartan, 2001:175). The integrator role has two components those of critical observer and reflective learner.

A simplified version of the model reworks the primary dimensions as internal-external focus and people-task focus. The number of operational roles is reduced to five: innovator, broker, monitor, deliverer, and developer with the integrator as the central role (Vilikas & Cartan, 2006:505). Vilkinas and Cartan (2001:175) further argue that these roles are paradoxical in nature. In other words, postgraduate supervisors need to be able to act in ways that are inherently contradictory e.g. caring for postgraduate student and dealing with their personal issues (developer role) while simultaneously demanding that the student is productive (deliverer role). A central assumption of this approach is that an accomplished supervisor/manager must be able to adaptively switch between the various roles as the situation demands. Vilikas and Cartan (2006:506) claim, somewhat opaquely, that effective postgraduate supervisors handle these paradoxes by creating "generative paradoxes as opposed to exhausting conflicts". Indeed, Gurr (2001:83) has observed that supervisors need to be able and willing to alter their approach to supervision appropriately as the student develops.

In order to assess the effectiveness of supervisor beliefs and practices within the ICVF framework Vilikas (2008:297) performed an exploratory study of the attitudes of 25 senior faculty members from seven Australian institutions. She found that the majority of supervisors were primarily task-focused coupled with some concern with the humane aspects of postgraduate supervision, there was little evidence of innovation and reflection. Vilikas argued that the lack of evidence of a reflective role potentially limits the ability of postgraduate supervisors to respond effectively to the dynamic demands of their position.

Another business-inspired framework is that proposed by Gatfield (2005:311). He extracted eighty key variables from the supervision literature to construct a four-quadrant supervisory styles model adapted from the Blake and Moulton Managerial Grid model. The eighty factors were clustered into three groups: 'structural', 'support' and 'exogenous'. The structural component is defined as those elements supplied primarily by the supervisor in negotiation with the candidate. These factors can be further grouped into 'organisational process', 'accountability and stages', and 'skills

provision'. Examples include identifying roles, negotiating meetings and training seminars. The support factor constitutes those non-directive, discretionary elements supplied by the institution and supervisor and is further broken down into 'pastoral care', 'material', 'financial' and 'technical' sectors e.g. mentoring, office space, research funds, and network support. The final category is comprised of those relatively fixed factors not encompassed by the support and structure categories. These include 'candidate variables' such as research skills, and a 'various' category that includes factors such as second supervisor contribution.

By assuming that the candidate variables are relatively fixed, Gatfield identified four 'preferred' (as opposed to invariant) supervisory styles that emerged as quadrants in a support-structure graph; contractual (high support, high structure), directorial (low support, high structure), laissez-faire (low support, low structure), and pastoral (high support, low structure).

In order to examine the reliability and applicability of the framework Gatfield performed a verification study. This entailed interviewing 12 postgraduate supervisors independently classified as excellent and mapping their responses onto the grid. Gatfield (2005:311) confirmed that the vast majority of supervisors classified as excellent mapped onto the high support, high structure contractual quadrant. However, he stressed that as all of the supervisors were rated as excellent, and not all fell into the contractual quadrant, that a range of viable effective supervisory styles exist. In an extension of this idea, Gatfield (2005:311) suggests that the prevailing management style for a given supervisor will also vary as a function of the stage at which their postgraduate students are at within their Ph.D.’s as a result of a change in the supervisory requirements attendant upon each stage.

A framework similar to that employed by Vilikas (2002:129) emerged from the work carried out by Murphy in 2004 who attempted to characterise beliefs held by postgraduate students and supervisors about supervision. Murphy (2004) conducted a small-scale (n=34) survey of supervisors and doctoral candidates in the engineering school of Griffith University, Queensland, Australia. She describes postgraduate supervision as a "plexus of closely related educational beliefs about research, teaching, learning and supervision" and argues that four global orientations to supervision emerge from this perspective: controlling/task-focused, controlling/person-focused, guiding/task-

focused and guiding/person-focused. Paradoxically, Murphy found that whilst supervisor's beliefs regarding supervision tended to cluster within the guiding/person-focused category, student's beliefs regarding supervision were more commonly characterised as controlling/task-focused. Murphy suggests that the supervisor's role in shaping the candidates' beliefs are undermined by the student's preconceptions of what supervision entails.

The use of frameworks and lists to identify supervisory roles has not gone unchallenged. Walford (1981:148) cautioned against the use of role theory on the grounds that "the degree of simplification required to make any analysis of this kind in terms of role theory is so great that the resulting analysis exclude much of what is important in understanding the development of the supervisor/student relationship and the degree of satisfaction for postgraduate student. In particular, the gathering together of opinions of postgraduate students and supervisors who are concerned with an enormous variety of projects, from highly sophisticated theoretical problems to complex projects that are concerned with experimental design and development, means that to talk in terms of a single role misses the very aspects which may well give rise to dissatisfaction" (Walford (1981:148).

This last point is amplified by Cullen et al. (1994:149) who highlight the "extreme variability and subtlety" of the relationships that emerged from their analysis. They note that "the difficulty with such lists as guides to practice is that although they are well intended, they are very general and indicate little sense of the judgements involved in their application." In an attempt to avoid some of these issues Cullen et al. (1994:149) adopt a more holistic approach that acknowledges highly complex and dynamic relationships between the supervisor and postgraduate student. Eventually, they strive to avoid focusing on the individual relationships which prevail between postgraduate students and supervisors. By uncovering the relationship in a broader context, the researcher hoped to identify universal strategies that transcend individual differences.

Cullen et al. (1994:149) present a high level three-stage model of supervision that attempts to encompass the key features of how experienced supervisors seek to structure the supervisory relationship as a student's Ph.D. study progresses. The first stage is characterised by a significant input of time and effort helping postgraduate student to find or establish a question, problem or topic for their thesis. In the

next stage postgraduate students are monitored but allowed to operate with greater independence. Unless there are warning signs, contact is most often left to the student to initiate. The final stage involves writing up and, like stage 1, is again characterised by an increase in the time and effort exerted by the supervisor.

Cullen et al. (1994:149) claim that this model is common to all disciplines and highlights certain basic elements:

- negotiating/guiding the transition from dependence to independence (i.e. the level of direction given varies bi-modally)
- adapting the supervisory approach to individual student's needs and personalities, disciplinary differences etc.
- recognising that a key to the entire process is the deft formulation of the problem/topic/question since it is that which ensures focus and engagement.

The tension here arises from the delicate task of guiding postgraduate students away from non-productive paths without taking over or undermining student 'ownership' of the problem. The importance of focusing on process over roles is also advocated by Pearson and Brew (2002:135) who argue that the primary utility of elaborating the roles of the supervisor is limited to enabling supervisors to articulate their practice. Crucially, the authors suggest that role elaboration is not so useful for determining the content of supervisor development programmes. Several reasons are adduced to support this claim:

- the role of the supervisor too complex to be usefully captured by role categories;
- research practice itself changes and supervisory arrangements are becoming more varied;
- a focus on roles can lead to an unproductive strengthening of the focus on personal relationships and;
- a focus on roles does not facilitate allocation of the various responsibilities and practices in cases where others are involved in supervision in addition to the formal principal supervisor.

This last point is related to the process of 'enculturation' during which postgraduate students learn the socialised skills of laboratory work, and through which research problems are conveyed. Since a number of individuals typically contribute to this

process over time, continuity arises from the process, and not from the peripatetic individual participants (Delamont et al., 1997:319).

A useful set of dimensions for assessing the quality of the supervisor relationship has been proposed by Kam (1997:81). She performed a factor analytic investigation of the level of postgraduate student satisfaction with the supervisory process within a large population (n=250) of postgraduates at the Royal Melbourne Institute of Technology. Kam found that student responses were consistently clustered around three emergent factors: 'work organisation and problem solving', characterised by work tasks that denote efforts made to assure work quality in the research process, 'research preparation' representing work tasks typical of those found during the early part of the research process, and 'communication' standing for work tasks centred on communication and interaction at different levels. Based on student responses with respect to these three factors, Kam (1997:82) isolated four distinct groups of students that varied in their level of independence or dependence as measured by each factor. Group 1 represented students who were relatively independent along all three dimensions and constituted the largest grouping at 38% of the student body. Other groups represented students who exhibited mixed levels of (in)dependence along the latent dimensions of ‘work organisation and problem solving', 'research preparation', and 'communication'. Interestingly, none of the groups were highly supervisor- dependent on all three dimensions. The level of subjective student satisfaction (as distinct from the objective quality of the research outcome as measured by completion time, pass rate, etc.) was found to be strongly dependent on the extent to which the supervisor addresses needs engendered by the most salient dependent dimension. Consequently, Kam suggests, no one supervisory style can adequately meet the needs of all postgraduate students.

A novel IT-based metaphor of supervision is pursued by Zhao (2001:25) who argues that the quality and productivity of research supervision would be enhanced if knowledge management concepts were effectively integrated into the process. He proposes a model that conceptualises the supervisory process as an input-output process mediated by a knowledge conversion stage. The input is the research candidate and environment and the outputs are a competent researcher, completion of the research degree, and research products. The intervening knowledge conversion process is modified by separate knowledge creation, transfer, and

embedding processes. On the assumption that goal of research supervision is to nurture capable researchers (Down et al., 2000), Zhao claims that effective supervisors develop students as independent researchers by interventions targeted at enhancing these sub-processes.

Following Cullen et al. (1994:149), Pearson and Brew (2002:136) suggest that a more productive approach is to focus on what supervisors are actually doing and why. This is done on the assumption that this grounds discussion in the practice of supervision and the behaviour of participants, ensuring that their learning is situated in their particular research contexts.

Although the international research literature on postgraduate supervision is replete with examples of what constitutes good supervision practice (Moses, 1985; Zuber-Skerritt, 1992; Christie and Adawi, 2006; Holbrook and Johnston, 1999; Johnson et al., 2000), there is a dearth of longitudinal research that actually assesses the impact of interventions designed to improve postgraduate supervision.

2.5 Technical writing

Maintaining accuracy in a technical writing is perhaps the most important step for postgraduate engineering students. Although many people understand that technical writing is one of the fastest growing occupations in the twenty-first century, most are not aware that technical writing has been around for hundreds of years. Writers such as Isaac Newton and his scientific discourse, Thomas Jefferson and his political works, and Benjamin Franklin with personal invention pieces and public documents wrote technical documents with great regularity. Throughout its existence, “technical writing has proven to be diverse and includes many different types of correspondence, written by different types of people, in different types of professions, for different reasons” (Gerson, 2000:1).

Despite the diversity of the profession, the definition of the term technical writing is constant and inclusive to all writers who follow a set of defined technical standards to produce readable instructional documents. Despite the type or reason for producing the technical document, technical writing is always the simplification of complicated information in order to convey a specific message clearly to a reader. According to Lannon, (1988:28) in technical writing people communicate and interpret specialised information for readers’ practical use”. Each document prepared with the specific purpose of instructing a reader is considered to be a technical document. Sharon and

Gerson state that “technical writing both analyses and explains in order to communicate with the reader”. In order for postgraduate engineering students to communicate effectively, it is essential that students follow a set of standards to produce a readable technical document. The four objectives or standards to be followed by postgraduate engineering students include clarity, conciseness, accuracy, and organisation. Each of these standards are important for successful completion of a research project. These essential standards are both evident and constant in modern technical writing. Even though these standards have only recently been outlined in modern technical writing manuals by technical writers such Lannon and Gerson.

Despite the long tenure of technical writing in American culture, the terminology and documentation of technical writing standards are a relatively new concept. Although the profession itself is actually centuries old, technical writing has been deemed a new occupation created out of necessity in an increasingly technological workplace. Due to innovation in workplace materials, there is an increasing need for technical writing for postgraduate studies.

To this point, scholars and historians alike have failed to document the existence and usage of technical writing in early America. As a result of the lack of attention given to both the profession of technical writing and the existence of technical writing for postgraduate studies. However, due to the recent increase in the demand for technical writers in today’s workplace, there are new technical writing textbooks, guides, and manuals produced for postgraduate students.

Technical writing is broad enough to include any writer who creates a document based on a defined set of standards that guide postgraduate engineering students to produce a readable instructional document. In this research study, the researcher defined the primary technical standards as clarity, conciseness, accuracy, and organization. Also, this study identifies the existence of technical writing standards as far back as the early American Republic by using examples from Benjamin Franklin’s works. Although other writers from the early Republic could possibly be identified as technical writers, Benjamin Franklin can easily be identified as the greatest of these Early-American instructional writers (Gerson, 2000:1).

2.6 Academic writing

According to Hyland (2002:81) an environment which provides peer support and opportunities for postgraduate students to talk about their writing-in-progress with skilled, attentive readers through writing conferences is considered as crucial to academic writing development. Postgraduate engineering students do not compose in the same way so they need specific strategies for generating plans, researching topic information, rough drafting and gradually refining both content and form. To accomplish this, supervisors must provide postgraduate students with training in composition strategies which can be transferred across situations, assist them to brainstorm, draft in stages and to separate rhetorical revising from grammatical editing to accommodate their restricted communicative resources.

According to Hyland (2002:81) postgraduate students are provided with little advice with regard to structuring their academic writing experiences in accordance to the demands and constrains of research contexts. The focus should be on writing in order to discover students' thought more than to verbal expression. As a result, postgraduate engineering students have to acquire strategies of response and involvement to a research discourses. The solution to this can be solved through tailoring approach. Flowerdew (1993:307) points out genre approaches emphasise that writing varies with the social context in which it is produced. So, we have a range of kinds of writing such as research articles and reports that are linked with different situations.

Hyland (2002:81) further suggests that writing tasks should be authentic in order to give postgraduate engineering students the alternatives they need to achieve real rhetorical purposes in the target context. Postgraduate students learn academic writing that must be related to specific topics that should produce contexts in which they have to produce them. Moreover, Hyland (2002:82) explains that supervisors can also utilise their academic writing syllabuses to emphasise on the formal constraints of the topic in order to provide postgraduate students with adequate patterns and rhetorical conventions they will need.

According to Ibrahim, Yunus, and Khairi (2017:160) there are three aspects that students who study engineering face difficulties with when writing academic articles which are content, structure and language related. These authors further argue that in order to enhance the quality of academic writing among postgraduate engineering

students, these aspects must be critically taken into consideration. This research study proposes a tailored supervision framework that is academic writing-centred led by a content supervisor and a postgraduate student both located within the faculty of engineering. The proposed supervision framework will allow academic writing to provide a conducive research learning environment in postgraduate supervision process. Notably the subject of power relations between the student and a supervisor remain inherent in the traditional one-on-one (face to face) supervision practice hence academic writing to a large extent exist on the margins of academic work.

2.7. Conclusion

The increasing international importance of innovation and knowledge generation has driven an increase in the research literature on research supervision. However, although a rich array of supervisory frameworks or models have been proposed to account for the multifarious factors that are associated with effective supervision there is still a salient need for a program of coherent empirical validation.

In this chapter, global perspectives were discussed in the context of postgraduate supervision. One could ask whether postgraduate supervisors are born or made and whether one could acquire the necessary skills, roles, attributes and requirements to be excellence in supervision. The chapter discussed the competences that postgraduate supervisors needs in order to be an effective leader with the essential requirements and combination of characteristics and functions to flourish with excellence in the academic research globally and in a South African UoTs context. It is the responsibility of postgraduate supervisors to know the different roles they may play and skills they must possess during supervision process so as to assist postgraduate students to complete their studies. In addition, the supervisor must concentrate on the right planning, quality, goals and vision to provide direction for postgraduate students to achieve such success in their academic research projects. The need for postgraduate supervisors to keep up with advanced frameworks in supervision was also discussed. Unfortunately, there is no easy way to acquire all the capabilities that are required for good supervision, but postgraduate supervisors could use various sources and information to assist them, with technology being an important source.

The next chapter focused on postgraduate research studies in South Africa and its impact at UoTs.

Chapter 3: Postgraduate research studies in South Africa and its impact on UoTs.

3. Introduction

An element of importance in the South Africa higher education structure is its history of apartheid that led to inequality that continues to influence democratic principles, which became the foundation of categorising HEIs currently into comprehensive, traditional and universities of technology. South African higher education system post-apartheid is established deeply and firmly in the White Paper 3 (DoE 1997), which shaped new higher education framework system that is designed, regulated and financed as a distinct national negotiated system. This presented the foundation for the merger of open HEIs into 23 universities. The aim or purpose of this was to break inequality and inefficiency, which continue to trouble the democratic higher education system in South Africa; “it was from this series of actions that the contemporary higher education demarcation of institutional type was entrenched” (Motshoane & McKenna, 2014:185). The classifications of three HEIs, which become prominent from this exercise, were traditional universities, that offered mainly conventional white-collar qualifications for professional careers (such as law and medicine); universities of technology, that provided mainly vocational (engineering) diplomas and comprehensive universities, that provided a mixture of the two qualifications. The distinction among universities congregated near the variety of qualifications and reasons for distinct universities expected to meet unprecedented requirements for knowledge. Hence, very little interest was given to the relationship between distinct knowledge demand of independent universities and their effects on postgraduate research studies specifically supervision (academic staff with doctoral qualifications), postgraduate engineering student throughputs and research outputs at UoTs (Motshoane & McKenna, 2014:185). Consequently, distinctions focused on dealing with imbalances of apartheid, the way it criss-crossed with other influences, which may have caused divergences, such as the history of an institution, circumstances in which it can be fully understood and the effects these have on postgraduate academic staff profiles, supervision, throughputs and outputs regarding quantity and quality that needs to be strongly regarded. For instance, UoTs have fewer academics with Ph.D.’s (see Tables 1 and 2) and not enough funding capacity when compared to traditional

universities, to the extent that it impacts on their postgraduate throughputs and research outputs. Other effects of such a change in structure for UoTs is institutional directorate capacity and not having enough resources, which make it unfavourable for investment and funding for development of research. It has been contended that national power to increase postgraduate throughputs and outputs is necessitated by these deliberations (Badat, 2010). Sadly, South African 2030 NDP struggle in its operation to enhance postgraduate throughputs and outputs from currently just over 2500 annual average to 5000 annual average as expected by the year 2030. This type of structure as a vehicle to propel postgraduate studies and capacity development for postgraduate supervision could potentially be complicated as it moves to focus on quantity in a coercive way at the cost of quality, which is what the supervisors on base tend to pay attention to. According to Mouton, Louw and Strydom (2013:285), this problem of quality propelled by supervisors and quantity by 2030 NDP needs to be effectively dealt with by universities and government in reaching a justifiable footing for national desire and normal supervision approach due to universities expressing necessity to preserve credibility of academia. A risky prediction of the NDP 2030, which further compounded strain on quality and quantity is requirements to produce greater numbers of South African postgraduates at doctoral level while the trends in South African universities indicate doctoral graduation mostly by international students predominantly from Africa. This also put more pressure on universities to drive transformation agenda at these institutions. A further feature of NDP 2030 vision, which draw special attention to and added more pressure on quality and quantity, is the target that has been set to increase academic staff percentage with Ph.D.'s from thirty-four percent in 2010, to seventy percent by 2030, which seems unrealistic taking into account the current trends. This does have a direct impact on postgraduate supervision capacity, throughputs and outputs, especially at UoTs and the issue of quality assurance, since these universities focused more on teaching and learning, with lesser focus on postgraduate studies. Another connection is that there is also less focus on staff development in obtaining doctorate qualifications since a B-Tech or Honours qualification was and still is sufficient for teaching or lecturing. Another related feature, which also restricted staff to pursue doctoral degrees comprised of heavy workload on teaching and learning as well as research infrastructure particularly at UoTs (Mouton et al., 2013).

This disposition impacted not only on funding for research and supervision capacity for these universities to sustain and manage research and for funding on its academic venture. An indicator of a university's research capacity is for example, academic staff with doctoral degrees and at UoTs, this is very low, averaging less than thirty percent as compared to traditional universities in the country with an average of almost sixty percent. According to the DHET (2015) statistics, staff at the universities with the highest per capita research output in South Africa have an average of fifty-five percent doctoral qualifications and twenty percent with master's qualifications. Those in the middle with forty-two percent and thirty-three percent, respectively, while staff in the lowest per capita output cluster have nineteen percent doctoral and thirty-nine percent masters' qualifications. This implies that more than half of UoTs academic staff do not have doctoral qualifications which seems not suitable for research and postgraduate supervision but mainly focusing on teaching and learning.

This conduct leads to questions around the many challenges of postgraduate studies at UoTs and how they impact on throughputs production process in which both the supervisors and postgraduate engineering students are considered as agents. Many academics have contended that the rationale of binary parts and people is essential to identify how various mechanisms operate to bring about events and experiences (Archer 1995; Ashwin, 2009; Motshoane & McKenna, 2014:185). Although, the tendency in South Africa to use structure (policy in higher education, procedures, history of university, university rules and regulations) to deal with all challenges associated with postgraduate studies (specifically doctoral throughputs) has led to university management not dealing effectively with roles that institutional research depicts, thereby not only contributing to some of these problems, but also in understanding and rectifying them (Bunting, Cloete & Van Schalkwyk 2014; Motshoane & McKenna, 2014; Mouton 2013). Motshoane & McKenna, (2014:186) argued that the NDP 2030 vision has set a target to increase doctoral throughputs by almost two-hundred percent, which will not be achieved if interchange between structure, agency and culture is not blended into research on postgraduate studies in South African institutions. This is complex because university differentiation and history of university is critical structural matter, which control, for example, postgraduate supervision processes.

Quality supervision in postgraduate studies is critical for realisation of 2030 NDP goals in higher education and objectives for increased doctoral qualification production, since research will contribute towards the development of the economy and community at large (Frick, McKenna & Muthama, 2017:444). Nonetheless, prevailing status of number of throughputs at postgraduate level in South African universities are low, inclusive of academic staff who also have influence as supervisors in the production of masters and doctoral graduates. This has negatively impacted on UoTs, considering the relationship between quality supervision, postgraduate throughputs and research outputs (DHET, 2015).

Where university funding is influenced by postgraduate throughputs and research outputs, postgraduate supervisors are faced with increasing pressure to assist postgraduate engineering students to complete their studies timeously, with too much focus on publications. However, the problem, particularly with UoTs, is that not many lecturers are equipped with research skills and knowledge to supervise postgraduate engineering students at these universities. Over the last few decades, there has been a huge drive for doctoral supervision 'pedagogy' (Petersen, 2007:475). According to Golde (2007:344), pedagogy supervision impacts effectively on postgraduate throughputs while Firth and Martens (2008:279) emphasise that supervision requires a form of special skills in 'teaching' together with institutional roles and responsibilities.

According to Thompson, Kirkman, Watson and Stewart (2005:284), universities and departments practices regarding research supervision sometimes differ significantly to the extent that there seems to be little explanation to draw recommendations from. According to Olivier (2007:1127), quality supervision for postgraduate engineering students is critical for successful and timely completion of a research project concurrently with enhanced research capacity. Universities in South Africa, especially UoTs, have taken specific focus of interest in the process of postgraduate supervision to capacitate their academic profiles and in the process, improve university throughputs and outputs.

Quality supervision for postgraduate studies requires academic staff, professional developmental and research support in terms of resources needed for postgraduate engineering students who are embarking on research tasks as components of research development. Intense personal and interpersonal characteristics require

distinctive and special attention on postgraduate studies. Postgraduate supervision is an important aspect of not only the development of the student as a researcher, but also for academic staff development and research enterprise. According to Olivier (2007:1137), effective and efficient supervision extends mainly to customary fulfilment and professional growth for students and supervisors. Quality supervision should be an integral element of good research governance (Thompson et al., 2005:286).

The problems facing South African universities in post-apartheid period have created much investigation and reaction in a refining world. Some of these changes are political, economic, and social and have a direct impact on how universities perform. It has become widely recognised that postgraduate engineering students graduates or throughputs in South African universities are too low when comparing to other universities in the world (Lewin & Mawoyo, 2014:25).

There has been a declining funding from state to universities. Since 1994, support from government for higher education has been far below the real costs. From 2006 to 2013, funding of universities increased from R11 billion in 2006 to R26 billion in 2013. Although the funding increase was greatly appreciated, it must also be recognised that expenditure in higher education was on a downward trend for student per capita. It was also decreasing as Government's percentage on gross domestic product (GDP) was lower than expected to the level that budget on higher education expenditure of GDP was almost equivalent to countries in sub-Saharan Africa. Subsidy decline on higher education had put a lot of pressure on the alternative sources of income, such as commercial operations, public-private partnerships, donations that were accessible for universities but mainly on tuition and research grants. Even though universities increased the amount of third stream income to some extent, these increases did not balance the notable expansion in student numbers and the comparable decline in Government subsidies, abandoning universities with growing financial increases. The main concern for most universities in South Africa is capacity building for generation of young academics. About twenty percent of academics at universities in South African are about to retire in 10 years and almost half are at professorship level. A great concern for this is that there is not enough production of Ph.D.'s and supervision training for academic staff to deal with the challenges of postgraduate studies (HESA, 2015:1).

There is a need to develop strategies aimed at improving the throughputs of postgraduate engineering student and research outputs (increased postgraduate quantity and supervision quality) generally at UoTs. A key public funding formula should consider the quantity of postgraduate engineering students in various universities and status of study in dealing with specific needs and demands of a university, for example, profile of academic staff and infrastructure needed for research to thrive.

The establishments of distinctions between universities and technikons (UoTs) played in the critical philosophical support for the government belief system, which raised many concerns for the higher education sector. It saw the idea of substance as a one of a trademark which recognised one race group from others. The National Party government trusted that it had possessed the capacity to recognise the substance of each of the two types of institutions into which it isolated the South African higher education framework, the path of a traditional university was science and the embodiment of a technikon was focused on technology and innovation. Immediately after the university mergers, restructuring of curriculum had little consideration and much focus was on the differences linking university-type curriculum and technikon-type curriculum. The necessity to keep two types of curriculum to reply correctly to the economic and social demands and needs of the country was to be recognised (DoE 2002:24). The academic shift from technikon-type to university-type agenda had to be ignored to cater for these needs (DoE 2001:18). According to Christiansen and Baijnath's (2007:223), research on the curriculum of UoTs had strongly suggested the need for diversification, which was managed by careful considerations for industry knowledge production, demand and supply, as well as institutional history (2007:223). Even though the difference between typical technikon-type programmes and traditional university programmes was not consistent and clear, desire for such dissimilarities has been recognised in the literature. It has been recognised that these conceptions do not greatly express compelling differences, but they exist in the perceptions of those who curriculate universities. These conceptions are theoretical as compared to 'applied', disciplinary consultations, higher education as compared to society and development in technology understanding (Christiansen & Baijnath, 2007:223). This comprehension demonstrates features of technology, specifically practical and application, which might be applicable in curriculum design. According

to Blunt (2005:1030), higher education democratisation, highlights university engagement with NQF that can be comparable internationally, bridging the gap for students who are fully prepared for postgraduate studies and language issues as a root problem in curriculum development that is suitable for the curriculum of traditional universities. These problems are not distinct to UoTs, but are applicable to the entire sector of South African higher education, but it would be advisable to incorporate them into curriculum activities in traditional universities as well as advanced programmes. These universities accordingly offer professionally focused programmes that are university-specific and progressive (Jansen, 2004:18).

As an outcome of drawing this separation amongst universities and technikons as far as a refinement amongst science, technology and innovation, the administration assembled approaches about the elements of every kind of institution into its higher education structure (Kotecha, 2006:21).

The arrangement articulations contended that drawing unbending refinements between science (in the feeling of any precise or academic way to deal with the improvement of information) and innovation (in the feeling of the utilisation of learning) and giving out science to universities and innovation to technikons, did not suggest that technikons were not very good as compared to universities. The approaches focused on that state and separate studies could be embraced in science, technology and in innovation. The thought of isolated, yet equivalent, capability structures were taken to infer that technikon students could start with a three-year diploma (less equivalent to a three-year degree in universities), could in the long run accomplish a national certificate in innovation (proportional to masters' degrees), lastly, a national laureate in innovation (proportionate to a doctoral degree).

Because of these refinements, the strategies focused on that the essential capacity of technikons must be that of preparing students who might have the capacity to apply scientific standards inside the connection of a profession or employment. The courses at technikons along these lines needed to focus on utilisation of learning instead of on information itself and technikon programmes to be industry related.

The strategies focused on that the principle capacity of universities must be that of instructing students in a scope of science or insightful orders to empower them to enter high-level professions.

3.1 Conceptualising postgraduate studies in South Africa

Generally, universities as institutions of higher learning have two important roles, teaching and learning. Nevertheless, it is critical to see how they have included research, in what has turned into their third role. Research has a major part to play at universities especially at UoTs and for general training, from a change in innovation and in worldwide examples of technology. The relationship between industry and universities particularly at UoTs is important in studies of successful technology transfer and commercialisation. As a university of technology, research programmes should be directed at solving problems in business, industry, and government (this is known as the triple-helix approach), and should also aim at contributing to the socio-economic development of the region. By viewing these relationships in the context of national and regional innovation systems and the triple-helix theories, the environment in which universities operate and the relationship between firms and institutions emerge as important factors in influencing their ability to innovate and bring products to market for commercialisation needed for university sustainability.

Keeping in mind the end goal to contend, hold and draw in postgraduate research studies at UoTs and beat the absence of postgraduate throughputs, these universities are more industry or client orientated. In this manner, to increase the number of research outputs and postgraduate throughputs, UoTs will have to be distinguished and survey the quality holes in research support structures and break down the effect they have on postgraduate studies and academic staff such as supervision inside the university (Ngibe & Lekhanya, 2016:625).

It is largely acknowledged that the health of the postgraduate sector, in general, is an imperative element in a country's capacity to add to the development and job creation (ASSAf 2010, CHE 2009). The developing economy is driven by highly skilled people thus it is not surprising that the Department of Science and Technology and the National Research Foundation, amongst other national bodies, have acquainted a scope of activities and availing funds for postgraduate studies. The National Research Foundation's 2007 South African Ph.D. Project tried to double the number of doctoral graduates by 2015, while the Department of Science and Technology wishes to increment doctoral graduates five-fold by 2018.

The CHE and CREST reports on postgraduate studies in South Africa (2009) raised comparative worries about low throughput rates, particularly at UoTs, at all levels of

postgraduate study, furthermore showed that the opportunity to complete postgraduate studies was far more noteworthy than demonstrated in the national financing equation or the notional hours of the national capabilities structure. Students who can effectively finish master's degrees do as such in an average of 2.9 years and the individuals who effectively finish doctoral degrees do as such in an average of four and half years (CHE & CREST, 2009:13).

As was mentioned in 2016 DHET report by the then South African Minister of Higher Education (Dr Blade Nzimande), South African universities are not producing enough numbers of graduates when it comes to masters and doctoral qualifications, which impacts on research outputs, postgraduate throughputs and generation of new academics (supervisors). There is consequently a requirement for UoTs to draw in and expand the number of postgraduate studies and overhaul their academic staff to the level of postgraduate supervision capacity. While this issue is influencing the level of research and postgraduate throughputs in the country, these difficulties make it likely that they will affect the nature of teaching and learning techniques in the universities, with reference to the UoTs, if not rectified.

To build up a research culture in UoTs accompanies incredible difficulties since UoTs were primarily showing little research structures. Along these lines, legitimate components should be considered if UoTs are to endeavour to coordinate the powerhouse traditional research universities. According to Wadesango, Maphosa and Moyo (2014:49), it is of central significance for universities to give scholarly backing that offers an individual a useful way to deal with research studies, which is proper and applicable to the requirements of the economy, that can be energised. Appropriately, one of the key difficulties for the advanced higher degrees includes the conveyance of a high calibre of administration to fulfil its academic staff and postgraduate engineering students – consequently accomplishing maintainability in a challenging academic environment (DeShields, Kara & Kaynak, 2005:128).

As contended by Reddy (2014:58), customers (postgraduate students) ordinarily anticipate that they will receive services that is completely dependable, precise and adequate, within a decent turnaround time. This exhibits the significance of administration quality in picking up an upper hand for individual universities, while highlighting the need to better comprehend the part that supervision quality plays in the higher education area overall. Hence, to enhance the nature of assessment

administrations and instruction continually, preparing at UoTs ought to be monitored on a regular basis (Lekhanya, 2014:625).

Postgraduate research studies at some UoTs in South Africa are not well structured for research to thrive, while there is regularly extensive variety in methodology and even in satisfaction of the necessities for postgraduate exploration programmes (Mutula, 2011:184). Subsequently, there are some difficulties confronting postgraduate studies in Africa generally. Wadesango & Machingambi (2011:31) stated that postgraduate engineering students at UoTs thought that it was hard to focus on their studies, as an aftereffect of academic staff being too occupied by teaching and learning to ever be successful in their research projects; absence of inputs from supervisors because of too much workloads delays student progress (Kandiko & Mawer, 2013:82).

Keeping in mind the end goal to bolster postgraduate throughputs and research outputs, there ought to be more openness of information about the student-supervisor relationship. This situation can be better comprehended considering the quality of postgraduate engineering students in UoTs having multiplied during the last few years, whilst the number of academic staff has just expanded by 40 percent over the same period. This has brought about academics being progressively loaded with an unreasonably high number of postgraduate engineering students to manage, while frequently deficient with regards to the quality of supervision (CHE, 2009). In addition, inclusion in exploration exercises among academic staff is unacceptable and many staff members put little accentuation on research exercises, as these do not guarantee many rewards, as far as the advancement of postgraduate studies (Tahir & Bakar, 2009:416).

3.2 Postgraduate supervision

Much of the literature on postgraduate research studies acknowledges supervising postgraduate engineering students as a process that requires multiple academic and interpersonal abilities/skills. These abilities incorporate postgraduate engineering student’s guidance that articulate research proposal preparation, methodological decisions, recording and publication of results or findings and reflecting on the research procedures (Mapesela & Hay, 2005:114).

According to Van Laren, Pithouse-Morgan, Chisanga, Harrison, Meyiwa, Muthukrishna and Naicker (2014:639), quality supervision on postgraduate studies necessitates specific connections between the supervisor and student that expand further than academic projects. The supervisor is required to demonstrate involvement and dedication, not only to the academic development of postgraduate engineering students, but also to the ability to comprehend student's personal circumstances that involve family responsibilities, work, business and activities that are non-academic. Quality supervision demands responsibility that is shared between the student and the supervisor, building student-supervisor relations as an affectionate partnership. Both student and supervisor jointly spearhead the research project and gain knowledge and both rely on one another for assistance (Van Laren et al., 2014:639).

These requirements pose challenges to most postgraduate research supervisors. Supervision for postgraduate studies is a form of investment, which should be taken responsibly by senior academic staff. The academic staff responsible for supervising postgraduate engineering students should have equitable expertise to demonstrate skills to supervise (Mutula, 2009:184).

According to McCormack (2005:240), postgraduate student's experience different elements that are probably going to negatively impact on student's successful and timely completion of their studies. These comprised of loneliness (academic and social exclusion), insufficient resources, absenteeism or poor-quality supervision, individual and/or professional compassion (McCormack, 2005:240). In some instances, these pressures would rise from incompatibility between student-supervisor understanding and institutional concepts of postgraduate research (McCormack, 2005:240). According to Malfroy (2005:170), often supervisor's expresses frustration at postgraduate student's lack of enthusiasm and their approach towards learning independently.

To address postgraduate engineering students' needs is of critical importance in today's modern era, which is marked by a move to ensure responsible, accountable and quality research (Albertyn, Kapp & Bitzer, 2008:749). However, it is also important to note that student's background often leads to different supervisory relationships, which range from high level of autonomy to high level of dependency (McClure, 2005:3). Academic loads to evaluate progress and determine quality should be

considered as the most critical supervision needs for postgraduate engineering students (Albertyn et al., 2008:764).

Conflict would often become apparent in the process of supervision for postgraduate studies. Sometimes conflict is inevitable because of the relationship being personal (if professional) and too long (Lategan, 2008:29). It may be due to interpersonal matters, prejudices in corresponding to work and expectations, technical and moral issues, ethical standards and disagreements over differing approaches. It is recommended to find resolution when conflicts arise, it should be dealt at an early stage before it can reach a boiling point. When conflict is between the supervisor and postgraduate engineering student regarding the supervisory relationship, it is advised that two parties must first discuss and try to find an amicable solution amongst themselves. If no consensus is reached, then it can be escalated to a higher level for mediation. However, it should be noted that it could be difficult and disruptive to resolve at a higher level.

Several studies have found that many factors contribute towards successful postgraduate completion. These comprise mainly of institutional research culture, quality supervision and funding opportunities or support (Leonard, Becker & Coate, 2005:142). Postgraduate engineering students occasionally go through personal issues that may be in the form of relationships problems (divorce) family difficulties (death) and so on. Personality features from supervisors and institutional support in general are critical contributing factors to successful and timely postgraduate completion (Albertyn, et al., 2008:761).

According to Ngcongo (2001:53), who expressed that institutional authority in the supervision process is required to empower postgraduate engineering students. In this way, it will enhance mentoring and evaluation of student-supervisor relationship. According to Abiddin, Hassan and Ahmad (2009:13), the fundamental potential of supervision consists of the managing of procedures, which are clear, in addition helping and acknowledging related challenges to carry out specific objectives. These scholars further emphasise that a quality supervisor is a person who certainly appreciates and is passionate about supervision, is a person who is focused on academic development of postgraduate engineering students and the institution,

reinforces his/her inclusion in all supervisory workout routines using predominant inclusion (Abiddin et al., 2009:13).

Postgraduate supervision is an approach where academic staff (lecturers) guide postgraduate engineering students on how to complete their masters or doctoral degrees (Maxwell & Smyth 2010:407). Pressure has been increasing on universities for accountability in the last few decades and this pressure has kept escalating. In this setting, Cranfield and Taylor (2008:86) clarified that globalisation and marketisation "constrained larger education businesses to consider the route in which they instruct, habits scrutinise and oversee". Different researchers have determined that South African higher education has a deficiency of proficient authority and an absence of supervision capacity, with a component of the factors being increasing contention for property and open subsidising, new kinds of learning, weight on Human Resources and adjustments in education and technology (Van der Westhuizen & De Wet, 2003:191).

How does authority in guidance pick out with postgraduate supervision in South Africa, with its one of a kind history and modern scholarly power structures? Adair (2009a:139) disclosed that academics want to set up the reducing aspect to give up the pioneers barring bounds and this needs to be completed with the aid of putting extra accentuation on authority. Development and formative open doors for postgraduate supervisors should be perceived, as development is primary for universities to deliver the best results and objectives (Glickman, Gordon & Roos-Gordon 2014:8).

Universities should create an environment in which research can thrive. In the past, it was stated that universities ought to be considered and the core ought to be put on to make sure of extended research education in the future (Van der Westhuizen & De Wet 2003:191). South Africa has encountered a drastic change and development in the research studies and the postgraduate supervision surroundings have long gone underneath elevated investigation over the last two decades (Mapasela & Wilkinson 2005:1239; Mouton 2005:1078). Wadee, Keane, Dietz, & Hay (2010:16) recognised the difficulties being confronted by the way supervision of postgraduate engineering students is done in South Africa as "deficient scholastic education and composing aptitudes and inadequate readiness in evaluation system". This underscores the

testing and complicated project of the postgraduate supervisor in the academic settings (Vilkinas, 2002:129).

The dedication or phase of the postgraduate management is thought to be triple, namely information in the research area, assist the student and the balancing of creativity and critique (Lessing & Lessing, 2004:75). The progressing studying procedure in postgraduate supervision is an opportunity to improve supervisors' academic qualities and characters, whereby they live up to their personal aspirations and those of the universities.

Supervision of postgraduate engineering students is a method of "encouraging and improving learning, exploration and correspondence at the most excessive level" (Zhao, 2001:2). Supervisors want to get research tasks finished and in this manner, need outstanding interpersonal aptitudes, hear with sympathy, impart adequately as pioneers and delegate work to university students all via research techniques (Robbins & De Cenzo, 2001:19).

According to Lessing and Lessing (2004:74), who argued that guidance, change and development are critical, keeping in mind the end goal to keep up the quality of postgraduate research in the evolving environment. Nerad (2009:6) portrayed the exploration populace of South Africa as youthful and expressed that the country needs to develop that youthful populace with huge information as makers for funding development. "Being quality minded in higher education implies keeping up an exploratory premise and holding fast to investigative and moral standards in research" (Lessing and Lessing 2004:74).

Supervision of postgraduate engineering students is a procedure including complex academic and interpersonal abilities, including "leading postgraduate engineering students towards sound proposition planning, methodological decisions, recording and their exploration, keeping up both steady and expert relationship and considering the research procedure" (Mapasela & Wilkinson, 2005:1242). According to McPhail and Erwee (2000:77), the student-supervisor relationship about meetings will vary "contingent upon the supervisor's style of leading students, the attributes of the postgraduate engineering students, the research environment and foundation in the organisation and external components, for example, the specific plan". The postgraduate supervision relationship between meetings is affected by various

elements, for example, supervision style, rank, sexual orientation, trust and feelings (Hean & Matthews 2007:2).

Armstrong (2004:599) demonstrated that some of the reasons behind the low of postgraduate throughputs success is mainly related to inadequate matching of supervisors and students, improper prerequisites such as possessing research experience, together with proper time availability on the workload. The ASSAf (2010:79) report called attention to "issues emanating from the student-supervisor relationship developed as one variable directly influencing postgraduate engineering students" choice to complete their studies. On specific occasions, an unacceptable consultative relationship is emphatically involved in a number of students' not completing their postgraduate studies". Another issue reported by the ASSAf (2010:79) report was the requirement for brief, standard, positive verbal and composed correspondence showing postgraduate engineering students' advance and making insightful recommendations.

Armstrong (2004:600) and Buttery, Richter, & Filho, (2005:19) clarified that it is indispensable for fulfilment in the postgraduate supervision procedure to guarantee to coordinate supervisors and students, reliable requirements, for example, having research experience, together with suitable time accessibility on the workload. Maxwell and Smyth (2010:413) acknowledged the value of observing out for the system and the item when studying is inspired through the enhancement of an association with postgraduate engineering students. The magnitude of cost educating/learning connections is critical in the postgraduate supervision process. Another indispensable part of connections is between universities, industry accomplices and associations that influence the comprehension of the motive for postgraduate studies and the assumptions about the sort of facts delivered from research (Hodges, Malfroy, & Vaughan, 2006:57).

Nsibande (2007:1118) expressed that "compelling supervision ought to make a domain that would acquaint postgraduate engineering students with the universe of exploration and give scholarly incitement so they can develop in their research field. This implies helping students to value doing research, which is centred around necessities for degrees and the world of research as practice. Both worlds have specific methods for considering, working and conveying discoveries, which students

ought to be presented to". Martin, Drage, Sillitoe and Clingin (2006:95) contend that when working in a conducive research environment, postgraduate engineering students could contribute in a greater imperative manner to the standard exploration yield of a region than if they work alone. Inside such a situation, there is a gadget of connections and responsibilities that provide consistent backing and heading to developing supervisors.

Postgraduate engineering students ought to be acquainted with conducive research environment so that they can improve their research skills through practicable supervision (Nsibande 2007:1118). Some postgraduate supervisors can also contend that diverse controls require specific types of supervision and authority of unrealistic challenging demands to postgraduate supervision (Vilkinas 2002:130).

Demonstrating postgraduate supervision relationship is imperative and most students need to be managed by way of supervisors that they see as an expert or any person that is seen as a role model.

The ASSAf (2010:76) document expressed a foremost problem about postgraduate supervisors that exhibit a lack of students' emotional support, an integral stride in postgraduate supervision is for the supervisor to inspire the student's growth academically and socially (Hean & Matthews 2007:2; Ngcongo 2001:55).

A standout amongst the most critical human activities at universities today is the prerequisite to adjust more to workforce with a differing student populace (Holtzhausen 2005:89; Mosley et al., 2008:22). The diverse postgraduate engineering students bring their own social qualities and way of life inclinations with them into a research project (Robbins & De Cenzo 2001:42). Hodges et al. (2006:56) clarified the present workforce diverse qualities as, diverse student partners and distinctive types of postgraduate degrees conveying changes to the conventional dyadic and progressive model of supervision. It is normal that in this new environment, supervisors will need to gain more from their students and that the relationship will converge in a great deal more equivalent relationship perceiving the diverse aptitude and interests of both sides in the supervisor-student relationship. Supervisors will need to commit to students whose skill may not just be more significant to explore in a specific circumstance, additionally somebody who is regularly more established or more senior in their position than the university academic staff required as a supervisor.

According to Lessing and Lessing (2004:74), the difficulties confronting universities is the greater heterogeneous the postgraduate engineering student populace, jointly with few facilities or infrastructures and the nature of supervision foundations, that implies students have different aspirations, needs and demands for postgraduate studies. Kiley and Mullins (2005:245) clarified that postgraduate engineering students' conceptions of research in correlation with that of the supervisor are pushed through the way of social impacts. Nsibande (2007:1117) also expressed that postgraduate supervision likewise "opens the students to the way of existence of exploration, techniques for instinct and working in a unique area of undertaking and support strong development".

Lategan (2009:161) further expressed that postgraduate supervision is "an extremely specific model for learning transmission (teaching and learning). On the off chance that you are new to supervision then you should be prepared". The second perspective is that although a postgraduate supervisor has "helped number of students to finish their postgraduate studies effectively despite everything he/she needs continuous supervision training to be very much updated with research developments and new practices associated with supervision" (Lategan 2009:161).

Significant individual differences exist among the various institutions in terms of their student-to-supervisor ratios. Perhaps surprisingly, the highest ratios are not associated with the five strongest research-orientated South African universities like the University of Cape Town, University of Kwa-Zulu Natal, University of Pretoria, University of Witwatersrand and Stellenbosch University as compared to UoTs, mainly because there is a low number of postgraduate engineering students and supervisors at these institutions, which impacts on the throughput and output rates.

A study conducted on library and information sciences schools in East, Central and Southern Africa by Mutula in 2009 on the supervisor-student relationship among postgraduates, uncovered the following:

- delays in a student getting feedback,
- lack of rules/guidelines stipulating supervision,
- poor supervision, that is, no calendar for meetings,
- no records of student and supervisor meetings,
- heavy teaching loads for academic staff.

According to Zhao (2001:25), postgraduate supervision expands the connections amongst universities and businesses/groups and adds to the generation of researchers; so, it is basic that postgraduate research ought to embrace the learning administration model with a specific end goal to connection information economy and postgraduate studies. The supervision of postgraduate research studies is along these lines without a doubt a vital part of the learning academic exercises in universities (Zhao, 2001:25). As a result, there is a requirement for appropriate postgraduate assessment preparing and it ought to endeavour to develop an instructive connection in which postgraduates obtain the learning information that is considered critical to the economy.

Mutula (2009:184) referred to in Wadesango and Machingambi (2011:31), hypothesise that postgraduate research studies are a type of apprenticeship taken under the supervision of senior academic staff members. The staff required in the supervision of postgraduate studies should accordingly have the ability and skills to assume the part of supervisor. It has been found that misguided or insufficiently arranged staff, whose interests are not quite the same as those of the postgraduate engineering students.

While the existing research offers a sophisticated picture of the roles played by supervisors and postgraduate engineering students and provides valuable information to these key stakeholders, the researcher believes the literature insufficiently addresses the ways in which, amongst other issues, institutional differentiation (traditional universities, comprehensive universities and universities of technology) and institutional history are crucial structural issues in determining among other challenges, the supervision challenge. Until research on the postgraduate sector shifts its boundaries to include in these postgraduate issues, the researcher argues that ambitious national goals, such as the NDP goal to increase doctoral output to 5000 by 2030 (NPA 2011), will remain unachieved.

Table 3.1 UoTs academic staff by qualification: Masters and Doctoral

	2013		2014		2015	
	Doctors	**Masters**	**Doctors**	**Masters**	**Doctors**	**Masters**
CPUT	131	354	155	372	187	386
CUT	88	115	96	121	92	123
DUT	97	277	112	281	125	291

TUT	194	324	217	350	258	386
VUT	47	154	60	151	59	164
TOTAL	**557**	**1224**	**640**	**1275**	**721**	**1350**

Source: https://chet.org.za/data/sahe-open-data

Table 3.2 South African research-intensive universities academic staff by qualification: Masters and Doctoral

	2013		2014		2015	
Universities	**Doctors**	**Masters**	**Doctors**	**Masters**	**Doctors**	**Masters**
UKZN	688	445	670	470	655	480
UP	663	382	724	334	754	360
UNISA	629	489	690	533	732	532
SU	616	195	639	256	646	260
WITS	639	327	661	313	701	329
Total	**3 235**	**1 838**	**3 384**	**1 906**	**3 488**	**1 961**

Source: https://chet.org.za/data/sahe-open-data

Table 3.3 Graduates by classification of educational subject matter (CESM), major field of study, level and race in 2016

Table 3.3.1 Major Field of Study for Africans in 2016

Major Field of Study Africans	Masters	Doctorate
Natural sciences	1 299	429
Engineering and technology	621	122
Health sciences	743	141
Business, economic and management sciences	1 626	185
Education	384	202
Humanities and social sciences	1 646	443
Unknown	0	0
Total	6 319	1 521

Table 3.3.2 Major Field of Study for Coloured in 2016

Major Field of Study Coloureds	Masters	Doctorate
Natural sciences	104	37
Engineering and technology	65	9
Health sciences	97	13
Business, economic and management sciences	178	4
Education	39	18
Humanities and social sciences	246	36
Unknown	0	0

Total	729	116

Table 3.3.3 Major Field of Study for Indians in 2016

Major Field of Study Indians	Masters	Doctorate
Natural sciences	139	63
Engineering and technology	134	23
Health sciences	240	47
Business, economic and management sciences	298	16
Education	32	19
Humanities and social sciences	165	44
Unknown	0	0
Total	1 008	211

Table 3.3.4 Major Field of Study for Whites in 2016

Major Field of Study Whites	Masters	Doctorate
Natural sciences	756	262
Engineering and technology	723	82
Health sciences	589	100
Business, economic and management sciences	854	97
Education	154	52
Humanities and social sciences	1 159	269
Unknown	0	0
Total	4 234	862

Source: https://chet.org.za/data/sahe-open-data

Despite the many challenges UoTs are faced with, in terms of postgraduate research throughputs and supervision capacity, these UoTs are determined to improve their postgraduate research studies and their contribution towards industry. These universities are also committed to providing support as well as incentives for staff members who wish to further their masters and doctoral studies and these institutions are increasingly employing more highly qualified academic staff with industry experience. Some of UoTs academic staff, for example, who hold higher degrees, are engaged in research activities and are supervising postgraduate engineering students including some ‘old' technikon staff (perhaps motivated by the incentives, promotions and retirements). International collaborations with technical institutes have started to

produce new ideas about what it might mean to become a research university in the South African UoTs context.

Any growth in the postgraduate sector needs to be underpinned by a framing of the context that incorporates the roles and capacity development of supervisors and postgraduate engineering students but also goes beyond that. This chapter outlines one possible theoretical framework that we believe could drive such broad-based conceptualisation of postgraduate education. It then very briefly raises just two of the possible areas, institutional differentiation and history.

3.3 Improving postgraduate research studies

Several studies have explored the importance of academic policies that affect the relationship between universities and industry. They have examined the effects of Intellectual Property Rights (IPR) about patents and licensing companies and how they influence the effect of technology transfer on that relationship. IPR policies at universities refer to copyright on academic publications, such as journals and books, or to patents filed by the university for inventions that were created because of research there. Ownership of these inventions shapes the analysis of IPR policies in general, not only because the definitions change from one university to another but also because of the differences in culture, history and organisation. For instance, one university might wholly own inventions while at another ownership is determined by the source of funding (Siegal & Phan, 2005:1).

For the most part, postgraduate engineering students at UoTs face comparative difficulties of interest, supply, quality and degrees of profitability both for establishments and postgraduate studies. Even though UoTs had been established a few years ago, the legislature just allowed consent for technikons to change their status to UoTs in 2005, a period when the higher education area was experiencing transformational changes. The effect of globalisation, innovation exchange and in South Africa, an administration focused on developing advanced education area for change.

The exploration nature of any university is seen as far as among other criteria quality of research facilities, nature of Information and Communications Technology (ICT) foundation, strong institutional structure, qualified academic staff, and quality of

postgraduate projects, assessment of funding, collaborations with industry and community oriented and multidisciplinary engagement (Mutula 2009:186).

Various components influence the success of postgraduate studies at UoTs and other universities in general. Such elements can be social, mental or scholarly in nature but the most important is related to the student-supervisor relationship. As indicated by Du Pré (2009), “South Africa has disregarded the connections between its university and industry," she further emphasised that South Africa needs to reinforce its ability for high innovation and technology development. Additionally, the UoTs must have a satisfactory research base to give learning and teaching to development and commercialisation by innovative ventures. Postgraduate training has been viewed as a main key issue, which is vital for the creation of postgraduate research studies with larger amount abilities adjusted to the prerequisites of industry and the scholarly world.

The challenge of the improvement of institutional supervision capacity is not bound to nor ought to be lessened to foundation, resources and infrastructure. It likewise identifies with the abilities to maintain doctoral projects, grow and establish new research projects, the administration of doctoral instruction, the administration of research and the activation of subsidising for doctoral studies. Just about 33% of academic staff at South African universities as of now hold Ph.D.’s and are consequently qualified to manage at this level (CHE, 2016). An additional issue is that the greater part of the supervisory capacity is mainly at traditional universities. In 2015, just over twenty percent of academics at UoTs had Ph.D.’s contrasted with more than thirty percent at comprehensives and more than forty percent at traditional universities (CHE, 2016).

3.4 New generation of young researchers

New Generation of Academics Program (nGAP) includes the recruitment of emerging researchers as new academics. The most critical elements of the programme are that researchers are delegated into research posts considered into staffing plans of universities which indicate the desire and commitment in dealing with supervision challenge and filling the gap for ageing academic staff. An arrangement of criteria connected to the transformational plan of the SSAUF and in addition different objectives, were set up to guide the selection of nGAP researchers. The criteria incorporate value objectives, institutional, national needs and demands.

While the age of doctoral graduates and proportion of male to female graduates in South Africa has remained steady over the years, there have been genuinely critical movements in the racial structure with a more prominent extent being black, however, non-South African. There has been an expansion in the quantity of non-South African students amongst doctoral graduates in most South African higher education establishments. South African postgraduate students decreased from eighty-nine percent in 2007 to seventy-three percent in 2014 and similarly, noteworthy declines happened in the individual fields (2014 HEMIS database, extracted in August 2015)

South African universities desperately need more academics (NRF, 2008; NDP, 2011). These universities additionally require a change in the demographics of academic structures. One marker of this is at present just fourteen percent of university academics are Black African and just two percent are Black African females (DHET, 2012). The staffing in South Africa's universities framework incorporates various activities to drive the way toward developing the up and coming era of researchers. For instance, the NGAP venture has contributed just 125 new posts into the higher education framework in 2015.

To address concerns about the availability of postgraduate masters and doctoral students to take part in the long and complex research process required full-time enrolment where a student can work with a mentor in a pre-doc process, which could significantly improve the poor output rates at a Ph.D. level in South Africa. However, many South African institutions are faced with bureaucratic courses of action and funding related advantages over what might most profit the researcher thus this pre-enrolment engagement is not generally an alternative. Gruchy and Holness' remarks could be useful in that appreciation of the recommendations are genuinely customary comprehension of supervision and learning creation, which without a doubt mirrors the overwhelming supervision model in South Africa. Progressively, however, supervision occurs in shared groups as doctoral projects to groups of researchers. This has different ramifications for supervision and mentorship and should be mainly explored during the time spent when developing generation of young researchers. Such research-oriented structures can increase postgraduate throughputs and research outputs.

Undertaking research is central to have in place writing centres, academic development units, educational technology centres, quality assurance units and many other support structures to conduct research in a conducive environment. It is of basic significance for universities to give academic support that gives an individual a reasonable way to deal with research studies and open doors for postgraduate engineering students to build up their research skills. Postgraduate engineering students require specific support and direction from their universities or faculties to end up with relevant research because South African universities critically need more scientific researchers (NRF, 2008; NDP, 2011). These universities likewise require a change in the demographics of researchers. One the contributing factors of this is about sixteen percent of university educators are Black African and just for percent are Black African females (DHET, 2015).

Undertaking research is integral to have set up Centres, Academic Development Units, Educational Technology Centres, Quality Assurance Units and numerous other bolster structures to lead research in a helpful domain. It is of essential criticalness for universities to give educational support that gives an individual and sensible approach to manage research studies and open entryways for postgraduate engineering students to develop their research skills. Postgraduate engineering students require certain support and bearing from their specific university or resources keeping in mind the end goal to increase postgraduate throughputs and research outputs (Mouton, 2016:34).

According to Bunting, new subsidising formula or structure for higher education in South Africa ought to be produced, which is reliable with the throughput improvement, productivity, university-industry partnership, innovation and technology with shared expenses (2006:216).

The next chapter focused on research methodologies that will be used in this study.

Chapter 4: Research methodology

4. Introduction

The research methodology for this study was a mixture of qualitative and quantitative methods. Mixed methods research has been practiced since the 1950s but officially introduced in the late 1980s and is progressively used by large number of academic scholars (Creswell & Plano Clark, 2011; Dunning, Williams, Abonyi, & Crooks, 2008:145). The growth in use of mixed methods substantiates the question of ascertaining the appreciation of using mixed methods as compared with solely quantitative or just qualitative study. It is essential to recognise the importance of mixing the two differing methods, primarily given the resources advantages, time and knowledge needed to apply a mixed methods study. Mixed methods approach requires more time due to the demand to collect and analyse the two distinct types of data (Creswell & Plano Clark, 2011:69).

Another significance of mixed methods is the merger element of a larger part. The combination of two methods allows readers more assurance in the outcomes and the conclusions they may gain from the study (O'Cathain, Murphy, & Nicholl, 2010:341). Mixed methods can also assist researchers develop suggestions for future research (O'Cathain et al., 2010). Furthermore, many researchers argue that mixed methods application for research is the most effective way to be sure of findings and results interpretations (Tashakkori & Teddlie, 2008:101).

Table 4.1 Comparison of quantitative and qualitative research methodology

COMPARISON OF QUALITATIVE AND QUANTITATIVE RESEARCH METHODS	
Qualitative	**Quantitative**
The purpose of this method is to understand and interpret social interactions.	The purpose of this method is to test hypotheses, look at cause and effect and make predictions.
The group that is being studied is smaller and it is not randomly selected.	The group that is being studied is larger and is randomly selected.

It is a study of the whole, not variables.	It is a study that focuses on specific variables.
The type of data that is collected is in the form of words, images, or objects.	The type of data collected are in the form of numbers and statistics.
The form of data collected is qualitative data such as open- ended responses, interviews, participant observations, field notes and reflections.	Data collected is based on precise measurements using structured and validated data-collection instruments.
The type of data analysis identifies patterns, features and themes.	Data analysis identifies statistical relationships.
Subjectivity is expected for qualitative methodology.	For quantitative methodology, objectivity is critical.
Researcher and their biases may be known to participants in the study, & participant characteristics may be known to the researcher.	Researcher and their biases are not known to participants in the study and participant characteristics are deliberately hidden from the researcher.
Results are specialised findings that is less generalisable.	Generalisable findings that can be applied to other populations.
Scientific method is exploratory or bottom–up; the researcher generates a new hypothesis and theory from the data collected.	Confirmatory or top-down: the researcher tests the hypothesis and theory with the data.
View of human behaviour is dynamic, situational, social and personal.	It is regular and predictable.
Most common research objectives are explored, discovered and constructed.	It describes, explains and predicts.
Focus is wide-angle lens; examines the breadth and depth of phenomena.	The focus is narrow-angle lens and tests specific hypotheses.
The nature of observation studies behaviour in a natural environment.	The study behaviour is under controlled conditions and isolates causal effects.
The nature of reality is multiple realities and subjective.	Nature of reality is single reality and objective.

Final report is narrative with contextual description and direct quotations from research participants.	Statistical report is with correlations, comparisons of means and statistical significance of findings.

Source: Mack, Woodsong, Macqueen, Guest, & Namey, 2005.

This chapter intended to gather information from two UoTs in the Faculty of Engineering, which was later analysed in Chapter 5 of this research study through quantitative and qualitative methods that was also used with an intention to answer the research questions posed in this study. The main reason for this research study was to attempt to achieve conclusions that depended on respondents/ participants' (postgraduate engineering students and supervisors) encounters and perspectives about postgraduate studies at two UoTs in the faculty of engineering and possibly develop a tailor-made supervision framework. There were about 16 masters' students from each UoT, 10 doctoral students from each UoT, five supervisors from each UoT with specific focus in the faculty of engineering, who participated in this research study, there were one research manager from each UoT who were also interviewed, which brought a total of about 62 participants. Perspective into the approach in this study was pragmatic and objective in nature and techniques that were utilised as a part of this research constituted a mix method strategy, which comprised of quantitative and qualitative research methods.

Most research studies depend on some fundamental philosophical presumption about what constitutes a substantial research and which explore method(s) is/are suitable for the advancement of information in each study. With a specific end goal to direct and assess any exploration, it is hence imperative to recognise what these suppositions are. According to Holliday (2002:7), regardless of how broad and diverse the research is, researchers will dependably seek and see altogether different things in a similar setting. The basic point is that the research method selected decided the results of the study.

According to Cooperrider and Srivastva (2001:1), this part planned to depict the frameworks of a deliberate and centred examination of the exact research handle as per the accompanying points, which inquire about worldview, scrutinise approach, explore, outline, testing, information gathering strategies, information accumulation techniques and information investigation.

As the research approach in this study was pragmatic in nature, the exploration techniques and methodology constituted a blended strategy plan comprising of both quantitative and quantitative methods. According to Onwuegbuzie and Leech (2005a:375, referred to in Leech, Dellinger, Brannagan and Tanaka 2010:18), practicality can be characterised as research utilising both qualitative and quantitative techniques and blending the two strategies when useful". Fouché and Delport (2011:307) clarified that "blended techniques consider expansion on both quantitative and qualitative methodologies". In this study, the quantitative and qualitative techniques supplemented each other and took into consideration a top to bottom comprehension and assessment that was stimulating with regard to postgraduate studies at UoTs. A noteworthy contention of realism is that quantitative and quantitative strategies are important, that is, both methodologies have enough similitudes in major qualities to permit their blend inside a solitary study. Along these lines, mix methods strategies concentrated on both numerical and content information, which was gathered and dissected to address the research question (Creswell & Plano Clark, 2007:263).

This chapter highlighted the research plan and approach as far as the exploration worldview, inspecting, ethics, unwavering quality, legitimacy, instruments and investigation of information. Information increased through the writing audit and in this study, interviews and distribution of questionnaires were then utilised to give conceivable arrangements and proposals and to advised the improvement of postgraduate studies and to measure the impact of postgraduate engineering student/ supervisor relationships at UoTs.

As indicated by Johnson, Onwuegbuzie, & Turner (2007:113), mixed method research strategy is a process of dealing with information (hypothesis and practice) that endeavours to consider different perspectives, points of view, positions and outlooks (continually including the viewpoints of qualitative and quantitative research). According to Pansiri (2005:191), "logic has been hailed as the establishment of mix methods and contingent upon the way of research, it can be embraced to yield better results". Rocco, Bliss, Gallagher and Pérez-Prado (2003:21) expressed that the pragmatic position would make utilisation of ideal systems and methods accessible for the research issue.

4.1 Research methodology

The research methodology is the systematic, theoretical evaluation concerning the strategies applied to a subject on the study. It consists of the theoretical evaluation of the strategies and ideas related to the body of knowledge (Myers, 2009:8). Even though there are several contrasts in the research modes, the most generally utilised are qualitative and quantitative methods. At a specific level, the concept of qualitative and quantitative methods alludes to qualifications about the way of learning: how one comprehends the world and a definitive motivation behind the research. On the other hand, the terms allude to research strategies, that is, the path in which the information will be gathered and broken down in this study and the kind of speculations and representations that will arise from the dissected information (Myers, 2009:8).

It is important to consider the research issue and the idea of the information to be gathered before choosing the methodology. Since mix method does not really constitute a solitary research worldview, it can be viewed as rising above the worldview wars. In any case, a mix method considers research parts being connected with a pragmatic approach, as it does not really concentrate on one philosophical way to deal with investigating the research problem and the research questions (Leech & Onwuegbuzie, 2009:270). Following a pragmatic approach which increased the meta-point of view inside the pragmatic perspective, enabling the researcher to address the foreordained research inquiries by applying strategies that yielded both quantitative and qualitative information; the length of these yielded significant information for this study.

Both quantitative and qualitative research techniques were applied by the researcher in this study. Neither one of these techniques was considered by the researcher as superior to the other; the propriety of which were chosen by the connection, reason and nature of the research study being referred to; on occasion the one interchanged with the other, relying upon the course of the study. Most researchers ordinarily prefer to utilise a blended techniques approach by exploiting the contrasts between quantitative and qualitative strategies, blend these two strategies and use in a solitary exploration venture contingent upon the sort of study and its methodological establishment (Brysman & Burgess, 1999:45).

Qualitative research is naturalistic in nature; therefore, it endeavours to learn about the everyday existence of different gatherings of individuals and the groups in their characteristic settings; it is especially useful to think about instructive settings and procedures (Denzin & Lincoln, 2000:3). The qualitative research additionally includes an interpretive, naturalistic way to deal with its branch of learning; it aims to accomplish rationale, it makes exemptions regarding the importance individuals convey to them (Denzin & Lincoln, 2003). According to Domegan and Fleming (2007:24), "subjective exploration plans to investigate and to find issues identified with other issues. There is typically a question about the measurements and elements of the issue. These attributes use straightforward information and provide rich information. As per Myers (2009:8), qualitative research aims to help researchers to comprehend individuals better and the social and social settings inside which they live. These sorts of studies permit the complexities and contrasts of the world that are being investigated and spoken to (Philip, 1998:267).

This approach developed the measurable and research-related information that was referred to from different sources that substantiate a portion of the contentions. Moreover, a cross-sectional methodology was utilised, implying that the perspectives that were chosen here were not considering exact discoveries (except for the reactions picked up from a few academics at various establishments) and might be seen to be more exploratory methodologically in that a cross-area might be critical; however, it was not completely illustrative.

4.2 Research design

The research design for this study was pragmatic in nature. Existing single paradigms did not provide adequate rationale for mixed methods research. Both transformative and pragmatic paradigms have some limitations. A realist perspective, it is argued, overcome some of these limitations and provided a satisfactory paradigm for mixed methods research. The study also included some elements of realism paradigm. The study followed a multi-strand sequential design with various data-collection phases, including a mono-strand approach during the first empirical phase of inference, with data collected by means of a developmental question followed by a questionnaire consisting of both closed and open-ended questions.

Mixed methods also assisted the researcher to develop suggestions for future research (O'Cathain et al., 2010). Furthermore, many researchers argue that mixed methods application for research is the most effective way to be sure of findings and result interpretations (Tashakkori & Teddlie, 2008:101).

Questionnaires and surveys were utilised to assess participant's abilities and knowledge to determine their levels of fulfilment during the course and toward the end of the contextual analysis. An engaging measurable technique likewise were utilised to dissect supervisor and student views about postgraduate studies at UoTs. Besides, the avocation for each of the information accumulation strategies utilised as a part of the study was described. With a specific end goal to guarantee dependability of the exploration, suitable criteria for qualitative research about and a few techniques that incorporated peer reviews and scholarly articles were employed.

Data for this research was collected using qualitative as well as quantitative methods of study. The research aim was to focus more on the qualitative method since the study mainly focused on social human conditions. In qualitative research, ideas and evidence were interdependent, so the researcher also aimed at organising data and apply ideas, simultaneously bringing the data and theory together. Since the research was multidisciplinary, various stakeholders were involved, specifically in the proposing of issues to be incorporated in surveys. Empirical data was gathered through a series of focus group discussions, individual interviews and questionnaires and analysed in terms of fractures and distinctions in the ideal relationship between research studies and the workplace. The researcher also aimed at quantifying data as the best way of measuring a phenomenon by assigning numbers to measure and quantify facts. Babbie & Mouton (2008:49) define the approach as related topic that concerns the central role of variables in analysing human behaviour".

Interviews were conducted mostly in the form of a face-to-face approach since this was the best way of gathering information that is more relevant. Questionnaires were distributed to postgraduate engineering students, supervisors, academic staff, and relevant stakeholders and verify the data collected. The study also identified a specific category of individuals, such as young males and females who did not enjoy the privilege of studying in their mother tongues. For those who were struggling with postgraduate studies, the study also looked at external factors, such as working while

studying, financial implications of their training and the living conditions, which might have affected students' progress.

4.3 Sampling and data collection

This research study involved 52 postgraduate engineering students and 10 supervisors from two South African UoTs. The researcher used randomly selected sampling size that was representative of the sampling population of postgraduate engineering students and supervisors since this methodology focuses on a specific group of the population (masters and doctoral students as well as supervisors in the faculty of engineering at two UoTs). Empirical data for this study was collected by means of questionnaires, several interviews and focus group discussions. The first phase was a developmental phase consisting of randomly selected sample size from each UoT, with postgraduate supervisors being invited (via an e-mail sent to the research units of the two UoTs) to participate in the qualitative developmental process. The second evaluation process consisted of an e-mailed invitation to postgraduate supervisors. This sample size in all phases was randomly selected sample of possible participants corresponding with the topic of research (Leedy & Ormrod 2010:212–213).

Questionnaires, interviews and focus group discussions were utilised to assess participant's abilities and knowledge to determine their levels of fulfilment during the course and toward the end of the research study. Empirical data were gathered through a series of individual interviews and distribution of questionnaires. The researcher collected and analysed both quantitative (closed-ended) and qualitative (open-ended) data using rigorous procedures that were appropriate to each method’s tradition, such as ensuring the appropriate sample size for quantitative and qualitative analysis.

According to Fischer (2004:159), a sampling size "is to get an outcome that is illustrative of the entire populace and should be inclusive. ". Strydom (2005:193) characterised sampling as any divide of a populace that is illustrative of that group. The example of participants for the exploration procedure comprised of postgraduate engineering students, supervisors and research managers/professors working at two specific UoTs in South Africa.

The researcher worked in conjunction with various UoT research officials in choosing participants, in view of their eagerness to participate in the study.

4.4 Data analysis

The researcher presented data analysed and collected for this research study through questionnaires and interviews, which focused on both quantitative and qualitative methods as well as procedures that were used to try to answer the research questions. This was done with the aim of directing the reader to the background of the data that were collected, analysed and the interpreted. The purpose of this research study was also to analyse data collected to reach deductions and inferences that are reliable and based on experiences of participant's viewpoints about postgraduate supervision at UoTs. The study also proposed the establishment of supervisory framework appropriate for supervisors and postgraduate engineering students within South African UoTs, aimed at improving postgraduate throughputs and research outputs in the faculty of engineering. However, it is important to remember that the strategies for analysing data might differ depending on the strategy and information gathering techniques. In the second stage of data analysis, the researcher depicted the different application components of this study, which incorporated people being studied (participants), the motivation behind data analysis, the perspectives of participants and the impacts of any exercises on them. Patton (2002:434) explains that the third stage of data analysis, interpretation of results, including explanation and clarification of the findings, answering questions, connects essentialness to specific outcomes and placing data into a systematic structure. The analysis of data concentrated on coding, examining, explaining, elaborating and formalising.

When taking part in qualitative data analysis, the researcher wishes to highlight recurring features, as well as various strides, methods and procedures that are at the disposal of a researcher. In such manner, the initial phase in breaking down qualitative data, as indicated by Best and Khan (2006:270), included gathering information.

A research methodology "considered and clarified the rationale behind application of research strategies and methods in this study" (Welman, Kruger, & Mitchell, 2005:2). McMillan and Schumacher (2010:285) state that the research approach is orderly and deliberate and the exploration is arranged regarding the path in which the information is gathered and broken down to explore a research issue. Saunders, Lewis and

Thornhill (2012:2) describe thoroughly ideology as the hypothesis of how research ought to be embraced. Henning, Van Rensburg and Smit (2007:36) also state that research technique alludes to "the lucid gathering of strategies that supplement each other and that have the integrity of it to convey information and discoveries that will mirror the exploration question and suit the research reason".

Lues and Lategan (2006:472) also state, "an arrangement of logical activities, strategies, and instruments used to execute the research extend by tending to the exploration issue and meeting the expressed point and targets of the venture". The rationality, strategies and plan are examined.

The study also investigated the impact of supervision at two UoTs and the relationship between postgraduate engineering students and supervisors from a mixed method research strategy of a request by applying both quantitative and qualitative research strategies to explore the main research question. This method of inquiry empowered the study to join components from two distinctive research philosophies with the end goal of comprehension and proving the exploration issues. The study adopted a blended technique method of request, as it yielded far-reaching information and proof for investigating the research issues. As indicated by Johnson et al. (2007:113), mix method research strategy is “a way to deal with learning (hypothesis and practice) that endeavors to consider various perspectives, viewpoints, positions and stances (continually including the points of view of the qualitative and quantitative method)”.

According to Curral (referred to in Johnson et al., 2007:119), mix method strategy considers the successive or concurrent utilisation of both quantitative and qualitative information accumulation as well as information collection and analysis. Creswell (referred to in Johnson et al., 2007:119) expressed that blended technique research is "an exploration plan (or system) in which the researcher gathers, examines and blends (coordinates or interfaces) both quantitative and qualitative information in a solitary study or a multiphase program of request". According to Migiro and Magangi (2011:3759), blended strategy incorporates quantitative and qualitative techniques that supplement each other, with the outcomes from the one technique being utilised to expound on the outcomes from the other. The researcher utilised both ways to deal with quality improvement in comprehension of postgraduate supervision administration (Castro, Kellison, Boyd & Kopak 2010:342).

This method of the request empowered the study to investigate objective and subjective information, which assumed a vital part in the elucidation, illumination, portrayal and approval of qualitative and quantitative results inside this research study. Johnson et al. (2007:115) expressed that the mix of qualitative and quantitative strategies empowers the study to build up a research with a specific goal to give rich information and data. Pansiri (2005:193) contended that a blended strategy (mix) approach could fill a shared need, since "the relative qualities of qualitative and quantitative strategies empower administration research to address vital inquiries at various phases of a research project. (Hanson, Creswell, Plano, Vicki, Petska, & Creswell, 2005:373). A constructivist approach was additionally connected to build a model for driving the postgraduate supervision process (Charmaz & Mitchell, 1996:287).

4.5 Exploratory research

According to Polit, Beck, & Hungler (2001:19), explorative studies are embraced when another territory is being investigated or when little is recognised around an area of intrigue. It is utilised to look at the full way of the current exercise and different elements identified with it. In this study, the attitude of postgraduate engineering students, supervisors and all relevant stakeholders including engineering departments at two UoTs were explored through questionnaires, interviews and focus group discussions.

4.6 Descriptive research

As explained by Burns and Grove (2003:201), graphic query "is intended to outfit a picture of a situation as it actually happens". It might furthermore be utilised to legitimise current practices and make judgment to enhance speculations. For the thought process of this study, descriptive research was utilised to achieve a picture of postgraduate studies at UoTs with a perspective of bettering the prominence of research at these universities.

4.7 Research approach

The research approach for this study incorporated both inductive and deductive usage. The major distinction between inductive and deductive application to research

conclusion was that while a deductive application was aimed at testing theory, an inductive application focused on creation of new theories emanating from the data.

An example of this was interviews that were usually regarded as qualitative, were semi-structured, which have allowed inductive and deductive analysis. The structured segments attempted to verify theory, however, the disposition to allow interviews to be formed by opinions and views of interviewees might legitimate a new theory establishment. Likewise, a questionnaire that usually relates to quantitative method might include closed and open questions. Closed questions provided verification of a theory through deductions and open questions allowed generation of theory. Populace, sample, sampling size, sampling method and evaluation were also being explored.

4.8 Research populace

According to Parahoo (1997:218), populace is the entire number of participants from which information can be gathered, for example, people, antiques, exercises or associations in a particular area. Burns and Grove (2003:213) portray populace as every one of the variables that meet the principles for incorporation in a study.

Burns and Grove (2003:234) describe qualification models as "a posting of characteristics that are required for the participation in the objective populace".

The criteria for incorporation in this study included:

- Registered masters and doctoral students in the faculty of engineering at two UoTs,
- Supervisors and academic staff in the faculty of engineering at two UoTs,
- Research managers in the faculty of engineering at two UoTs.

4.9 Sampling

Saunders et al. (2012:150) explain sampling as strategies that empower the researcher to decrease the measure of information that he or she has to gather by considering just information from a subgroup instead of all conceivable cases or components”. According to Fischer (2004:159), a sampling size "is to get an outcome that is illustrative of the entire populace without heading off to the inconvenience of asking everybody". Strydom (2005a:193) characterised a sampling as any divide of a

populace that is illustrative of that group. Respondents/participants for the exploration procedure comprised of postgraduate engineering students, supervisors and research managers/ administrators working at two UoTs. Jankowicz (2005:209) proposes that one needs to ask what number of individuals a study ought to have in its example and that the response to will shift contingent upon the exploration questions inquired. There were more than 60 participants in this research study from two UoTs as has been indicated earlier.

A sampling of the participants was done as follows:

- The researcher requested assistance from research managers and HOD's and Deans at the two participating UoTs in order to arrive at achievable number of participants.
- Possible benefactors were picked after the researcher has requested permission from participants.
- The query assignment gave a clarification to the available people who were randomly selected, in any case some did not wanted to take part in this research study due to different reasons.

Pilot et al. (2001:234) outline an example as "a share of a populace". A deliberately picked example will give information illustrative of the populace from which it has been drawn.

4.9.1 Sampling size

According to Holloway and Wheeler (2002:128), sampling estimation does not affect the significance or class of the study and there are no suggestions in making sense of estimations in qualitative research. Qualitative researchers do no longer typically comprehend the quantity of people in the research beforehand. Sampling is selected until is accomplished, particularly when there are no additional new certainties to be created (Holloway 1997:142).

In this study, reports concerning postgraduate engineering students and supervisors at two UoTs were taken into consideration. The researcher worked in conjunction with various research officials at these universities in choosing participants, in view of their eagerness to participate in the study.

4.9.2 Sampling process

Burns and Grove (2003:31) allude to testing as a system of settling on a group of individuals, events or conduct with which they might behave in a particular manner in a research study. Polit et al. (2001:234) certify that in inspecting a sample of postgraduate engineering students that speaks to the aggregate participants should be recognised. Sampling is precisely related to speculation of the discoveries. As indicated by Parahoo (1997:223), in some instances, researchers utilise their judgment to pick the subjects to be part of the study. The justification for deciding on this procedure was that the researcher also considered research manager's contribution towards postgraduate research at UoTs in the faculty of engineering.

4.10 Interviews

Interviews allowed face-to-face interaction with participants. The researcher used interviews to take notes and tape recording; although, this was time consuming, it was more reliable. The researcher recorded an interview timetable for questions, which were closed and open questions, a mixture of the two. Closed questions were used for asking and receiving answers regarding fixed facts such as name, surname, gender, and so forth. They did not require suppositions and they produced short and direct answers. Regarding closed questions, the researcher gave interviewees a small selection of probable answers from which they can choose. By so doing, the researcher was able to manage the data and quantify the responses easier. The problem regarding closed questions was that they provided limited responses the interviewee may give and that might enable participants to think thoroughly and test their real views.

4.10.1 Interview technique

The researcher utilised the accompanying strategy for discussion:

- The researcher conducted individual interviews and arrange meetings with the participants by scheduling a meeting guide with semi-structured questions.
- The interview strategies of testing (verbal and non-verbal) were utilised. These included probing or "investigating". The researcher endeavoured to encourage more participation by emphasising the importance of this research study (Holloway & Wheeler, 2002:84).

- The researcher utilised a semi-structured meeting guide, for adaptability and consistency.
- The participants were informed with respect to the requirement for subsequent meetings for questionnaires that were not clearly answered.

4.10.2 Procedure of recording interviews

Amid the interview that were conducted and recorded on audiotape, notes were taken at the same time with permission to enhance the taped discussions.

4.10.3 Note-taking during interviews

According to Holloway and Wheeler (2002:237), note-taking is an important action, but can be time consuming and uncomfortable to both the interviewer and interviewee. To minimise this, the researcher informed participants before the interview that notes would be taken during the interview in order to know if they will be comfortable or not. A non-participant may take notes so that non-verbal conduct of the participants and the researcher's responses and remarks may be recorded (Holloway & Wheeler, 2002:237). Note taking was refined cautiously to refrain from manipulating data.

4.10.4 Tape recording interview

The accompanying elements were respected by utilising the researcher to ensure a fruitful interview:

- Permission to utilise the recording device was asked before the interview to get consent from the interviewee; and
- The use of a recording device empowered the researcher to keep eye contact with the participant.

The accompanying tips empowered the objectives of the interview:

- The recording device was placed correctly between the researcher and the participants to report discussion;
- A "don't disturb" sign was placed on the entryway to guarantee silence; and
- The recording device was inspected preceding the interview to ensure that it is in a good working condition.

4.11 Questionnaires

Questionnaires usually appear to be a logical and easier choice as a form of gathering information from participants. They are sometimes strenuous to design because of the frequency of their use in all contexts in the modern world. The response rate is sometimes problematic (low response) unless the researcher creates a manner that make participants to complete them and submit at the same time (sometimes this may reduce a sample size, the length of questionnaire and the type of questions asked). As with interviews, the researcher may opt to use closed or open questions and can give participants multiple-choice questions to choose from. Questionnaires' layout should be well designed because when they are poorly structured questionnaires participants tend to repeat their ticking of boxes in the same way. When given a choice of response on a scale of 1-5, participants might opt for the middle point and often tend to miss out subsections to questions. The researcher took expert advice in setting up a questionnaire, ensure that all the information about the respondents is included and filled in and ensure that they are returned. Expecting people to pay to for participating is a financial burden to participants and drawing up a lengthy questionnaire could have inhibited response rates. The researcher ensured that questions were clear and that there are cost effective ways of collecting and managing the data. The researcher incurs cost for distribution of questionnaires, interviews and focus group discussions, those who wanted to be reimbursed for incurring cost were refunded.

Wisker (2001:142–143) recognised the questionnaires as a compelling strategy for gathering information from respondents/participants. Delport (2002:166) characterised questionnaires as an arrangement of inquiries on a shape that is finished by the respondent about an exploration procedure. McMillan and Schumacher (2010:195) saw the utilisation of a questionnaire as moderately sparing, since "it has similar inquiries for all subjects and can guarantee obscurity." Saunders et al. (2003:281) clarified that the questionnaire is a standout amongst the most broadly utilised overview information accumulation methods, because every individual (respondent/participants) is requested that react to similar arrangement and it in this way gives a productive method for gathering reactions from respondents/respondents. The primary purpose behind utilising a questionnaire as a part of this study was to draw in various institutions to take an interest in the foundation of a model on the

initiative component in the postgraduate research environment.

Onwuegbuzie and Leech (2006:478) clarify that the questionnaire in a study had a few parts, to assist the researcher in arranging the exploration and "giving it significance, bearing and lucidness, in this manner keeping the researcher centred over the span of the investigation". The questionnaires that were utilised to assemble data from every respondent ensured the anonymity of the respondents/participants was guaranteed.

The benefits of closed-ended questions were that respondents comprehend the importance of the inquiries and reactions can subsequently be contrasted. A clear impediment to making use of closed-ended questions was that it could be disappointing to the respondents if their desired answer is impossible (Delport, 2005:166). The research questions in this study shaped an expressive classification since they essentially tried to measure the reactions of respondents (Onwuegbuzie & Leech, 2006:478).

The qualitative questions in this study investigated a procedure or depict experiences of postgraduate research studies at UoTs regarding the supervision/student relationship (Onwuegbuzie & Leech, 2006:482). The benefit of utilising open-ended questions as a part of the questionnaires was that they permitted participants "to reply in their own words and to express any thoughts they think apply to the question" (Struwig & Stead, 2001:279). Open-ended questions in this research encouraged more participation than the closed-ended questions. The researcher tried to ensure that the information gathered from every question would offer appropriate data that could support a high-level comprehension of the research question.

Over the span of information accumulation, the researcher directed a semi-structured interview with experienced postgraduate researchers from two UoTs about postgraduate studies to learn the legitimacy of the information-gathering instrument. Every postgraduate supervisor who participated were requested to investigate the questionnaires and interview questions responding.

An invitation was e-mailed to the research units and the office of the registrar of each UoT accompanied by supporting documents such as ethical clearance. Each UoT conducted their own ethical approval on the questionnaire and then distributed the invitation and questionnaire to the respondents/participants. The researcher was not given any information about the postgraduate engineering students/supervisor without consent.

4.12 Establishing trustworthiness

According to Holloway (1997:161), "reliability is the true expense of a bit of research". A research study is honest when it mirrors reality and thoughts of the participants (Krefting, 1991:214). In this study, reliability was guaranteed by utilising preconceived thoughts about the topic under investigation and by returning information collected from participants to ascertain whether the analysis is a proper reflection of their responses. Lincoln and Guba (2000:163) and Krefting (1991:214) state that reliability involves validity, constancy, confirmability and transferability.

Moreover, the researcher ensured dependability by applying a variety of strategies in subjective research. Upgrading the dependability of the subjective information was that the reactions of the participants were cited to prepare for predisposition and points of view that the researcher may have while making an analysis. This research study obtained information from respondents/participants working with selected postgraduate engineering students in a specific discipline at each UoT (Creswell 1998, referred to in Onwuegbuzie and Leech 2005:380). The researcher likewise ensured that a review trail was accessible about the entire information process.

4.13 Validity

According to Venkatesh, Brown and Bala (2013:21), surmising quality in mix methods inquires about the precision of inductively and deductively inferred conclusions and it is an umbrella term that incorporates different types of legitimacy. Surmising quality in blended methodology outlined is characterised as a researcher’s development of the connections among individuals, occasions and factors and the development of respondents’ observations, conduct and sentiments and how these identify with each other in a rational and orderly way (Tashakkori and Teddlie, 2008:101 referred to in Venkatesh et al, 2013:21).

Delport (2005:160) and Zikmund (2003:301) characterised legitimacy as a two-fold idea: that the instrument really measures the idea being referred to and that the idea is measured precisely (Zikmund 2003:302). As indicated by Babbie and Mouton (2008:122), legitimacy alludes to the degree to which an observational measure mirrors the genuine significance of the idea of thought.

4.14 Reliability, validity and credibility

Triangulation in this research study was the use of more than one approach to the research question. The objective was to increase confidence in the findings through the confirmation of a proposition by using more independent measures. The combination of findings from more rigorous approaches provided a more comprehensive picture of the results than either approach could do alone. According to Polit et al. (2001:32), credibility alludes to the self-conviction of the information. Reliability is tantamount to inside legitimacy in quantitative research. Credibility exists when the exploration discoveries reflect the view of the general population. Polit et al. (2001:32) confirm that legitimacy and dependability are reasonable in research, however, subjective research to utilise unmistakable strategies to build up legitimacy and unwavering quality. Interior legitimacy is vital in subjective research, as researchers can exhibit reality of the individuals through the exact description of the discussion.

Strauss and Corbin (1998:160) hold that hypothetical ideas ought to have speculation and transferability, implying that thoughts ought to be pertinent to various practically identical circumstances.

This burdens the essentialness of thick depiction so that the reader has the data on which to base a judgment.

The following measures strived to enhance validity:

- Prolonged contribution
- Triangulation
- Peer reviewing

4.15 Dependability

As indicated by Polit et al. (2001:315), this alludes to the steadiness of records after some time and over conditions. Dependability can be compared to unwavering quality in quantitative research studies. As indicated by Lincoln and Guba (1985:161), some tried and true findings of research should be exact and predictable. Two techniques for evaluating the reliability of data comprise of stepwise replication and request review. Stepwise replication incorporates various researchers who can be partitioned into two groups to conduct isolated requests with a view to looking at records and

conclusions. Request review alludes to data and appropriate supporting documents being investigated through an outside reviewer. This identifies with good guidelines that the researcher has to consider in all exploration techniques, in all levels of the query outline. After permission (ethical clearance) granted from the University of the Free State to conduct the study, authorisation allowed from the ethics committee. The researcher applied for permission or ethical clearance from two UoTs to conduct interviews and for the distribution of questionnaires. The standard of value signified "most importantly do no harm when conducting research".

Consideration of morals in research and in life is of basic significance. It is critical to consider internal and external elements amid the procedure of information accumulation and research various vital viewpoints with respect to morality was adhered to by the researcher. These incorporated planning ahead of time, successful utilisation of time, rights to security and giving an itemised clarification of the thought processes behind conducting this research and the advantages of the study. Participants' consent was of high priority and adequate time was given to participants.

The inclusion of respondents was on a voluntary basis and there were no coercion or deception. Informed consent, another basic issue in the investigation was to ensure that the people who are going to take part in the study totally understand what they are being asked to do and that they are all aware of potential dangers that may arise. Finally, the researcher was as objective as possible and avoided being conflicted.

4.16 The right to privacy

Right to privacy refers to data provided by participants will not be shared without their approval or consent (Burns & Grove 2003:172). As the study was directed in the participants' common setting, there was no interruption of security concerning data provided. Secrecy was maintained.

The accompanying safety measures were used to guarantee confidentiality:

- The list of names, personal information, interpretations data collected and notes were guarded in a safe place.
- The list of names was kept separate from recordings, interpretation and notes.
- No names were appended to the tapes, interpretation, or notes (Polit et al., 2001:82).

4.17 Data collection and analysis

Kiessling and Harvey (2005:35) clarified that "the qualification between information gathering and information analysis may not be obvious" in mix method. Pansiri (2005:202) clarifies that data analysis along these lines bolsters back to both hypotheses and practice through discoveries, suggestions and proposals. Producing data and new thoughts are the entire embodiment of the research and this is in accordance with realism's accentuation on applications "what works" and answers for issues. It was critical in this study to distinguish the most noteworthy means score of supervision/student as was indicated by the respondents. The quantitative and qualitative research methods in this study was mixed and it is essential to recall that all researchers often make some type of speculation when deciphering their information in the exploration procedure (Onwuegbuzie & Collins, 2007:307). The next chapter focused on data collection and data analysis.

4.18 Conclusion

This section intended to depict the research strategy. The reason for a research plan was to augment legitimate responses to an exploration address. This was accomplished by application of qualitative and quantitative research approach. Information were gathered by a means of questionnaires, interviews and focus group discussions. The researcher made use of information by applying an elucidating strategy in breaking down data.

The next chapter focused on data collection and information analysed from interviews questionnaires and focus group discussions.

Chapter 5: Data collection and analysis

5.1 Introduction

Academic staff play a critical role in ensuring that teaching, learning and research are effective and efficient (Mouton et al, 2015:34). According to Mouton et al. (2015:27), in the year 2011, the overall number of South African postgraduate enrolments (990) was almost double those of the rest of Africa (526), however, by 2015 there were 850 more postgraduate enrolments from the rest of Africa 3 817 than the South African 2 967 enrolments. Moreover, the annual growth rate was nearly double for postgraduate students from the rest of Africa (17.7% versus 9.6% for South Africans). While the number of South African postgraduates increased by 78% after the year 2000, graduates from the rest of Africa increased sharply by 44% and by the year 2015, they outnumbered the South African students (596 versus 425). This meant that the massive growth in the number of postgraduate enrolments was predominately due to the influx of postgraduate engineering students from other African countries and not because universities were able to contribute in managing the rates of South African students to justifiable levels (Mouton et al, 2015:27).

In the year of 2010, the ASSAf report recommended, among other things, an increase in number of postgraduate throughputs and increased funding for masters and doctoral students, targeting specific institutions in science and technology to increase postgraduate supervision capacity for the production of more doctoral qualifications and promotion of public support for appreciation of the benefit for postgraduate qualifications. The NDP 2030 supports many of the ASSAf recommendations, but with much more specific targets, such as the aim to produce more than 100 South African graduates for doctoral qualifications per one million of population by the year 2030. However, many of the UoTs, if not all, would fall behind since lack of capacity in terms of supervision of postgraduate engineering students impacts directly on throughputs and research outputs, which has been a major challenge for these institutions for some time. This would translate into 5 000 outputs per annum in 2030 (compared to the output of 2 051 in 2015) (Mouton, 2016:8).

This chapter describes, explains and analyses, comprehensively, the purpose, rationale and processes for data collection application in this study. In this research study, a mixed methods research design was used to obtain a practical overview of

the extensiveness of postgraduate studies on the two selected South African UoTs in line with their multiple challenges, needs and demands. As it was distinctly outlined in the previous chapter, a mixture of qualitative and quantitative research methods was used with the intent for additional comprehensive feedback from respondents to allow unforeseen developments and to explain individual circumstances. A theoretical framework was built on the substantial literature study in the previous chapters aimed at assuring reliability and validity of the measuring instruments.

In this chapter, data was gathered using qualitative and quantitative methods, analysed and explained in a logical method as the subsequent development in the research process. The evidence and documentation process aimed to represent data in an abstract and understandable way to establish direction and connections with the aims and objectives of the research study.

The results were introduced initially as analysis of qualitative data gathered through questionnaires, interviews and focus group discussions that were semi-structured. Analysing of qualitative data was preceded by analysis of quantitative data, which were collected through questionnaires and individual as well as group interviews. It is important to note that data from quantitative and qualitative components were interconnected, because the conclusions of qualitative data developed to the subsequent growth of quantitative questionnaires for postgraduate engineering students and supervisors at the two selected UoTs.

Analysis of data may be explained as a process of building a structure and bringing order to the data that were collected. It is described as difficult, open to different interpretation and it is time-consuming, but also as compelling process. Generally speaking, it does not progress in sequence and it is an action of theorising and interpreting data that means searching for universal statements (Schwandt, 2007:6). Therefore, a researcher could presume that data analysis requires logical structure to be applied in the research process. According to Best and Khan (2006:354), the process of analysing and interpreting data represents the use for inductive and deductive validity to the research. According to Morrison (2012:22), the interpretation approach includes deduction from the data acquired that depends mainly on feelings and perceptions of participants in the research study, which subsequently forms elements of the qualitative research method. Sometimes researchers and supervisors

depend on their past experiences in analysing information given by the participants in the research study. This research study used a mixed method approach for data collection, through qualitative and quantitative methodologies from participants' viewpoints. It attentively adopted a pragmatic setting that followed a scientific approach for conducting and managing this research study.

The research study clearly expresses that data refer to information that is systematically collected, arranged, recorded and analysed to allow the reader to understand information more accurately; data that are gathered randomly, by responding to some research questions the researcher aimed to achieve. According to Schostak and Schostak (2008:10), the intrinsic nature for recording data is not considered precise and exact, but allows for different formations and thus there are different ways of discovering answers to questions a researcher wishes to answer.

According to Tuckman and Harper (2012:387), a mixed method research study necessitates an inextricable correlation between collection of data and data analysis to construct a logical presentation of data. The primary aim for conducting a quantitative study, as with a qualitative approach, was to construct valid and reliable findings. Qualitative methodology uses words (conceptualisation, phrases, images, etc) in developing a structure for transferring reliable and valid data reports, techniques and procedures that are applied in analysing data by numbers for quantitative approach (Sesay, 2011:74). Regardless of which method was used − qualitative or quantitative − the aim of conducting a research study was to generate results and by so doing, data must be dissected and evaluated to generate findings.

According to Kreuger and Neuman (2006:434), qualitative and quantitative analysis of data provides an effective synopsis of the similarities and dissimilarities between qualitative and quantitative methods in analysing data. They further argue that qualitative and quantitative analyses share similarities in four different ways, namely:

- Inference - the use of reasoning in reaching a conclusion based on evidence
- Public procedure or process – by allowing significant information in their study design in some way
- Similarities and dissimilarities are central exercises – identification of systems and features that are comparable

- Attempts to nullify inaccuracies, false deduction or assumptions and unreliable conclusions

This chapter presents data analysed and collected for this research study through questionnaires, interviews and focus group discussions, which focused on both quantitative and qualitative methods as well as procedures that were used to try answering the research question. The researcher presents an incisive overview of the impact on postgraduate supervision at two South African UoTs in the faculty of engineering. This was done with the aim of directing the reader to the background of the data that were analysed and interpreted. The purpose of this research study was to analyse data collected to reach deductions and inferences that are reliable and based on experiences of respondent's viewpoints about postgraduate studies at UoTs in the faculty of engineering and to instigate the establishment of a supervisory framework that is appropriate for postgraduate supervisors and students within the context of South African UoTs in order to enhance throughputs and research outputs. In outlining the recommended models, it was critical to explore student-supervisor relationship at UoTs from previously conducted research, students and supervisor's points of view.

The impact of postgraduate supervision and the relationship between the student and the supervisor were examined through literature review. The applications, aspects, considerations and perspectives of postgraduate supervisors and postgraduate engineering students assisted in providing independent data that are reliable. The data were collected during different phases in the research project. The researcher considered it essential to first manage a theoretical question to assess the suitability and the mental role that supervision plays and its impact on throughputs and outputs in the postgraduate supervision process. Secondly, questionnaires were designed based on the growth and expansion of postgraduate enrolment and supervision capacity at two South Africa UoTs with specific focus in the faculty of engineering.

A number of research studies have been conducted in the area that focused on supervision of postgraduate engineering students with little impact or gradual success, hence the findings of this study may produce valuable beneficiation to the postgraduate supervisory framework at UoTs in the faculty of engineering. Although, the findings of this research study were not generated for the purpose of being

generalised to all South African universities, but preferably with specific focus aimed at contributing to the development of UoTs in postgraduate supervision, which will hopefully impact positively on postgraduate throughputs and research outputs at these universities.

Because the research approach for this study was pragmatic in nature, the research methodologies and processes that were applied for the research study which comprised of a mixed-method design, that incorporated qualitative and quantitative methods. This chapter outlines the outcomes of different phases in the empirical analysis. The mixed-method design allowed the researcher to affirm the validity and compare qualitative and quantitative results of the two UoTs with the findings of the research. In some cases, the researcher used figures, diagrams and tables to explain the results and findings.

5.2 Analysis of data and the interpretation of results

The general population for this research was postgraduate engineering students and supervisors within two South African UoTs. Although the term population always refers to sample size, a smaller group of postgraduate engineering students and supervisors was selected. The first phase was developmental, consisting of a selected sample size from the faculty of engineering at each UoT, with postgraduate supervisors being invited (via an e-mail sent to the research units of each UoT) to participate in the qualitative developmental phase. The second phase consisted of questionnaires that were e-mailed to faculty representatives of each UoT with a request for it to be completed by postgraduate supervisors. The third phase consisted of semi-structured interviews and focus group discussions about the use of postgraduate supervision model, that were conducted with 10 postgraduate supervisors and 52 masters and doctoral students from two UoTs in the faculty of engineering. With the evaluation of a proposed supervision framework in the last phase, each UoT research unit identified postgraduate supervision experts to provide feedback. The second evaluation process consisted of an e-mailed invitation to the Deans of Faculty at these two UoTs. The sample size in all phases was randomly selected participants (Leedy & Ormrod 2010:212-213).

One of the main purposes for data collection and data analysis in this research study was to arrive at findings based on participants' circumstances, encounters,

experiences and perceptions or views regarding postgraduate supervision, research environment and its impact on postgraduate throughputs and research outputs at these two UoTs. In writing the proposed recommendations, it was essential to focus on supervision due to its predominant leadership role in postgraduate studies at UoTs from a research capacity viewpoint.

This chapter represents the analysis of the data that was gathered for the study between qualitative and quantitative methods and processes that were used in an attempt to answer the research questions. The main purpose for the analysis and the interpretation of the quantitative data was to arrive at conclusions supportive of respondents' circumstances, their viewpoints and what they are experiencing regarding postgraduate supervision and its impact on their studies at two South African UoTs. Qualitative and quantitative data were explored and analysed to understand the professional and personal relationship in the process of supervision of postgraduate studies from both students and supervisors' perspectives at UoTs in the faculty of engineering.

The quantitative data collected during the research study were assessed by Python programming language to analyse the data. This is a computer programmes which was used mainly for qualitative and qualitative data analysis, this programme provided basic descriptive statistics and did not give distinct interaction and contrasts. Data was analysed and described in a detailed explanatory way by the researcher. Eventually, the study was aimed at contributing to the development of a tailor-made postgraduate supervisory framework for UoTs in South Africa, with specific focus in the faculty of engineering.

The previous chapter explained and clarified in detail the procedure, reason and motivation behind using qualitative, quantitative and mix methods. The primary motivation behind this study was to achieve an analysis that depended on participants' encounters and perspectives about postgraduate studies and to conclude with the intention to develop a supervision framework that enhances supervision process and capacity management of postgraduate studies at UoTs in South Africa. In writing recommendations, it was imperative to take a glance at initiatives at UoTs in South Africa from student/supervisor perspectives. The semi-structured interviews were used to investigate the findings gathered from quantitative and quantitative

techniques. This approach is viewed as imperative considering the characteristics of the research study methods of application (Johl et al. 2012:6373).

5.3 Population and profile information of participants

It was not too difficult for the researcher to decide on the number of questionnaires to be distributed since they were done through online links, which comprised of postgraduate engineering students and supervisors, but to compensate for limitations that might have risen, an overview of the participants is presented in figures 5.1 and 5.2, which provide a summary of the sample in terms of qualifications. Majority of participants (81%) were masters' students, 14.3% doctoral students. It is important to note that while 4.8% indicated other, this is because from a follow up interviews some students mentioned that by the time they filled in the survey they had already completed their studies and were not registered at the time.

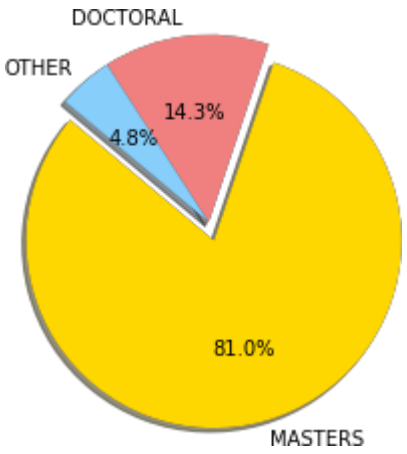

Figure 5.1 Student population enrolled for masters and doctoral studies

Figure 5.2 indicate about 75% of supervisors at the two UoTs in the faculty of engineering having obtained their doctoral qualifications while only 25% had masters' qualifications. It is important to note that during interviews some of the supervisors indicated that they have enrolled for doctoral qualifications. Supervisors with doctoral qualification give students the opportunity to develop and carry out their research and may offer the added benefit of expertise to give postgraduate engineering students a solid background in and knowledge of their specific chosen subject. They also indicated that having obtained a doctoral qualification provide a breadth of professional

development training opportunities to enhance students' capability and competencies to develop a world-class, highly skilled graduates. In some programmes there is a mandatory requirement for supervisors to participate in flexible professional internships during their doctorate. The objective was to support supervision training, in particular to deepen the awareness of academic staff and alert them of skills and attributes required for postgraduate supervision. It is also intended to widen candidates' experience beyond academia to alert them to the types of careers in which their research training could have an impact.

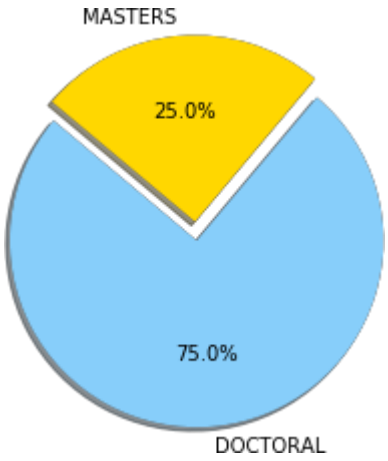

Figure 5.2 Supervisor population with masters and doctoral qualifications

Faculty departments

Student participants were asked to specify which department they come from. Figure 5.3 show the results obtained for the students. The results indicate that student participants came from various engineering departments were almost evenly represented.

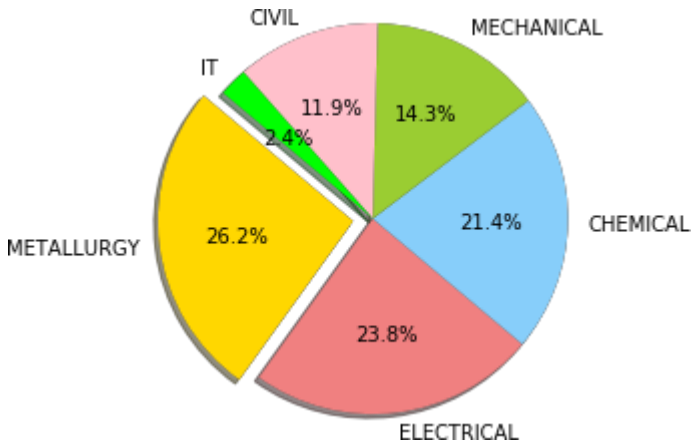

Figure 5.3 Student participants per department in the faculty of engineering

The level of department for supervisors' participation was somewhat satisfactory, while 50% of participants for supervisors came from one department as it shown in the figure 5.4. it is important to note that 12.5 percent indicated other which did not fall under one of the category listed.

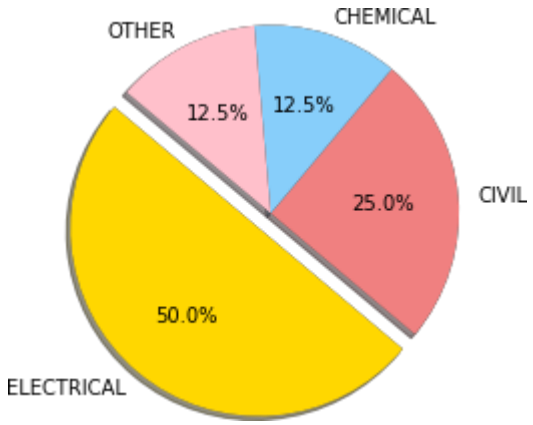

Figure 5.4 Supervisor participants per department in the faculty of engineering

Gender and race of student participants

Student participants were asked to specify their gender. Figures 5.5 show the results for students. In total, 59.5% of the participants were male and 40.5% were female students, which was somewhat satisfactory given the nature of the discipline. Gender comparison seemed evenly match for student participants. Due to gender sensitivity,

participants were also given an option to state other; no one indicated for students. Race for students was somewhat uneven with Africans as the majority with 88.1% and whites 11.9%.

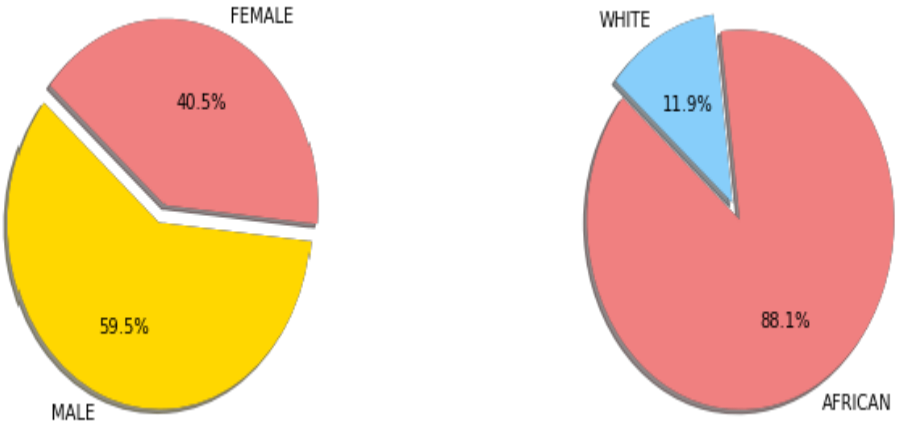

Figure 5.5 Participant gender and race for students.

Gender and race of supervisor participants

Supervisor participants were asked to specify their gender. Figures 5.6 show the results for supervisors. For supervisors, male participants were the majority, with 75%, while females were 25%, which indicated a shortage of female supervisors. The gender comparison seemed unevenly match for supervisors. Due to gender sensitivity, participants were also given an option to state other; no one indicated also for supervisors. Race for supervisor participants was somewhat satisfactory with Africans 62.5% and whites 37.5% as indicated in the figure 5.5.

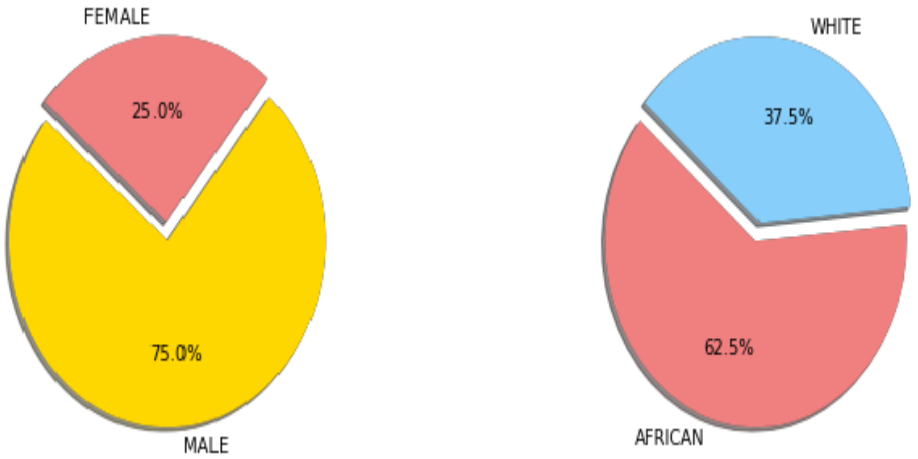

Figure 5.6 Participant gender and race for supervisors

Current year of registration

Students were asked to indicate in which year of study they are currently enrolled. The results are indicated in Figure 5.7. The level of first year of registration was somewhat satisfactory, as it is an indication that UoTs are attracting more postgraduate engineering students. However, there was a concern for student percentage of 14.3% since a masters' qualification duration is 2 years at this UoTs and this could be linked to shortage of supervisors which impacts on student progress.

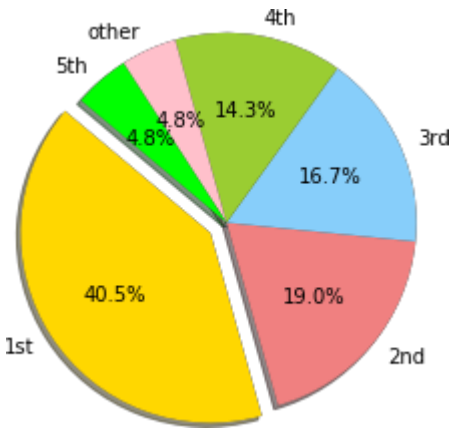

Figure 5.7 Current year of registration

5.5 Expected year of completion

Students were asked to indicate when they would be completing the qualification they enrolled for. The majority of student participants (45.2%) indicated 2020 as shown in Figure 5.8. As compared to the annual report of 2017 for the two UoTs, in 2020 the percentage of postgraduate engineering students' throughput will increase by 21 percent (HEMIS, 2018). The level of expected completion rate was somewhat satisfactory, as it is an indication that UoTs are investing more in supporting postgraduate engineering students wishing to complete their qualifications in time.

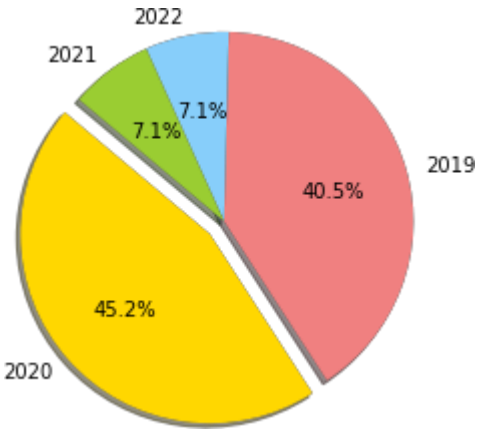

Figure 5.8 Expected year of completion

5.6 Full-time student or part-time student

The respondents were asked to indicate if they are studying part-time or full-time. The majority indicated that they are full-time and many were international students. Figure 5.9 illustrates the results of part-time and full-time students. Full-time registration for participants in this study was satisfactory, as it indicates that UoTs are improving some components of their postgraduate supervisors due to postgraduate students' willingness to obtain postgraduate qualifications.

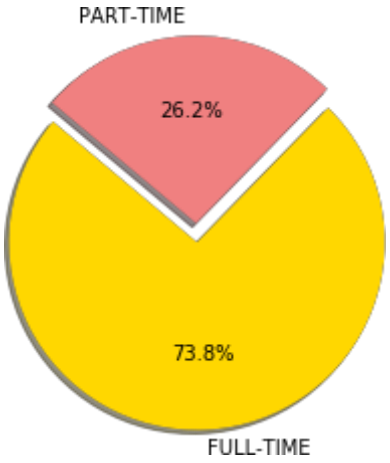

Figure 5.9 Part-time vs full-time registration

5.7 Nationality of participants

Student participants were asked to indicate their nationality. The majority were South African students (70%), but mainly studying part-time, as compared to international students (27.5%) who are mainly studying full-time. It can be seen from figure 5.10 that there is a huge difference on nationality of participants. The nationality of student participants indicates significant margin, but this factor could emerge as significant when the two universities are examined separately. It is important to note that 2.5 percent of participants represent those who could have dual citizenship hence they did not choose between international or South African.

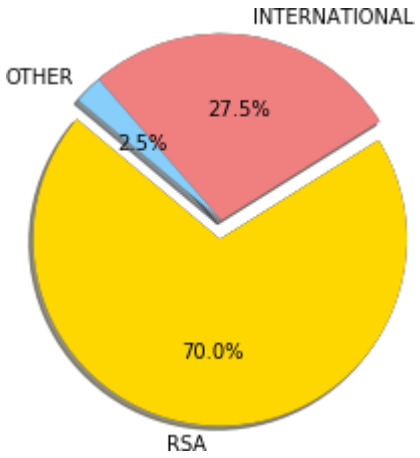

Figure 5.10 Nationality of participants for students

Supervisor participants were asked to indicate their nationality. The majority were international supervisors (50%) as compared to South Africans (25%). It can be seen in figure 5.11 that there is a difference on nationality of supervisor participants. The nationality of supervisor participants indicates some margin, but this factor could emerge as significant when the two universities are examined separately. It is important to note that 25 percent of supervisor participants represent those who could have dual citizenship hence they did not choose between international or South African.

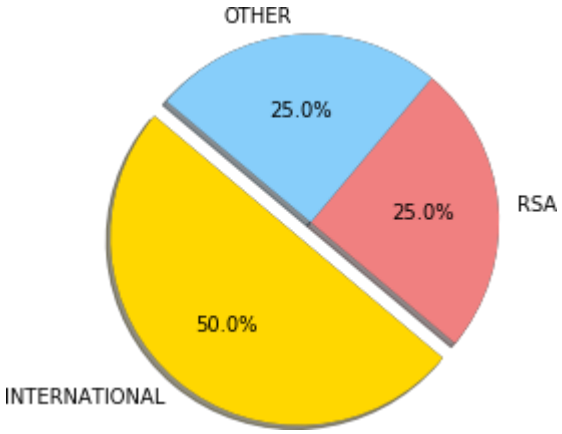

Figure 5.11 Nationality of participants for supervisors

Figure 5.11 indicates that South African UoTs in the faculty of engineering are struggling to establish capacity for national supervision of postgraduate students. This is an indication that there is a need for qualified South African supervisory cohort to efficiently and effectively cope with the influx of international supervisors. Diminishing supervisory skills consequent to the ageing, experienced supervision has been well discussed. The growing need for local supervisors at UoTs in the faculty of engineering, together with the desire for cross-disciplinary research to maximise innovation for future socio-economic development means that co-supervision will become the norm as opposed to the traditional apprentice-type supervision to best address the proposed increase in postgraduate throughputs and research outputs as per the NDP vision for 2030. It is more likely that the impact of globalization is playing a role, but, it is also important to note that UoTs have historically witnessed demographic shifts as a result of postgraduate supervision capacity challenge.

5.8 Type of qualification

The majority of the supervisors (75%) that participated in this study had doctoral qualification as indicated in figure 5.12 and were mainly professors in both gender groups, meaning that there is significant foundation of postgraduate supervision expertise among the male and female academic staff. With expert, qualified academic staff, UoTs can produce more postgraduate engineering students. This demonstrates the value of the study to mentor and coach postgraduate supervisors and institutions in dealing with supervision capacity challenges.

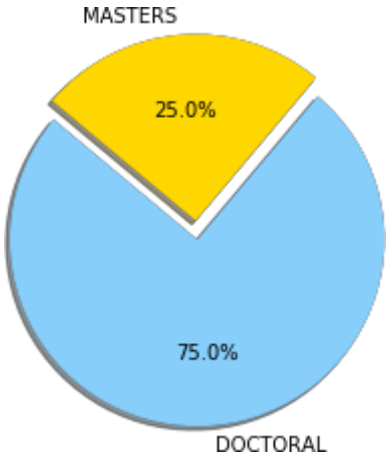

Figure 5.12 Qualification for supervisors

5.9 Age group for postgraduate students and supervisors

In the questionnaire, student participants were requested to indicate their age group. Figure 5.13 shows student responses. For student participants, the age group was satisfactory with the majority (42.9%) in their middle to late twenties as indicated in figure 5.13.

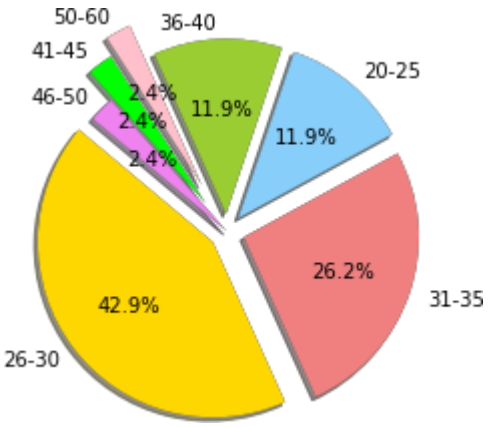

Figure 5.13 Age group for students

In the questionnaire, supervisor participants were also requested to indicate their age group. Figure 5.14 shows supervisor responses. For supervisors, the age group was

somewhat satisfactory with 37.5%, the majority, in their early forties as indicated in figure 5.14.

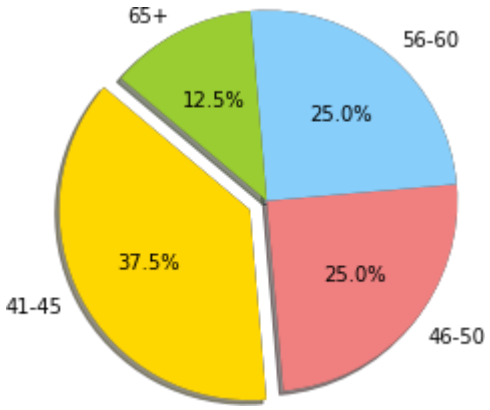

Figure 5.14 Age group for supervisors

The supervisors were asked in the interviews about funding information needed to assist their students. The majority (78%) of supervisors indicated that they assist students in applications for funding; however, many postgraduate engineering students were concerned about the available funds since they do not completely cover their research project needs and NRF does not cater fully for international students. There were also concerns from postgraduate engineering students who are in their research proposal phase since funding is mainly available to students whose research proposal has been approved.

In an interview with a group of five postgraduate engineering students, the researcher asked if supervisor(s) make(s) a real effort to understand the difficulties they face. All students indicated they show interest in their personal life while with two supervisors that were interviewed both indicated that they prefer keeping the relationship professional to avoid issues that may affect student/supervision relationship.

In one of the questionnaires, students were asked about receiving feedback from supervisors and whether it provides them with helpful tips to progress. The majority (66%) of participants indicated that, often, feedback impacts on their progress as they sometimes wait for more than four weeks before they get feedback on their submission. Those who were mostly concerned were full-time students because it impacts on their duration of study period since they are international students. Some

supervisors indicated that, due to workload, they are unable to give students feedback in time since they are also lecturing and undergraduate studies take most of their time.

5.10 Expertise in supervising research

In interviews, the researcher asked about how supervisors monitor and provide feedback about the student's performance to ensure adequate progress. Many (58%) responses were positive; however, it was also mentioned that delays often occur due to other academic commitments and the challenge with faculty supervision capacity contributing towards feedback delays.

The researcher asked about keeping records of all meetings with the students and indicating action taken or advice given. Many supervisors (71%) indicated that most of the meetings are recorded since most of the communication is done via email but sometimes meetings are informally arranged because students may visit them anytime during their consultation hours.

During an interview, participants were asked to state how long they had been involved in postgraduate supervision. One participant pointed out that she was starting to supervise for the first time since she completed her doctoral qualification. Other participants mentioned that they had been supervising for 5 to 10 years. The participant who had been supervising for the longest time was for 16 years and had supervised more than 19 masters and 8 doctoral students who all graduated.

The researcher asked participants to indicate their personal reasons for involvement in postgraduate supervision and three respondents indicated that they were participating in postgraduate supervision for various reasons, such as promotion.

The majority (62%) of participants who started supervising students indicated that postgraduate supervision was part of their activity as academics. This pointed out that they regarded supervising postgraduate engineering students as part of their job and some of them mentioned that they were appointed to supervise students due to capacity or shortage of academic staff in the department, therefore, they had no choice. This was an interesting and concerning point, because a significant part of supervision process has to do with passion about a research project and the drive to subsequent development of postgraduate engineering student success. Another concern for the researcher was that some participants indicated that they were only

supervising because it was part of their job and they derived no satisfaction from the process.

One of the HOD commented in an interview that he is compelled to supervise postgraduate engineering students due to capacity challenge.

- *It is one of my responsibility as an academic staff to supervise students.*
- *One of my role at the university is to give guidance to postgraduate engineering students.*
- *It is expected from me as an academic staff with doctoral qualification.*
- *As a member of academic staff, it is required to be involved in research activities.*
- *As a member higher degree committee, I was asked to assist master's students with the models of research processes.*
- *There is not enough supervision capacity in some special fields and the success of postgraduate engineering students is essential in that field.*
- *It is part of requirement for postgraduate engineering students to practice.*

A synopsis of respondents constituted the following reasons for their involvement in postgraduate studies and supervision. Many supervisors (61%) indicated that they were passionate about their student research projects and contribution to new knowledge as an essential part of their career development and an interesting exercise for academic success. This statement showed that some of supervisors were willing to be involved with student and university success, which could eventually lead towards their own personal development. The researcher may conclude that some of the supervisors who provided an answer to that question were happy, willing and satisfied to be part of this research study. In order for UoTs to succeed in its research plans, attitudes such as this from academic staff will contribute greatly towards the development of research and student success. The following comments were made by some of the supervisors during the interview:

- *The experiences and qualifications I have allows me the opportunity to be involved in research and supervisory exercises.*
    - *Continually I need new knowledge contribution, particularly for UoTs which focuses mostly on applied research. It is therefore necessary to give*

postgraduate engineering student's guidance for credible research that contribute to the value in society, industry and business.

- *To transfer acquired research knowledge to emerging young researchers so that we can deal with capacity challenges at our university.*
- *By so doing I get motivated to keep abreast with research trends and developments locally and internationally.*
- *By being kept informed of trends and developments within my specific field allows me to provide coaching and mentoring for emerging generation of young researchers.*
- *Research allows me to contribute towards solving current societal challenges.*
- *To change other peoples' lives and towards improvement and development of their academic prospects.*

5.11 Graduated students at UoTs

Supervisors were asked to specify the number of postgraduate engineering students that graduated under their supervision. Feedback to this question showed that UoTs are understandably developing capacity for supervision of postgraduate engineering students, particularly at doctoral level. The answers from the respondents supported this conclusion. All respondents specified that they have altogether supervised and co-supervised more than 159 masters and 44 doctoral graduates, successfully.

5.12 Conclusion

Overall analysis shows that many participants viewed their relationship in the supervision process as, predominantly, guiding in nature. The participants mainly regarded the relationship as guiding of a research project (44.5%), followed by advisory (29.5%), (16%) coaching and mentor and, lastly, colleague (10%). The relationship as an academic represents useful data, because it indicated to the researcher that some academic staff attend regular supervision training workshops and courses and this could enhance the supervision elements within UoTs.

The study allowed the researcher to understand the level of the participant's views regarding different aspects of leadership demands and its impact on postgraduate supervision process.

Findings have indicated that funding challenges comprise of the production of increased postgraduate engineering students at UoTs. These funding challenges are common to historically-disadvantaged students. Little progress and retention of postgraduate engineering students is mainly associated with part-time registration on masters and doctoral level. South African students in the faculty of engineering are a larger percentage of students who study part-time and have notably lower completion and progression rates.

Different elements impact on the choice of students to continue or cancel postgraduate registration, but the main two reasons are quality supervision and funding availability. Student choice of which university to enrol in for postgraduate studies is mostly influenced by the reputation and quality the institution. The challenge and demand to increase the number of academic staff with doctoral qualifications at UoTs remains and, this proportion is likely to increase, but not significantly so.

Previous research studies have reported that strategies for making progress and that some of the main problems students face are those related to academic writing, postgraduate studies adjustment, intellectual isolation, loneliness, personal difficulties and lack of appropriate research facilities. The importance of matching students' expectations with those of supervisors to deal with these issues.

From interviews, the study discovered that several students (37%) were dissatisfied with the supervision they were receiving and that there was considerable uncertainty for academic staff about their role and responsibilities as supervisors. Some of the issues students were concerned about included supervisor neglect, late response, personality clashes, communication barriers such as age, culture and language differences and personal differences in approach to work.

Supervisors (29%), on the other hand, were concerned about the appropriate amount of supervision, since most of them are also involved with teaching and learning, topic selection, the frequency of meetings, the variety of approaches to supervision and personal relationships with students.

The findings also revealed that more communication should be encouraged between students and supervisors, that supervision should be more structured and that meetings should be more formal and documented.

The study found that although more than half (63%) of postgraduate engineering students were satisfied with the supervision they were receiving, the area of greatest dissatisfaction concerned a lack of appropriate guidance in the early stages. This dissatisfaction seemed to increase with the number of years of candidature, especially for part-time students. The study suggests a more structured approach to the research proposal and to the monitoring of the student's progress.

The study also revealed the issues of lengthy completion rates which also affect students studying part-time, while those studying full-time are more likely to complete in time.

Even though factors leading to increased student late completion rates appear to be multiplex, which include students' personal life and not only university circumstances, students who said they were planning to cancel their studies seemed unhappier with their experience of supervision. They expected better guidance and feedback during the earlier stages when they were busy with their research proposals.

Other significant sources of difference include gender, cultural background, age and part-time status. The study also identified factors contributing to communication failure, mainly because students felt neglected and made their concerns and expectations clear. An example provided by one participant is that he felt he was progressing and later discovered that the supervisor noticed student was unable to write scientifically.

Several recommendations have been made on how to enhance postgraduate studies at UoTs in Chapter 7. The researcher suggests that one of many strategies for improving students' motivation and experience of research is for pre-enrolment briefing or counselling to clarify students' expectations about postgraduate research studies, their own role and their supervisors' responsibilities.

This research study seems to show a problem regarding the different expectations between students and supervisors and point to the need for more clear communication between supervisor and student and for more structured approaches to the development of postgraduate studies at UoTs in the faculty of engineering.

As far as socialising with students, it is significant to understand that most of the postgraduate supervisors disliked the idea of associating with their postgraduate

engineering students at social and personal level. Some supervisors indicated that they might have an “espresso” with their postgraduate engineering students in their workplaces, yet would not go to an "open place" or welcome them to their home, regardless of the possibility that it would be to do with their research studies.

At some point when the participants were asked some information about their perspectives on support and engagement, unmistakably, they felt that postgraduate supervisors ought to guide students. Student participants (15%) felt that postgraduate supervisors ought to give "physical, enthusiastic and scholarly support to keep student persuaded". Another vital perspective as indicated by participants was that "Head of Department ought to have the capacity to give clear direction and support on every single related field of supervision in engineering". Another vital point as indicated by student participants was that a postgraduate supervisor ought to be proficient, well educated (Ph.D.), well trained to supervise and that the supervisor, not the student, ought to give leadership in the supervision relationship. The participants concurred that both sides "must set up a master plan for a research project because it is vital to the official engagement in the entire supervision process.

From the interviews, it became clear that the correspondence procedure between the postgraduate engineering students and the supervisor is a key component in the human and academic part of the supervision requirement. Supervisors felt that they ought to allow "students to commit mistakes, to learn" on the grounds that this will encourage "students to utilise the experiences so that independence of the student's voice can be heard amid the research process". Inside this environment, postgraduate supervision and initiative involves the activity to have the capacity to "enhance, energise and direct students", by "giving useful feedback and guidance" additionally "having the capacity to listen and be mindful" to postgraduate engineering student's challenges, without imposing their own ideas.

Postgraduate supervisors ought to focus on:

- *Promoting grant scholarships in their field of intrigue;*
- *Acting as the facilitator within the student research project;*
- *Providing integrity and trustworthiness in the entire supervision process;*
- *Allowing sincere and mentally stimulating research environment;*

- *Acknowledge the requirements and desires of postgraduate engineering students in the supervision process;*
- *Ensuring listening attitudes in the supervision process;*
- *Allowing adaptability and space for innovation; and*
- *Having common regard and comprehension within the research environment.*

Confidence was seen by participants as an important aspect of the postgraduate supervision process. Many participants (62%) indicated that "the progress of a student from being a scared, inexperienced researcher to that person who is confident with his/her research project provides the passion for starting the research supervision cycle". Some participant (51%) felt that "constantly reading articles about research methodology and his or her subject field of interest" enhanced own confidence. Two participants indicated "learning from other postgraduate engineering student's experiences are the best way to learn". They believe it is important to attend workshops where supervisors share experiences that may improve confidence and some practices in their own field of discipline. At the core of emotional attributes is the confidence in own capabilities. Generally, participants agreed that "one needs to master the topic himself or herself and then guide students to explore the topic systematically to form a theoretical model for the execution of the research". Another aspect identified by participants was the "ability to guide postgraduate engineering students through the full research cycle within the limitations of your knowledge and expertise". Emotional attributes need to include confidence in one's work, such as "doing what is right for the student, the institution and the discipline". When people are confident they will be more dedicated, they will "believe in what they are doing and be motivated". One participant commented that "supervisors need to learn from every opportunity."

Postgraduate supervisors ought to focus on:

- *Being energetic about students' research work;*
- *Being naturally spurred and giving essential inspiration;*
- *Promoting trust in themselves and in their field of study;*
- *Having compassion for students;*

- *Understanding diverse societies and perspectives of different circumstance;*
- *Fostering a commitment to students' work; and*
- *Recognising students' own shortcomings in the research endeavour.*

From the data acquired it turned out that postgraduate supervisors have diverse perspectives and encounters of the supervision procedure in a UoT. The questionnaires added and affirmed the individual perspectives and encounters of postgraduate supervisors inside the supervision procedure. Despite some negative remarks from respondents regarding specific inquiries, the questionnaires still provided critical information and data on the production of an authority demonstration for postgraduate supervisors together with focus group interviews at UoTs in South Africa.

This section elucidated on the semi-structured and focus group interviews with postgraduate engineering students and some experienced supervisors in various engineering departments at two UoTs in South Africa. In this section, the translations of the discoveries were exhibited. The point of this section was to address the reason for building up an initiative for supervision framework within the UoTs regarding postgraduate studies by creating an environment with a specific end goal to improve postgraduate throughputs and research outputs at these universities.

UoTs are under pressure to attract and maintain quality postgraduate engineering students who will complete their research project in time and receive external funding needed for university sustainability. Although, many universities are planning to do more with less in research, teaching and learning because allocation of funding has become too competitive and is also associated with production of postgraduate throughputs and research outputs. Postgraduate engineering students represent exceptional scope in diversity such as age, culture, experience and ability, part-time or full-time, local or international, needs and funding support. There is always pressure on postgraduate engineering students to complete their research project in time, to publish or present papers in conferences and to support their families by developing research skills that will strengthen their employability. Being a postgraduate engineering student comes with many challenges that need to be dealt with such as family commitment, job commitment and financial planning, which may impact on their progress; most of them have family responsibilities such as marriage, children and so

forth. These demands become more challenging for postgraduate engineering students who are studying part-time, since some of them finance their studies from their own pockets. Many research studies have indicated that most part-time registered postgraduate engineering students, who are unable to complete their studies in time, associate this with family responsibilities. Mostly, what contributes to non-completion is related to the supervisory process. Postgraduate engineering student needs often become conflicted, as they do not have alternatives in guiding them for timely completion. Conflict in student-supervisor relationships often leads them to extend their studies and experiences difficulties in completing their research project. This condition also leads to a defective quality of research supervision.

There is no doubt that the difficulties in information and services given by the participants in this research study contribute to low completion of research projects at UoTs. The principal responsibility of UoTs is to improve research facilities for postgraduate studies to thrive. This will allow postgraduate engineering students to work in a conducive research environment that stimulates innovation and technology. The advantages of having improved facilities is that they often contribute to a student's selection of the institution he/she would enrol in for his/her research studies. Nowadays, postgraduate engineering students are focusing on high-quality working environments, not only quality supervision. In some cases, postgraduate engineering students are faced with personality clashes, communication barriers, language, cultural problems and personality differences. For example, in this research study, both local and international students identified various problems at different stages of their postgraduate studies. The condition and availability of research facilities are regarded as critical elements in completion of a research project and for some postgraduate engineering students there is a necessity to have effective and efficient supervisory framework. Postgraduate engineering students encounter many difficulties throughout their research process. Some of them are not familiar with the research topic and some of them lack knowledge about research writing. Supervision is one of the main elements that should be taken into account when debating postgraduate engineering students. Observation from this subject must be seriously administered in order to guide postgraduate engineering students to complete their studies timeously. Many researchers have operationalised supervision in so many ways. However, the nature of the exact function is still shrouded with uncertainty. In

recent years, research supervision has become critical for postgraduate engineering students to achieve higher degree certification. It is out of the realisation that supervision is now a central process for the successful completion of graduate programmes. Supervision can be interpreted as a two-way interactional process that requires both the student and the supervisor to engage each other within the spirit of professionalism, respect, collegiality and open-mindedness. Supervision is a complex social encounter, which involves two parties with both converging and diverging interests. Therefore, balancing these interests is crucial to the successful supervision of graduate research projects.

Whilst the interaction between supervisor and student allows a considerable degree of free expression, it is enacted within a wider context of institutional power, which itself is continuously modified by that interaction. These arguments are based on the findings from this research study. The primary part of the data collection in this research study was to first recognise the social impact on the student/ supervisor relationship and to compare prerequisites in the whole process of supervising postgraduate engineering students. The researcher examined several communication processes with special attention to interpersonal features of supervisors and postgraduate engineering students. This section included vital elements of ethics that are essential in the research process. Another feature that was important is the effectiveness of a memorandum of understanding (MoU) between the student and the supervisor. The secondary part of collecting data for this research study was to recognise individual attributes with the aim of locating similar attributes as part of the supervision process. The researcher also focused on the demands and expectations of postgraduate engineering students regarding the relationship between them and their supervisors and whether it encourages the development of postgraduate engineering students into independent or dependable researchers. Another feature of importance was the supervisor's commitment in guiding and facilitating the process with honesty and integrity. Most of the supervisors indicated that this might only occur when there is respect and trust between the student and the supervisor by allowing students to own their research project.

The other part which was interesting to recognise was supervision expertise and management attributes that are also critical elements in the process of postgraduate supervision. Growth in leadership skills was regarded as the most important aspect for leading and guiding a research project. The researcher asked, during interviews, that supervisor look at the introduction, design, layout, wording and the content of each question before answering and some of them gave helpful advices for semi-structured interviews, after which some questionnaires were adjusted before they were distributed to participants.

It is necessary for a supervisor to help the student to understand the importance of consistency and the links required in a research project. Some supervisors (38%) indicated that it is important to criticise a student's work constructively to prepare them for external examination. Another essential element providing feedback was to give written reports on submitted chapters by meeting students face-to-face. It is important for supervisors to give students reasons for their feedback so that students can understand the reasons for negative or positive feedback and that they are only criticising students' work; it is not a personal attack. It is important that feedback should be communicated professionally in a manner that indicates encouragement. The participants also indicated that guidance should be given to motivate students' progress, which might develop confidence in the student. Another vital element was availability of resources for consulting their supervisors since some of them are far from the university and that supervisors should make efforts to visit students in their own settings. Some participants indicated that they sometimes must remind supervisors about providing them feedback.

The researcher responded to possible limitation by attempting to ensure that the participants (Supervisors and postgraduate students) were given transcripts of their interviews for comment and verification. This aspect was particularly pertinent with regard to the postgraduate participants as there could have been inherent and underlying power issues which may have proved difficult for the participants.

It must be stressed that the sample size was also a limitation of the study. Further future research should ideally be based on a larger and a more representative sample that can adequately span the population of postgraduate engineering students and supervisors in order to facilitate more generalisation of results.

Chapter 6: A proposed postgraduate supervision framework for engineering students

6.1 Introduction

In the last two decades, many universities have initiated training programmes for supervisors and various innovative frameworks aimed at supporting postgraduate engineering students and supervisors. The programmes were proposed to develop the required expertise and academic skills to assist staff in supervising postgraduate engineering students (Carton & Kelly, 2014:17).

The challenge of developing academic writing skills for engineering students and the pedagogy of innovation and technology in postgraduate supervision with a view of reinforcing postgraduate throughputs and research outputs is a major challenge, which many South African UoTs currently face.

In reaction to the identified needs, several universities in South Africa and globally started developing training programmes aimed at supporting postgraduate supervisors and prospective supervisors in their continuous development as academics (McGagh, Marsh, Western, Thomas, Hastings, & Mihailova, 2016:73). According to Luca, Standing, Adams, Borland, Erwee and Jasman, (2013:63) it is critical to respond to the changing demands in postgraduate supervision by developing a student-supervisor research toolkit. The toolkit should provide resources needed throughout the entire process of supervision, from selection of a supervisor to examination of a dissertation or thesis. According to Carton and Kelly (2014:18), it is important to address the supervision from an institutional perspective, hence by developing a postgraduate supervision framework that includes the needed resources in support of supervisors and postgraduate engineering students. The institutions referred to in this study have to develop and implement an institutional framework with assistance of a toolkit that is aimed at supporting and improving supervision of postgraduate engineering students (Petrie, Lemke, Williams, Mitchell, Northcote, & Anderson, 2015:1).

For the past few decades, most South African UoTs begun to address the challenges on postgraduate studies such as supervision capacity and the preparedness of postgraduate engineering students. In the past, the methods used to enhance student

engagement in postgraduate studies and the strategies aimed at supporting development of students and supervisors have been somewhat makeshift in nature and application (McGagh et al. 2016:73). The recent focus on support of academic writing and the provision for professional development academic staff as expert supervisors has been implemented by developing support resources, workshop programmes and conferences. For example, recent research in the fields of researcher education and supervisor development has focused on the construction and provision of professional development systems that support supervision of HDR students, also known as research supervision training frameworks (Carton & Kelly, 2014:17). Furthermore, various resources have been developed to enhance postgraduate supervision and postgraduate engineering students support activities such as writing centres (Sisson & Crawford, 2016:1).

According to Knott (2015), a greater focus on the pedagogy of research supervision has surfaced and emphasises the process of postgraduate supervision as a form of relationship and engagement of postgraduate engineering students and the supervisor in mentoring and coaching as a form of learning. Postgraduate throughputs and research output at many universities has now strongly been viewed as critical to government funding (Knott, 2015). Along with a growing focus on research within universities, the long-held need to support both academic supervisors and their research students is becoming increasingly crucial and institutions have been developing a range of initiatives both at institutional and national levels (Sisson & Crawford, 2016:1). Moreover, students themselves are offered support from national bodies to enhance their preparedness for post-study work.

According to Frisher and Larsson (2000:132), to be able to support postgraduate engineering students for timely completion of a masters and doctoral qualification, a framework for supporting students and supervisors should include a definite plan in academic writing, which differs from faculty to faculty and from department to department and that caters for specific needs in line with supervisory practices.

The discrepancies between postgraduate engineering student and supervisor participation may be due to the institutional context preceding the development of supervision frameworks in the faculty of engineering. For a number of years, many academic staff had requested a more systematic approach to the support of

postgraduate engineering students and a more institutional approach to the provision of professional learning opportunities for postgraduate supervisors. Hence, higher staff contributions to the data collection process may have been due to their intense interest in the framework's development, especially since it was, a response to their previous and consistent requests.

6.2 Proposed supervision framework

The proposed supervisory framework aims to guide research and graduate supervision, which focuses on the strength that resides in its integrative and systemic approach with supervisor and postgraduate engineering student experience of learning at the core. The framework aims to integrate various factors that influence students experience so that they can envision response to this issue in a coherent and effective approach and potentially improve postgraduate engineering student's throughput and research output rates because students are central to the postgraduate studies.

To enhance quality assurance for the supervisory framework, several universities in Australia developed supervisor registration and accreditation systems. The University of Adelaide, for example, developed a supervisor classification and reporting system in 2015 and a supervisor and accreditation programme was also developed by Queensland University of Technology in the faculty of education. However, a gap remains in evaluating the effectiveness of postgraduate supervision frameworks at many universities. It becomes visible that the assessment of supervisory models is not as clear-cut as the frameworks for postgraduate studies. According to McGagh et al. (2016: 89), currently in Australia, the research training methods have no uniformity for distinguishing an exceptional research training framework. This chapter aims at developing a model with which to assess the effectiveness of postgraduate supervision sustenance by developing a framework for supervision of engineering students at UoTs.

The independent variables (IV) that influence postgraduate studies at UoTs are factors that influence postgraduate engineering student's successful completion of a research project and the dependent variable focuses on supervision. Diagram 1 is a proposed supervision framework for postgraduate engineering students at UoTs.

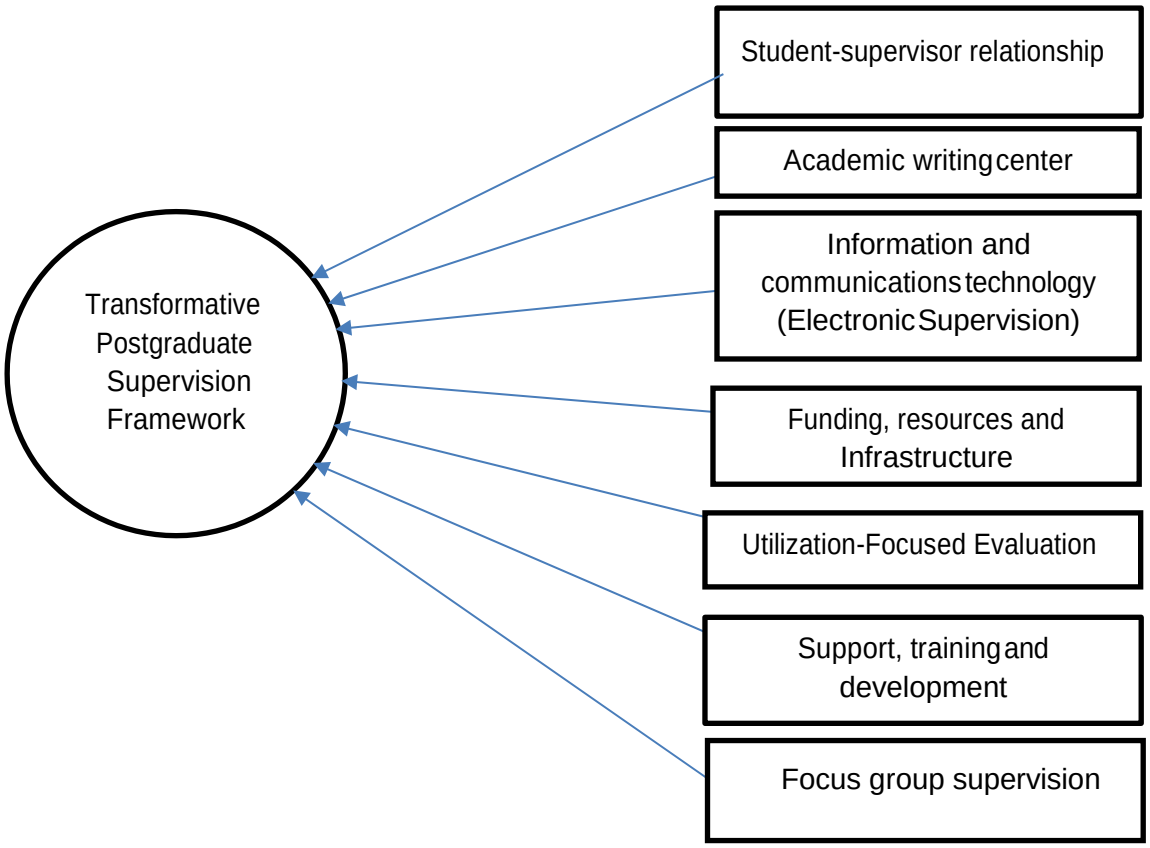

Diagram 6.1: *Proposed supervision framework (dependent variable) that influences independent variables in postgraduate studies*

Source: Authors own construct

Diagram 6.1 is a proposed supervision framework for engineering postgraduate engineering students at UoTs, which focuses on a theories of postgraduate supervision such as functionality, critical thinking and academic writing, emancipation, enculturation, development of student-supervisor relationship, activities of supervisor, postgraduate tasks, evaluation, constructivism supervision, research knowledge and skills, project management skills, mentoring and coaching, constructive feedback, regular facilitation, cultural sensitivity, student, role modelling, regular communication, teamwork, growth and emotional intelligence.

In ensuring growing capacity of the institution to provide for increasing postgraduate engineering student enrolment and the increasing demand for quality postgraduate

supervision, a framework is aimed at facilitating academic writing of engineering students studying masters and doctoral qualifications at UoTs and academic staff that supervise them. Research conducted at Queensland University of Technology indicated that postgraduate students and supervisors required more funding and resources, which could enable them to enhance their research studies (Petrie, Lemke, Williams, Mitchell, Northcote, & Anderson, 2015:1). Moreover, postgraduate supervisors require regular training and development in the processes linked with supervising postgraduate engineering students effectively. Although the university had several policies in place that regulated the selection of supervisors, an all-inclusive structure that included students and supervisors through a committee of higher degree and research was needed, (McGagh et al., 2016:73). Hence, the first stage of the chapter reported on three main objectives:

- Development of institutional postgraduate supervision framework that supports engagement and empowering emerging and academic staff currently supervising masters and doctoral students in the faculty of engineering
- Implementation of institutional supervision framework that is supportive in engagement and empowering emerging and academic staff supervising masters and doctoral students in the faculty of engineering
- Developing and enhancing academic staff members' supervision knowledge and skills, aimed at improving postgraduate engineering student and supervisor's research experience in the faculty of engineering.

Given some disadvantages in existing models of supervision for postgraduate engineering students, it is critical that a new framework in which academic writing is accorded central attention and where scholarly writing is a process, not a product, and where writing is the main integral part of supervision not only a tool to uncover meaning to research. This does not suggest that other elements relevant to the supervision process are not important, (McCormack, 2004:319; Pearson & Brew, 2002:135) it is this research study argument that most issues should be dealt with through a writing-specific framework in supervising engineering students to supplement their technical skills. Even on current frameworks of supervising students, it is critical to give research writing main priority in the supervision process. Caffarella and Barnett (2000: 39), who suggest an active view in supervising and training of postgraduate engineering students for research skills, argue in support of involving students in academic writing

when they first register, for experience that will be needed later in their postgraduate research project. With this approach, the aim is to assist postgraduate engineering students in developing research skills, content and quality of their scholarly writing during the first phase in their research project. Writing is a generic skill that supervisors need to develop in their research students (Colbran, 2004:1).

However, there is a more potent theoretical reason for giving writing proper weight in the supervision process. As recent developments in linguistic theory have established, writing and research, or language and meaning, are inextricably linked. The electronic supervision process should be aimed at creating an enabling academic research writing environment between technically skilled postgraduate engineering students and the supervisors, which includes acquiring more research skills, experiences, attitudes and learning strategies for effective completion of masters and doctoral qualifications through technology and innovation. On the other hand, it aims to provide the supervisors continuous and open support to their supervision, which will relieve other tasks such as teaching and learning and less daily time through electronic supervision communication system. The purpose of this chapter is also to recommend an electronic supervision system (e.g. e-supervision) which is aimed at assisting the professional development of the supervision process and which connects students and supervisors academic writing skills through technology.

This supervision framework should focus on increasing positive communication and interaction between postgraduate engineering students and supervisors for an integrated academic writing of postgraduate supervision at UoTs in the faculty of engineering.

It is not only enough to know that writing and research are integrated into a supervisory framework. Academic writing should be clear and purposively brought to the depth of supervisory framework. As an example, developing conscious recognition that reflect on how supervisors will enable students to advance individually as emerging researchers and how supervision framework enhances transformative and innovative learning. It will also be helpful to ask students to complete similar responsive academic writing tasks. An example would be what constitutes transformative and innovative supervision. This approach could reinforce training in developing supervisory frameworks or models that capacitate writing mentors for students and these writing

mentors should be student-focused. Key elements of student writing-centred postgraduate supervision at UoTs in the faculty of engineering may be summarised as follows:

- Robust educational methods should be implemented where postgraduate engineering students are essential focus in the supervision process and in which academic writing constitute multiplicity in technology, transformation and advancement of postgraduate studies;
- Writing characterised by outcomes that enable multiple learning pathways and writing styles;
- Acknowledgement of group supervision and academic writing exploration that enables adjustability but with structured support for postgraduate engineering students;
- Enables postgraduate engineering students to identify and monitor their progress through advancement of group supervision system and continuous assessment that is aligned with supervisor-student expectations;
- Administer a framework where postgraduate engineering students establish their own writing pathways that inspire postgraduate engineering students to notice their own academic vigour and shortcomings and use this to advance their writing skills,
- Expand awareness of existing research skills, proficiency, competency and determination; and
- Allow separate rating progress but in relation to UoTs rules and regulations for timely completion of a research project that could produce research publications that have intrinsic value to the student and the supervisor, as well as community at large (business/industry/academia) and as such showcase the quality of electronic supervision in the faculty of engineering.

Student writing-focused group supervision necessitates a supervisor to develop and maintain jointly supportive roles. Within postgraduate electronic supervision, the supervisor will be expected to give advice and guidance. This guidance requires support and advancement towards independent academic writing. This could empower students and should encourage constructive critique that may be conveyed in a manner that develops student self-confidence.

The student and supervisor may need and must be ready to act in an advocacy capacity for group supervision in relation to the rules, regulations, policies and procedures of postgraduate studies at UoTs. For example, it be may needed to negotiate, on behalf of the student, with the Research and Higher Degrees Committee to involve documentary procedures and protocols, extensions, scholarship applications and completion times. The supervisor needs to ensure that such negotiations becomes fruitful and in the interests of all parties. Therefore, writing-focused supervision must be 'streetwise' regarding electronic supervision policies and procedures pertaining to engineering students.

A group supervision process should be aimed at developing supervisory practices within the context of learning how to acquire academic writing skills and incorporating them with technical skills. To maintain a writing-focused approach to electronic supervision and utilise the approach of e-learning, it is critical for postgraduate supervisors to see themselves in this role as co-learners. It is important for supervisors to remember that various emotions such as anxiety, frustration, doubt, elation and even despair that they went through during their own research as students are also being experienced by postgraduate engineering students they currently supervise. It is important to bring this to the student's attention and encourage students to recognise that such learning experiences are a crucial and valid aspect of any research process. This could help students in developing their own ability to learn independently and thus manage their own learning more effectively. Independent learning is a critical measure to the successful completion of a research project.

The literature on supervision has identified positive features associated with group supervision. According to Kadushin and Harkness (2002:23), group supervision allows postgraduate engineering students to share their experiences with others in similar circumstances, which aims to increase opportunities for learning, new ideas and emotional support.

- Group supervision can be a powerful means of reducing isolation, which is particularly relevant for staff working shifts, working from home or on their own. It can support the development of group cohesion and shared values.
- The group may allow different views and opinions to be voiced. This kind of diversity, including ideas that may challenge those of the supervisor may be more difficult to achieve in one-to-one supervision, so there may be more distribution of power in group supervision.
- Being involved in group supervision may help participants develop skills that are transferable to other practice situations; many of these involve working in teams and groups.

However, it is important to consider the benefits alongside some potential challenges. For example, with group supervision, it is difficult to meet the specific needs of individual participants and there is the risk that discussions remain generalised and do not meet everyone's needs in a satisfactory way.

The development of a postgraduate supervisory framework that is student-writing focused to group supervision involves several basic requirements. These will include the following:

- *To act in different roles of being a counsellor, a negotiator, a mediator, an interpreter, a friend, an assessor, a co-learner, enabler, a listener, a comforter, a challenger, a coach, funding and resource provider, including the responsibility of selecting examiners;*
- *To encourage a student in growing scholarly and to become independent with regards to academic writing;*
- *To assist students in monitoring and reviewing their academic writing progress;*
- *To demonstrate regular improvement with respect to the role of group supervision through personal reflective practice;*
- *To indicate continuous development regarding academic writing through practices that are reflective of students' progress; and*
- *The demonstration of group supervision success and student expectations that indicate continuous review and assessment that is evaluated right through the duration of a research project.*

These proposed supervision framework requirements focus on an approach, which identifies postgraduate engineering students as key to academic writing for a research project and the role of the supervisor's is to create a conducive research environment (funding, resources, etc.). This process rates supervisor/ student relationship as one of cognitive and personal development for both; it highlights the benefit of academic writing and is guided towards research autonomy and the development of postgraduate engineering students as scholars or emerging future researchers.

The five main approaches to supervision were identified in table 6.1 below. They intertwine in a complex manner and, although they are disentangled, they are independent of each other. The framework is integrative in that it includes organisational, sociological, philosophical, psychological and emotional dimensions. Table 6.1 describes the original framework as it has been applied to postgraduate supervision, looking at the supervisor's activities, knowledge and skills and hypothesising potential postgraduate engineering student reactions. There are several relevant areas of literature which illuminate this framework:

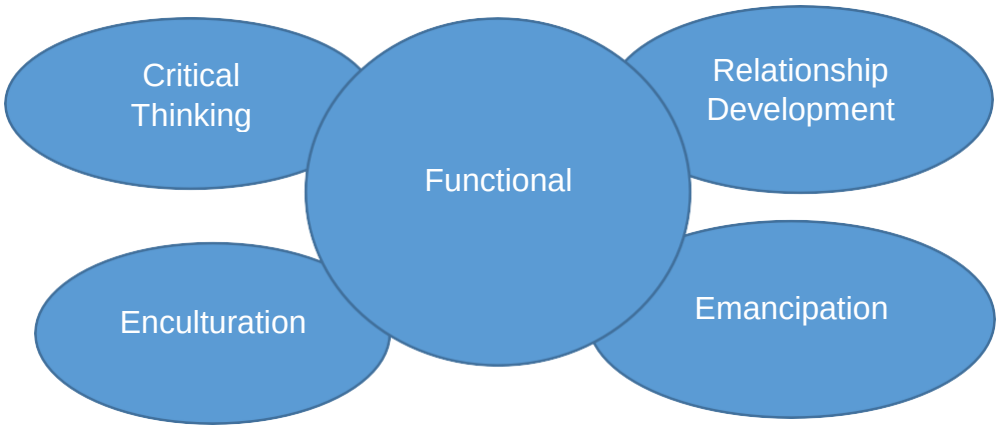

Figure 6.1 The interrelationship between different approaches in practice

	Functional	**Enculturation**	**Critical Thinking**	**Emancipation**	**Relationship Development**
Supervisor's	Rational	Gatekeeping	Evaluation,	Mentoring,	Supervising by

activity	Progression		Challenge	supporting	experience,
	through tasks			constructivism	developing a
					relationship/team
Supervisor's	Directing	Diagnosis	Argument,	Facilitation,	Integrity, managing
knowledge and	Management	Deficiencies,	analysis	reflection	Conflict
skills	Negotiation	Coaching			Intelligence
Possible student	Obedience,	Role modelling	Constant inquiry,	Personal growth,	A good team
reaction	Organised	Apprenticeship	Fight	Reframing	Emotional, intelligence

Table 6.1. Personal and professional approaches to research supervision

6.3 Conclusion

To supplement the data gathered from the supervisory framework's future postgraduate engineering students and supervisors, further guidance to design and develop a tailor-made framework for UoTs should derive from recent literature on postgraduate studies (Baker, Cluett, Ireland, Reading, Rourke, 2014:637). A mixed mode of analysis was used to explore quantitative and qualitative data gathered from the questionnaire, focus groups, interviews and expert panels. This analysis was conducted to determine the needs and experiences of supervisors and students at the institution. Descriptive statistics (frequencies, percentages, mean scores, standard deviations (SD) and range) were used to examine data collected from the academic staff and postgraduate engineering student survey developed by the researcher. This survey was based on a Likert scale and open-ended questions that measured the level of supervision experience, supervisors' need for training and resources and confidence levels in supervising postgraduate engineering students.

Strong recommendations emerged about how the framework should be implemented and how the varied groups of students enrolled in postgraduate studies and the staff supervising these postgraduate engineering students could be contacted, invited and engaged in professional learning activities. These recommendations had implications for the framework's design

The primary aim of this research was to design and develop a tailor-made postgraduate supervision framework to support postgraduate supervisors and candidates undertaking postgraduate studies in engineering at UoTs. This study has reported on the processes adopted to design and develop the framework. The construction of a framework that meets the needs of students, supervisors and the institution is critical, especially in the context of significant change in the higher education sector and the need to demonstrate the quality and impact of research. The design of the framework should best be developed in consultation with academic staff and students and international expert collaborators using a utilisation-focused evaluation (UFE) method that was developed by Patton and Horton (2008:451).

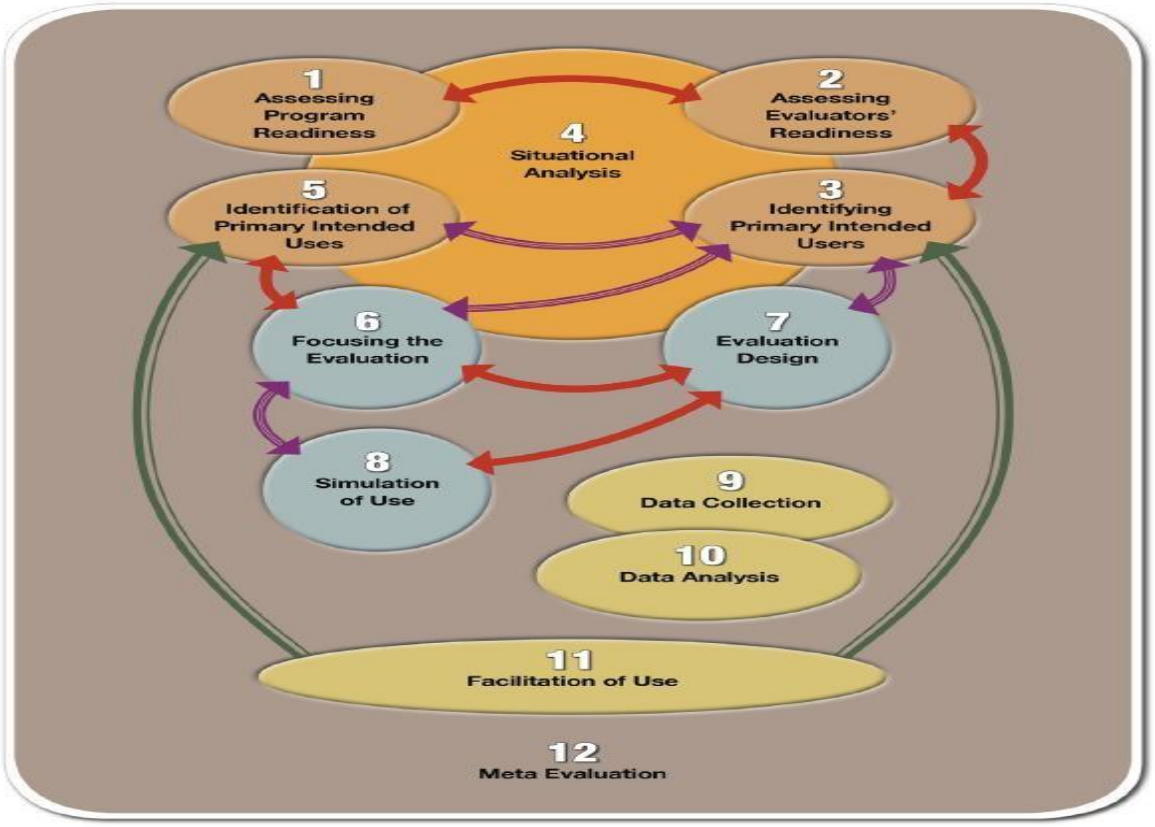

Figure 6.2. UFE Steps (Patton and Horton: 2008)

Therefore, assessment must be planned and managed in a manner that improves the

quality of investigations; the process appraises the decisions and enhances performance. UFE framework has two critical components. First, the main subjects of assessment should be clearly distinguished and be involved at an early stage of the assessment process to make certain that the intended subjects are correctly identified. Secondly, assessors should ensure that intended subjects of the evaluation by the intended users manage all findings that are reached about the assessment process. Instead of focusing on general and theoretical subjects, UFE focuses on factual and specific subjects. The assessor's task is not aimed at making decisions independently without approval of subjects, but instead to guide the decision-making process amongst those involved in the findings of the overall assessment (Patton & Horton, 2009:22). This approach facilitated the concept that supervision should be viewed as a unique pedagogy. Feedback from those involved in this research enabled the development of a framework that reflected issues that were viewed as important to its users, as well as issues that were viewed as valuable from participants who possessed wide-ranging views. While this research study concentrated on the construction of a framework to support supervisors and students, issues associated with the implementation of such a framework need to be considered to ensure the future evolution of this type of guiding resource. A key challenge for higher education institutions is to ensure that academics are supported and a culture of supervision, including supervisory skills and support systems, is developed institutionally. Similarly, the varied needs of students at different stages in their candidature also require integration into the institution's research culture. In the future, these challenges need to be balanced against academic autonomy and the issues associated with an overly prescriptive framework, including the degree to which supervisors are required to implement all elements of the framework and the degree to which their students are expected to engage in using its components, online or otherwise. A more prescriptive approach may require a regulatory arm to examine compliance. Stiff regulatory processes that focus on compliance with a framework may distract resources away from essential components of postgraduate studies.

From this research study, a number of practical recommendations were identified for consideration by others engaged in the process of developing a framework to support students engaged in higher degrees and their supervisors:

- *The use of a methodology that works collaboratively with stakeholders will increase the likelihood of a framework that is fit for purpose and accepted by user-*

stakeholders, while also incorporating views of well-respected scholars with national and international experience.

- *A framework that guides practice, but is not too prescriptive in nature, is preferable. A 'one-size-fits-all' approach is not suitable for small higher education providers or larger institutions where transdisciplinary and multidisciplinary research is undertaken.*
- *Engagement of staff in the frameworks' development is critical to its success. When developers work alongside students, supervisors and administrators, it is possible to produce a framework that is suitable for different disciplines and for transdisciplinary research.*

The outcomes of this research study have demonstrated the development of a framework that is useful for those whom it was designed. The design process was informed by clear theoretical principles and supported by a welcoming research community. The resulting framework offers a supervisor a support programme comprising a variety of resources and formal and informal processes. Further, the eclectic nature of postgraduate engineering students is taken into consideration when providing support and resources. The framework identifies UoTs as institutions that integrate the joy and excitement of research into its postgraduate programmes. To this end, the implementation of such a framework has the potential to instigate positive institutional change and to promote a research-focused culture. The method by which the research support training framework was designed and developed is offered here for consideration by other small higher education institutions that face the challenge of developing a tailored resource at an institutional level that aims to serve both postgraduate supervisors and postgraduate engineering students. This method may be considered especially relevant to institutions with candidates who enrol externally or online postgraduate programmes. This construction process, using a participatory evaluation-focused and utilisation-focused research methodology, incorporates the views of internal stakeholders as well as the more global and external views of recent researchers and experienced experts.

Taking into consideration the time and challenges of postgraduate supervision, it is expected that various problems will arise because of professional and structural factors. Structural factors include policies, rules and regulations entrenched or not entrenched for postgraduate supervision process, the way information is conveyed to

students and supervisors, the number of postgraduate engineering students that are being supervised, the supervisor's ability or inability to manage a research group effectively or not enough available support services and resources. Professional factors may include ill-prepared supervisors or a supervisor who has interests that are different from those of the student. All of these issues are related to the responsibility of the faculty.

Chapter 7: Conclusions and recommendations

7.1 Introduction

Most postgraduate supervisors and academic staff in South Africa universities utilise supervision approaches as a form of leadership in postgraduate studies. One important leadership approach in supervision that should be incorporated in the supervision process is the principles of *ubuntu*, which is a quality that embraces essential human morality, humanity and dignity, because of the nature and background of postgraduate engineering students at UoTs and this should form part of student-supervisor relationship. This is an African approach, which contemplates that a person is a person through other people and emphasises that it takes a village to raise a child, this includes characteristics such as kind-heartedness, sensitivity, sympathy, group work and helping each other.

Two main components that are critical elements in the process of postgraduate supervision, which are leading and managing a research project, by which an experience for postgraduate supervision must provide knowledge, wisdom and student success through guidance in a research project. The elements of leadership should involve safety, assurance, correct planning and organising of research management to accomplish the aims and objectives of the project.

Accordingly, postgraduate supervisors or postgraduate leadership should include consideration, expertise, order, passion, patience and support in the multiplex research demands.

Most supervisors that participated in this research study regarded themselves as leaders who guide students' research projects. Many did not see themselves as mentors but accepted that it is important to create an enabling research environment where postgraduate engineering students can develop by taking more responsibility in leading their research project.

At the current rate, South Africa might not produce the 5000-6000 doctorates required annually by 2030 in terms of the NDP. The lack of transformation is a major hindrance for the advancement of emerging researchers, especially in the faculty of engineering. The NDP states the country should produce 100 doctorates per million people in a

year. "Double the number of graduate and emerging postgraduate researchers and increase the number of African and women postgraduates, especially Ph.D.'s, to improve research and innovation capacity and make university academic staff more representative, (NDP, 2012:78).

However, a lack of funding is among the key factors keeping top academics, mostly white and male-dominated, from being recruited at UoTs in order to deal with the shortage of supervisors at these universities. The country's transformation of the academic sector has been slow, with the number of black South African researchers standing at just 1 355 out of 7 187 recorded in the last three years.

Full-time postgraduate studies require many financial sacrifices, as a result, most young graduates from previously disadvantaged background at UoTs would rather get a good paying job in industry than struggle on little or sometimes no funding that the universities provide. The NRF has also pointed out the slow transformation of the sector and believes there has been a slight increase in the amount given to postgraduate engineering students and black researchers between the years 2013 and 2016. Lack of opportunities for postgraduate engineering students in South Africa also discourage sharp minds from striving to continue with masters and doctoral studies (Luruli, 2014).

After consultation with many relevant stakeholders on the challenges and the status of postgraduate studies at two UoTs, the study makes the following recommendations with respect to the key components aimed at improving and enhancing the supervision capacity, low throughputs and research outputs at UoTs in South Africa.

7.2 Recommendation 1

According to Frisher and Larsson (2000:132), to be able to support postgraduate engineering students for timely completion of a masters and doctoral qualification, it is proposed that a framework for supporting postgraduate engineering students and supervisors should include a definite plan in academic writing that differs from university to university, faculty to faculty and from department to department and should cater for specific needs in line with postgraduate supervision practices.

The discrepancies between postgraduate engineering student and supervisor participation may be due to the institutional structure preceding the development of

supervision frameworks in the faculty of engineering. For a number of years, many academic staff had requested a more systematic approach to the support of postgraduate engineering students and a more institutional approach to the provision of professional learning opportunities for postgraduate supervisors.

The proposed supervisory framework aims to guide research and postgraduate supervision, which focuses on the strength that resides in its integrative and systemic approach with supervisor and student experience of learning at the core. The framework aims to integrate various factors that influence postgraduate engineering students experience so that they can respond to this issue in a coherent and effective approach and potentially improve postgraduate engineering student's throughput and research output rates because students are central to the postgraduate studies. To supplement the data gathered from the supervisory framework's future postgraduate engineering students and supervisors, further guidance to design and develop a tailor-made framework suitable for UoTs will derive from current investment on postgraduate studies (Baker et al. 2014).

Strong recommendations emerged about how the framework should be implemented and how the varied groups of postgraduate engineering students enrolled in masters and doctoral studies and the academic staff supervising these students could be contacted, invited and engaged in professional research learning environment. These recommendations may have implications for the framework's design.

The primary aim of this research was to design and develop an institutional supervision framework to support postgraduate supervisors and candidates undertaking a higher research degree in the faculty of engineering. This study has reported on the processes adopted to design and develop the postgraduate supervision framework. The construction of a framework that meets the needs of postgraduate engineering students, supervisors and the institution is critical, especially in the context of significant change in the higher education sector and the need to demonstrate the quality and impact of research at UoTs. The design of the framework should be implemented in consultation with academic staff and postgraduate engineering students with international expert-collaborators using a UFE method. This approach facilitates the concept that supervision should be viewed as a unique pedagogy. Feedback from those involved in this research study enabled the development of a

framework that reflected issues that were viewed as important to its users, as well as issues that were viewed as valuable from a panel of experts who possessed wide-ranging views. While this study concentrated on the construction of a supervision framework to support supervisors and students, issues associated with the implementation of such a framework need to be seriously considered to ensure the future evolution of this type of guiding resource. A key challenge for higher education institutions is to ensure that academics are supported and a culture of research, including supervisory skills and support systems, is developed institutionally. Similarly, the varied needs of students at different stages in their candidature also require integration into the institution's research culture. In the future, these challenges need to be balanced against academic autonomy and the issues associated with limitations of the framework, including the degree to which supervisors are required to implement all elements of the framework and the degree to which their students are expected to engage in using its components, online or otherwise. A more prescriptive approach may require a regulatory arm to examine compliance. Rigid regulatory processes that focus on compliance with a supervision framework may divert resources away from essential components of postgraduate studies. From this research study, a number of practical recommendations were identified for consideration by others engaged in the process of developing a framework to support postgraduate engineering students engaged in postgraduate studies and their supervisors:

- *The use of a methodology that works collaboratively with stakeholders will increase the likelihood of a supervision framework that is fit for purpose and accepted by user-stakeholders, while also incorporating views of well-respected scholars with national and international experience;*
- *A framework that guides practice, but is not too prescriptive in nature, is preferable. A "one size fits all" approach is not suitable for postgraduate engineering students at UoTs; and*
- *Engagement of academic staff in the supervision frameworks' development is critical to its success. When developers work alongside students, supervisors and relevant stakeholders, it is possible to produce a framework that is suitable for different disciplines and for transdisciplinary research.*

The outcomes of this research study have demonstrated the development of a supervision framework that could be useful for those whom it is designed for. The design process was informed by clear theoretical principles and supported by a postgraduate engineering students and supervisors. The resulting framework offers a supervisor support programme comprising a variety of resources, formal and informal processes. Further, the eclectic nature of postgraduate engineering students is taken into consideration when providing support and resources. The framework should identify UoTs as institutions that integrates the desire and excitement of research into its postgraduate programmes. The implementation of such a framework has the potential to instigate positive institutional change and to promote a research-focused culture. The method by which the Research Support Training Framework was designed and developed is offered here for consideration by other small higher-education institutions that face the challenge of developing a tailored resource at an institutional level that aims to serve both postgraduate supervisors and postgraduate engineering students. This method may be considered especially relevant to institutions with candidates who enrol for technical programmes. This construction process, using a participatory evaluation-focused and utilisation-focused research methodology, incorporates the views of all relevant stakeholders.

7.3 Recommendation 2

Postgraduate supervision relationship between the student and a supervisor is considered as the main critical element for successful completion of a research project. A successful supervisor-student relationship is mainly related to high graduate completion rate and that is completed in time.

Critical elements of successful postgraduate supervision are:

- Comprehensive and regular communication;
- Consensus on agreed expectations; and
- Mentoring and coaching that is adjusted to meet the needs, attributes and expectations of student-supervisor and research project demands.

These features should be entrenched as early as the beginning of student registration and be continuously monitored and evaluated for the duration of the study. Clear and accessible communication regarding expectations and responsibilities is vital between postgraduate engineering students and supervisors that incorporate cultural differences with shared responsibilities.

As to a smooth transition to the postgraduate life, supervisors should start thinking about providing the same kind of positive reinforcement that every student is used to experience in the undergraduate course. The recognition for a job well done will mean a lot for a postgraduate engineering student. Supervisors should organize regular meetings for (and with) postgraduate engineering students in order to not only discuss their projects but also improve their coping skills, including critical thinking and problem-solving methods. The act of sharing knowledge and experiences can motivate the students to persevere in their studies.

When needed, supervisors should use their power of influence to increase the time that the student has available to devote to research while maintaining a part of their employment activities, since many postgraduate engineering students at UoTs are also full-time working.

Recommendations include supervision training for inexperienced supervisors, continuing training/education for more experienced supervisors and that on an annual basis funds be made available by the faculty of engineering for such training of academic staff.

- *Supervisor should have complete knowledge in the domain that the student is interested;*
- *Supervisor must be interested to supervise the student and should have sufficient time at her/his disposal;*
- *Support the student through all stages of research project both technically as well as personally. Many times postgraduate engineering students get disheartened because of the work not going as planned when they need moral support;*
- *Allow the student to take independent decisions about the research and then critique their work so that the student can become a better independent researcher;*

- *Most supervisors have already published sufficiently good quality papers in the area of interest and peripheral areas and this should translate to postgraduate engineering student research project;*
- *Supervisor must be fair, ethical and considerate towards postgraduate engineering students; and*
- *Supervisor should be established in the specific area and has many projects either completed or ongoing so that he/she can support postgraduate engineering student.*

The researcher would like to add that a good guide should include and understand the cultural differences and act accordingly. Advice on time management can seem like stating the obvious. However, as a postgraduate engineering student they are likely to be juggling a busy life with their university commitments and other responsibilities. Even if students have studied at undergraduate level, they may find that postgraduate studies bring new challenges of self-motivation and self-discipline, as they are required to work more independently. Time management provides some advice and strategies for self-organisation, prioritising tasks, planning student time and dealing with distractions.

7.4 Recommendation 3

Many UoTs are faced with substantial growth in the numbers of postgraduate engineering student enrolments from South Africa and mainly neighbouring countries. This growth and student diversification brings about many challenges in ensuring postgraduate engineering students' successful and timely completion. What the student wants to receive by way of feedback may sometimes differ from what the supervisor provides, thereby creating potential tensions in the supervisor-student relationship and impair its effectiveness.

According to Lantolf (2000), a critical element in "becoming independent" is constructive feedback. According to Hattie and Timperley (2007:81), it is important to sustain feedback that signifies positive influence on the research project and has influential capacity to improve the research study. Effective reporting on students' progress is a key element of quality supervision (Ramsden, 2003) and supervisors' constructive and fair feedback on student's work is regarded as a key attribute of a

good supervisor (Engebretson, Smith, McLaughlin, Seibold, Teret, & Ryan, 2008:1). Constructive feedback plays a critical role in the gradual acquisition of the research skills, characteristics and norms of a postgraduate engineering student. According to Kumar and Stracke (2007:462), it is through recorded feedback that a supervisor should communicate and gives improved academic exercise, especially in writing, to the student. The main significance of feedback to student academic writing is entrenched in the literature (Hyland & Tse 2004:156). Subsequent to that, feedback is rooted firmly and deeply within a mutually beneficial relationship, which should justify research success in the long run. Positive feedback is critical to the subsequent development of postgraduate engineering student research and independence towards achieving the research goals and objectives. Nevertheless, differences in interpretations on what constitutes effective feedback and effective student-supervisor relationship might represent serious challenges for both the students and the supervisors. These contrasts may eventually lead to tension in the supervisor-student relationship and have a negative impact on student progress.

In the relationship between a student and the supervisor, the benefit of feedback might be influenced by various expectations from both parties. Through feedback, the supervisor suggests and advises the student to read more literature to support his or her arguments (Grant, 2005:76). Nonetheless, the advice or suggestions sometimes are not clearly interpreted by the student and at times are likely to give confusing signals. According to Li & Seale, (2007:514), communication can be blocked by the differences in language and culture between the supervisor and postgraduate engineering student regarding the pressure of postgraduate studies and might obstruct effective communication between students who are from different cultural backgrounds, particularly international students. As a result, weak communication may contribute to the conflict in student-supervisor relationship (Delamont, Atkinson, & Parry, 2000). It is important that the supervisor-student relationship is well maintained and that feedback is effective, with consideration for understanding the student's different cultural backgrounds. According to Li and Seale (2007:514), where differences exist in the student-supervisor relationship, often there is a favourable tendency towards the language and culture of a supervisor. It is therefore noteworthy to take students' points of view into consideration to determine what works best for both parties.

7.5 Recommendation 4

There is a need to increase the numbers of qualified supervisors and academic writing for postgraduate engineering students at UoTs in the faculty of engineering through internal programmes, for which there is an effective point of reference about South African higher education history.

Available HEMIS information demonstrates clearly that the generation of academics and postgraduate engineering students in the faculty of engineering at UoTs is and has stayed stable for quite a long time. It is similarly obvious that working just inside existing frameworks and considering accessible limits at various UoTs, there is no chance that a quick development in this abnormal research environment at the level of the supervisors and postgraduate engineering students will emerge within a reasonable period in line with South African NDP 2030 doctoral production goal. Undeniably, limitations on postgraduate creation lie profoundly inside the undergraduate programmes, where just a little number of graduates meets all requirements for postgraduate studies at UoTs. Along these lines, from when students begin with their undergraduate studies, the area of accessible students from whom postgraduate passages should be created, is to a greater degree restricted at many UoTs since most undergraduate programmes do not teach research methodology extensively at a B-Tech level.

Mentoring can help facilitate the transition from undergraduate to graduate school. Unlike undergraduate programmes, where classes encourage students to obtain information, in postgraduate studies, the goal should also be to contribute knowledge to the field of study. Although postgraduate programmes often emphasise the mentoring role of an advisor, it should not limit students to one supervisor as a sole mentor.

Nevertheless, issues additionally occupy the structure of undergraduate programmes at UoTS and they outline undergraduate programmes, with high dropout and unemployment rates guaranteeing a little success on postgraduate studies. Postgraduate qualifications, thus, provide options for the individuals who do not plan to or do not have sufficient energy or ability to finish the B-Tech qualification. This implies that the number of qualifying postgraduate engineering students for potential masters and doctoral studies stays small. In addition, the issue of supervision capacity

remains a huge challenge for increasing postgraduate throughputs at masters and doctoral level. There are just not enough postgraduate supervisors at UoTs to accommodate the increasing enrolment number of postgraduate engineering students. This implies any endeavour to build the capacity with expert supervisors and postgraduate engineering students in the faculty of engineering will have to occur outside the boundaries of these universities, such as industry. For example, the traditional triple helix, which is predominantly academics and innovation consultants, specialising in innovation systems, knowledge transfer, university-industry collaboration, science parks and incubators should be explored.

Industry and private organisations could have some effect, however, reluctant of transformation, some industries and business organisations need fully fledged specific postgraduate programmes in partnership with UoTs for preparation that focuses on increasing the number of specific skilled graduates. Since UoTs grant qualifications, the onus will stay on these institutions to lead the generation of young emerging academics.

Fortunately, there is a point of reference for focussing on postgraduate engineering students with huge external financing for increasing the number of supervisors and postgraduate engineering students at UoTs. The infusion of an expansive number of remotely prepared masters and doctoral students over specific faculty disciplinary fields throughout the decade could affect the South African supervision framework in various ways. To begin with, it will address the critical deficiency that has developed in various key scholarly regions, for example, science, technology and engineering at UoTs. Secondly, it will infuse tremendous scholarly differences not only business needs, perhaps infuse creativity into innovations. Thirdly, it will assemble new, dynamic and natural scaffolds between the traditional supervision framework and others over the world. Fourthly, it will bring into the local framework new societies of and ways to deal with postgraduate supervision. Fifthly, within the next decade, this could reshape the issue of supervisory limit.

It will take authority by the South African government and its departments, for example, DST and DHET, working with the NRF, MRC, ARC and others, to re-build a comparative programme focusing on innovation and technology postgraduate engineering students at UoTs. In the meantime, it ought to be conceivable to grow, to

some degree, the smaller projects for global position of postgraduate engineering students, for example, the Fulbright Program, the Nelson Mandela/ Rhodes Scholarship and Harvard South Africa Programme. In any case, these activities were not intended for huge admissions of postgraduate engineering students. In an asset-compelled environment like UoTs, the relationship between some of these proposals should be precisely looked at.

7.6 Recommendation 5

There is a need to extend essentially the levels of availing funds for supervisors and postgraduate engineering students at UoTs, with specific attention on moving the adjustment of postgraduate engineering students towards full-time enrolment since most part-time students are employed and they have little or limited time to focus on their studies and complete their research project in time.

The information underlines the way that South Africa has a more diverse postgraduate populace than most nations, particularly in the science and technology fields. This implies students come into postgraduate studies at a phase in the life cycle when there are families to look after. For such student to concentrate on the somewhat restricted bursary reserves accessible from the primary wellspring of financing (the NRF) implies genuine hardships must be confronted and decisions made. Students who can concentrate full-time on their research projects are probably going to complete more quickly than those that are studying part-time. Such students can go to workshops, deliver papers, commit to research assignments, work with their supervisors and promoters and go to research symposiums more often than part-time students who are working. The ideal situation, accordingly, is to have even more full-time supervisors and postgraduate engineering students to improve throughputs and research outputs at UoTs, which will indirectly increase the capacity of supervisors.

For this to happen, funding organisations, such as the NRF have decisions to make; to utilise the constrained subsidising accessible to bolster more students with insufficient funding or allocate financing in ways that discourage part-time student enrolment yet support full-time students more. The main other choices, obviously, is for government to increment fundamentally the grant financing accessible to the NRF and different departments, through the parliamentary concede. Whatever the system for sourcing reserves that empower full-time students through liberal supervisors and

doctoral awards, plainly drawing in and having bigger quantities of supervisors and doctoral students at UoTs is just unrealistic without exceptionally huge increments in resource investment and staff development for subsidising accessible cutting-edge research.

There are some innovative research projects in progress at some UoTs. These UoTs offer bursaries in excess of R200 000 per annum to postgraduate engineering students; others go up against the most prominent postgraduate engineering students as junior lectures, even though in such cases there are administrative pressures between paying students and paying employees.

Giving grants to different types of enrolment (i.e. full time and low maintenance amid various periods inside the course of postgraduate studies) could likewise be compelling. This study suggests that major and new renegotiating models for postgraduate studies at UoTs be planned if the undertaking of expanding the number and nature of senior academic staff is to end up a reality.

7.7 Recommendation 6

Make an all-encompassing and interconnected UoTs vital arrangement for managing the high-level production of research projects, for example, technology and innovation unit for postgraduate studies, with the goal that all parts of the university research structures and supervision frameworks work in the same direction.

It is clear from the proof accessible to the study that there is an exceptionally constrained feeling of intelligibility as far as postgraduate research at UoTs. There is no feeling of a rational methodology that incorporates the key postgraduate units like DST and NRF with Academic Writing Centre.

The new National Planning Commission responsible for strategic planning of the country in line with 2030 NDP seems, by all accounts, to be a better vehicle for uniting such variation components of planning to propel the pool of masters and doctoral student’s throughputs necessary for national monetary and social development.

7.8 Recommendation 7

UoTs need to address the pipeline issues of B-Tech students as an issue of direness, for in the long run, it will not be conceivable to maintain large numbers of supervision and postgraduate engineering student participation into research methodology

knowledge preparations without a sharp increment in the quantities of students coming from undergraduate instruction, early postgraduate training and in the end into Ph.D. programmes.

At the end of the day, a fractured and unique arrangement of activities for human capital advancement at a level of doctoral could mutedly affect the recommendations proposed by this research study.

7.9 Recommendation 8

UoTs need to promote open support for and understanding about their postgraduate programmes so that there is more noteworthy mindfulness and acknowledgment of its importance in research and funding advancement for the effective quality supervision. Building up this mutual importance about the estimation of the postgraduate studies is key for gathering open support for South African postgraduate engineering students to obtain their doctoral degrees somewhat early in their careers. The data demonstrates that the choice to enrol for doctoral qualification is not a long-haul aspiration but rather something that comes, for most, in their mid-careers.

It is likewise genuine that most postgraduate engineering students in the faculty of engineering think about the degree in self-awareness terms, or more for a specific occupation in industry. There is no convention of thinking outside the significant strategy, for example, DST or the NRF that connects the fulfilment of the doctorate to NDP 2030 demands.

It is the perspective of the researcher that with a specific end goal to construct a more extensive consciousness of the significance of the postgraduate engineering student's supervision capacity at UoTs in national improvement terms, a purposeful and centred exertion ought to be made as a major aspect of open comprehension in science and technology. These UoTs themselves ought to start showcasing research and doctoral capabilities among their senior academic staff through publications and surely by increased postgraduate throughputs.

7.10 Recommendation 9

It is important to target foundations with existing limit and built up track records for scaling up the generation of young academics for supervision and doctoral projects that are financed inside UoTs that aimed at developing supervision capability.

Political contemplations could be an extra obstruction to postgraduate throughputs at UoTs. Generally, governments internationally settle on choices in view of political legacy variables and South Africa is no special case. Nevertheless, when such choices act to disadvantage postgraduate studies, for example, supervisors and qualified academic staff, then the political activities ought to be considered as a critical. What does this mean? South Africa is hesitant to make a refinement among universities on the premise of their racial legacies. Along these lines, for instance, all UoTs can, in principle, offer Ph.D.'s. One methodology could be to take after models, for example, in the California advanced education framework, where there are devoted doctorate-allowing universities since a large portion of UoTs focus on technology and innovation. This may be a bitter pill to swallow in the South African context, since the top six leading Ph.D. granting universities, are previously white universities. Another method for managing this is to perceive that these universities are creating expanding quantities of black doctoral graduates and ventures must be coordinated where the limitations such as infrastructure and equipment's occurs.

7.11 Recommendation 10

UoTs ought to reinforce and expand the relationship among themselves, government and industry and additionally technology institutions, so that bigger quantities of postgraduate engineering students at these universities are prepared and bolstered through teaching, learning and research. It is important that current cooperative energies amongst university and industry be altogether improved to expand quality and quantity in postgraduate research at UoTs.

There are effective cases of existing coordinated efforts, for example, the model of the Medical Research Council (MRC) in the sciences, or the extreme in service preparing backing of African (now Aurecon) in designing, or the high assimilation rates of postgraduate studies in science at SASOL where for example, Vaal University of Technology graduates can profit. The researcher has likewise found that these current connections could be fortified through more successful utilisation of university-based managers preparing and industry-based coaches in preparing postgraduate studies. Another imperative region for cooperation is between the UoTs and the human science gatherings, for example, the Human Sciences Research Council (HSRC). As of late, driving social researchers have floated towards the HSRC, leaving institutions with

little number of senior and experienced academic staff to prepare and administer expert supervision and doctoral instruction. Instead of moaning about lack of experienced academic staff, another approach is structure entry-level positions for postgraduate studies such as HSRC, which, for instance, permits students to profit by joint supervision and in the meantime generating funds for their research projects. While universities are the main degree-offering establishments, there is no reason that assistant educators from industry, for instance, cannot be employed to the faculties.

7.13 Conclusion

As urgent measures in dealing with postgraduate engineering student challenges, the two UoTs should consider the following:

- Organising a separate academic writing centre for postgraduate engineering students that is open all year and that is open to B-Tech students.
- Many postgraduates are adults with families and children, their residences should be separate from undergraduate students where there can be arrangements for family visitations.

- During university holidays, some postgraduates are continuing with their research projects, therefore, with special permission, residences should be open during this time for students who wishes to continue with their research.

7.14 Funding

- Review the process of claiming student and supervisor funds. Sometimes it takes too long for some students to get their research funds in their accounts. There is a need for clear governing policy for a turnaround time regarding claims (e.g. 4 to 7 days); and
- Review postgraduate funding. Expenses go high from the time. It is not enough to assist full-time students with just accommodation or living expenses.

7.15 Supervision

- Students need a clear adopted policy stating the rights and responsibilities of the supervisors together with students. The policy must also have a monitoring system, which is able to track meeting times/consultations of supervisors and

students. Developmental training is needed for supervisors and a platform whereby they can network and discuss their different experiences within supervision process;

- Students often complain that some supervisors take too long (2 to 3 months) to give feedback and measures should be taken for late feedback; and
- Students should not stay for more than 3 months without a supervisor.

7.16 Registration

- Conduct introductory workshop for new postgraduate engineering students, which contains registration process, introduction of policies, funding application timelines, proposal approvals and so on.
- Review part-time, full-time registration and proposal approval duration.

7.17 Library

- Some students do not have laptops/computers at home therefore they do research and typing work with computers in the library. Capacity is an issue as there are few computers in the library. Preferably, also laptops can be bought to be borrowed to postgraduate engineering students like books, so they can use other spaces within the library. Alternatively, a sponsorship for tablets or laptops for postgraduate's students is needed.

7.18 Overall study limitations

This study had several limitations; extensive data gathering from other UoTs may be needed for a more thorough investigation and analysis as well as for improved verification of the results. Since participation was voluntary, participants had to be continuously reminded to complete questionnaires and some since they are working did not have time to complete by the due date. High response rates could have provided a more comprehensive data analysis; however, the researcher still received a more detailed picture as to how respondents view postgraduate supervision and challenges associated with postgraduate studies at UoTs in the faculty of engineering. It could be argued that the study has limited generalisation, the researcher is

convinced that the study managed to provide adequate guidelines applicable to postgraduate supervision.

Although a sufficient participation and response rate was obtained, the study had to accept the response rate due to rules laid down by the participating UoTs. Due to deadlines, higher response rate could have been achieved and would have provided or influenced the results of the questionnaire; however, the researcher still received a detailed picture as to how respondents view postgraduate research supervision within their own institutions. Although it could be argued that the study has limited generalisation since there were only two UoTs that participated, the researcher is convinced that the study has provided adequate guidelines applicable to other research units in higher education institutions in South Africa, especially within a young research environment at UoTs.

References

Abdelhafez, A. M. M. 2007. Postgraduate students' knowledge & attitudes towards good supervisory practice at Exeter University. Exeter, UK: Exeter University.

Abiddin, N. Z. Hassan, A. & Ahmad, A. R. 2009. Research Student Supervision: An Approach to Good Supervisory Practice. The Open Education Journal, 2, 11-16.

Abiddin, N. Z. Ismail, A. & Ismail, A. 2011. Effective supervisory approach in enhancing postgraduate research studies. International Journal of Humanities and Social Science, 1(2), 206–217.

Acker, S. Hill, T. & Black, E. 1994. Thesis Supervision in the Social Sciences: Managed or Negotiated? Higher Education, 28(4), 483-98.

Adair, J. 2009a. How to grow leaders: The seven key principles of effective leadership development. London: Kogan Page.

Adair, J. 2009b. The Inspirational leader: How to motivate, encourage and achieve success. London: Kogan Page.

Aitchison, C. & Lee, A. 2006. Research writing: problems and pedagogies Teaching in Higher Education, 11(3), 265-278.

Aitchison, C. Catterall, J. Ross, P. & Burgin, S. 2012. 'Tough love and tears': learning doctoral writing in the sciences, *Higher Education Research & Development,* 31 (4), 435-447.

Albertyn, R.M. Kapp, C.A & Bitzer, E.M. 2008. Profiling exiting postgraduate students' performance and experiences. South African Journal of Higher Education, 22(4):749-772.

Amacher, R. E. 1962. Benjamin Franklin. New York: Twayne.

Amos, T.L. Ristow, A. Ristow, L. & Pearse, N.J. 2011. Human resource management. 3rd Edition. Cape Town: Juta.

Anderson, G. 1990. Fundamentals of Educational Research. London: Falmer.

Anderson, C. Day, K. & McLaughlin, P. 2006: Mastering the dissertation: lecturers' representations of the purposes and processes of Master's level dissertation supervision, Studies in Higher Education, 31 (2), 149-168.

Andrew M 2012. Supervising doctorates at a distance: Three trans-Tasman stories. Quality Assurance in Education, 20(1):42–53.

Altbach, P.G. 2013. Global Perspectives on Higher Education: The International Imperative in Higher Education. Center for International Higher Education, Boston College, USA. SENSE PUBLISHERS.

Archer M. 1995. Realist social theory: the morphogenetic approach. Cambridge: Cambridge University Press.

Archer, M. 2000. Being Human: The Problem of Agency. Cambridge, UK: Cambridge University Press.

Archer, M. 2003. Structure, Agency and the Internal Conversation. Cambridge, UK: Cambridge University Press.

Archer, A. 2010b. Challenges and potentials of writing centres in South African tertiary institutions. South African Journal of Higher Education, 24(4) 495–510.

Archer, S. 2017. The function of a university in South Africa: Part 1. South African Journal of Science, (5/6) 113.

Armstrong, S.J. 2004. The impact of supervisors" cognitive styles on the quality of research supervision in management education. British Journal of Educational Psychology, 74(4):599–618.

Ashwin, P. 2009 The Routledge International Handbook of Higher Education. Tight, M. Mok, K. H. Huisman, J. & Morphew, C. (eds.). New York and London: Routledge, 37-46 10.

ASSAf (Academy of Science of South Africa). 2010. Consensus Report: The Ph.D. study – An evidence-based study on how to meet the demands for high-level skills in an emerging economy. Pretoria: ASSAf.

Babbie, E. & Mouton, J. 2008. The practice of social research. 8th ed. Cape Town: Oxford University Press.

Badat, S. 2009. Theorising institutional change: post-1994 South African higher education. Studies in Higher Education. 34(4),455-467.

Badat, S. 2010. Global Rankings of Universities: A Perverse and Present Burden. Rhodes University, South Africa.

Baker, F. A. & MacDonald, R. A. R. 2013a. Flow, identity, achievement, satisfaction and ownership during therapeutic songwriting experiences with university students and retirees. Musicae Scientiae, 17(2), 131–146.

Baker, V.L. Pifer, M.J. Lunsford, L.G. Greer, J. Ihas, D. 2015. Faculty as mentors in undergraduate research, scholarship, and creative work: motivating and inhibiting factors. Mentor Tutor, (23) 394–410.

Baker, M.J. Cluett, E. Ireland, L. Reading, S. & Rourke, S. 2014. "Supervising undergraduate research: A collective approach utilising groupwork and peer support." Nurse Education Today, (4), 637-642.

Benshoff, J.M. Cashwell, C.S. & Rowell, P.C. 2015. ‘Graduate students on campus: Needs and implications for college counselors’, Journal of College Counselling (18), 83–94.

Berdahl, R.M. 2008. Developed Universities and the Developing World: Opportunities and Obligations in Weber, L.E. and Duderstadt, J.J. (ed.) The Globalization of Higher Education. London: Economica Ltd.

Bergh, Z.C. & Theron, A.L. 2008. Psychology in the work context. Oxford: Oxford University Press.

Best, J.W. & Kahn, J. 2006. Research in Education: New Delhi: Prentice Hall of. India Pvt. Ltd.

Biesta, G. J. J. 2010. Good Education in an Age of Measurement. Paradigm Publishers.

Bhaskar, R. A. 2013. Realist theory of science. London: Routledge.

Billot, J. 2010. The changing research context: implications for leadership. Journal of Higher Education Policy and Management, (1), 37-46.

Bitzer, E. 2010. Postgraduate research supervision: More at stake than research training. Acta Academica Supplementum, (1), 23–56.

Bitzer, E.M. 2011. Doctoral success as on-going quality business: a possible conceptual framework. South African Journal of Higher Education, (3) 425–443.

Bless, C. Higson-Smith, C. Kagee, A. 2007. Fundamentals of Social Research Methods: An African Perspective.

Blunt, R.J.S. 2005. Challenges for the curriculum of a comprehensive university: A critical case study. South African Journal of Higher Education, 19(6):1021- 1032.

Bothwell, E. 2017. The World's Most International Universities 2017. Gene Editing. University of the Witwatersrand.

Bourke, S. Holbrook, A. Lovat, T. & Farley, P. 2004. Attrition, Completion and Completion Times of PhD Candidates. In Proceedings of the Australian Association for Research in Education Annual Conference, 28. Adelaide, South Australia.

Bowen, G. & Rudenstine, N. L. 1992. In search of the PhD. Princeton: Princeton University Press.

Brewster, C. Carey, L. Grobler, P. Holland, P. & Wärnich, S. 2011. Contemporary issues in human resource management gaining a competitive advantage. 3rd Edition. Cape Town: Oxford University Press Southern Africa.

Brown, G. & Atkins, M. 1986. Academic Staff Training in British Universities: Results of a National Survey. Studies in Higher Education, (1) 29-42.

Bruce, C. & Stoodley. I. 2009. Towards a pedagogy of supervision in the technology disciplines: Project plan and conceptual model. Queensland University of Technology ALTC Fellowship 2008.

Brysman, H. & Burgess, R. 1999. Qualitative Research Methodology. A review. London: Routledge.

Bunting, I. 2002. The higher education landscape under apartheid. In N Cloete, R Fehnel, P Maassen, T Moja, H Perold & T Gibbon (eds). Transformation in Higher Education: Global Pressures and Local Realities in South Africa. Lansdowne: Chet/Juta.

Bunting, C. J. 2006. Interdisciplinary teaching through outdoor education. Champaign, IL: Human Kinetics.

Bunting, I. Cloete, N. & Van Schalkwyk, F. 2014. An Empirical Overview of Eight Flagship Universities in Africa: 2001–2011. A report of the Higher Education Research and Advocacy Network in Africa (HERANA). Cape Town: Centre for Higher Education Transformation.

Burns, N. & Grove, S.K. 2003. 3rd ed. Understanding Nursing Research. Philadelphia: Saunders.

Burton, S. 2011. The need for a constructivist approach in supervising counselling students: The intersection of life experience and counsellor development.

Bush, T. 2008. Leadership and management development in education. London: Sage.

Buttery, E.A. Richter, E.M. & Filho, W.L. 2005. An overview of the elements that influence efficiency in postgraduate supervisory practice arrangements. *International Journal of Education Management,* 19(1) 7–26.

Caffarella, R. Barnett, B. 2000. Teaching doctoral students to become scholarly writers: The importance of giving and receiving critiques. Studies in Higher Education, 25(1), 39-52.

Canfield, P. 2005. Developing leadership skills in the research student experience. (22) 29–33.

Carton, J. & Kelly, A. 2014. Lessons learned from a multi-institutional collaboration to develop a national framework for research supervisor support and development. Paper presented at the Quality in Postgraduate Research.

Castro, F.G. Kellison, J.G. Boyd, S.J. & Kopak, A. 2010. A methodology for conducting integrative mixed methods research and data analyses. Journal of Mixed Methods Research, (4) 342–360.

Council on Higher Education (CHE). 2009. The CHE Higher Education Monitor: Postgraduate studies in South Africa: A statistical profile. Pretoria: CHE.

Centre for Research on Science and Technology, University of Stellenbosch. 2009. Destination study: a survey of doctoral graduates across a sample of fields and

institutions. Commissioned paper for the ASSAf Consensus Study on Ph.D. production. Unpublished.

Centre for Research on Science and Technology, University of Stellenbosch. 2009. Doctoral attrition study. Commissioned paper for the ASSAf Consensus Study on Ph.D. production. Unpublished.

Centre for Research on Science and Technology, University of Stellenbosch. 2009. Doctoral students in South Africa: A statistical profile. Commissioned paper for the ASSAf Consensus Study on Ph.D. production. Unpublished.

Centre for Research on Science and Technology, University of Stellenbosch. 2009. Employer study report. Commissioned paper for the ASSAf Consensus Study on Ph.D. production. Unpublished.

Charmaz, K. & Mitchell, R. G. 1996. The myth of silent authorship: Self substance and style ethnographic writing. Symbolic Interaction, 19(4), 285-302.

Chikte, U. M. E. & Chabilall, J. A. 2016. Exploration of Supervisor and Student Experiences during Master's Studies in a Health Science Faculty. South African Journal of Higher Education, (30) 57-79.

Chisholm, L. 2004. Changing Class: Education and Social Change in Post-Apartheid South Africa. Cape Town: HSRC.

Clark, B. 1998. Creating Entrepreneurial Universities: Organizational Pathways of Transformation. New York: lAU Press.

Clarke, J. & Newman, J. 1997a. The Managerial State: power, politics and ideology in the remaking of social welfare. London: Sage

Cloete, N. Fehnel, R. Maassen, P.A. M. Moja, I. A. Perold, H. & Gibbon, T. 2002. Transformation in Higher Education. Global Pressures and Local Realities in South Africa. Lansdowne: Juta and Company (Pty) Ltd.

Cloete, N. & Maassen, P. 2006. Chapter 1: Global Reforms Trends in Higher Education. In Cloete et al. (eds.) Transformation in Higher Education: Global Pressures and Local Realities. The Netherlands: Springer Press. 7-31.

Cloete, N. & Bunting, I. 2013. Strengthening Knowledge Production: Five South African Studies. OECD.

Cloete, N., Mouton, J. & Sheppard, C. 2015. Doctoral Education in South Africa: Policy Discourse and Data. Cape Town: African Minds.

Colbran, S. 2004. Collaborative supervision of legal doctoral theses through e-learning. University of New England Law Journal, 1-20.

Colwell, J. L. 2012. Looking Ahead: Some Trends in Graduate Education and Their Impact on Engineering and Technology Paper presented at 2012 ASEE Annual Conference & Exposition, San Antonio, Texas.

Colwell, J. L. Whittington, J. & Jenks, C. F. 2011. Writing Challenges for Graduate Students in Engineering and Technology Paper presented at 2011 ASEE Annual Conference & Exposition, Vancouver, BC.

Comley-White N, & Potterton, J. 2018 The perceived barriers and facilitators in completing a Master's degree in Physiotherapy. South African Journal of Physiotherapy, (1) 430.

Connell, R. W. 1985. How to Supervise a Ph.D. Vestes, (2), 38-42.

Constitution of the Republic of South Africa Amendment Act, No. 35 of 1996.

Cooper, D.R. & Schindler, P.S. 2011. Business research methods. (11th ed.). New York.

Cooperrider, D.L. & Srivastva, S. 2001. “Appreciative inquiry in organizational life”, in Cooperrider, D.L., Sorensen, P.F., Yeager, T.F. & Whitney, D. (Eds), *Appreciative Inquiry: An Emerging Direction for Organizational Development*, Stipes Publishing, Champaign.

Council on Higher Education. 2000. Towards a new higher education landscape: meeting the equity, quality and social development. imperatives of South Africa in the 21st century. Council on Higher Education, Pretoria.

Council on Higher Education. 2004. South African Higher Education in ten years of democracy. Pretoria: Council on Higher Education.

Council on Higher Education. 2016. South African Higher Education Reviewed: Two Decades of Democracy. Pretoria: Council on Higher Education.

Cranfield, D. & Taylor, J. 2007. "Knowledge Management Practices within Higher Education Institutions in the UK". KMPro, (2) 6-15.

Cranfield, D. & Taylor, P. 2008. Knowledge Management and Higher Education: A UK Case Study. The Electronic Journal of Knowledge Management, (2) 86-100.

Creswell, J. W. 1998. Qualitative inquiry and research design: Choosing among five traditions. Thousand Oaks, CA, US: Sage Publications, Inc.

Creswell, J.W. & Plano-Clark, V.L. 2007. Designing and conducting mixed methods research. Sage, Thousand Oaks, CA.

Creswell, J.W. & Plano Clark, V.L. 2011. Designing and conducting mixed methods research (2nd ed.). Thousand Oaks, CA: Sage.

Christiansen, I.M. & Baijnath, N. 2007. Perceptions of the `university of technology' notion amongst HE institution managers. South African Journal of Higher Education, (2) 217-227.

Cross, M. & Backhouse, J. 2014. Higher Education Policy. Evaluating Doctoral Programmes in Africa: Context and Practice, (27) 155– 174.

Cryer, P. 1997. Helping students to identify and capitalise on the skills which they develop naturally in the process of their research development programs. In P. Cryer (Ed.), Developing postgraduate key skills: Issues in postgraduate supervision, teaching and management: A series of consultative guides, (3) 10-13. London: Society for Research in Higher Education.

Cullen, D. Pearson, M. Saha, L. J. & Spear, R. H. 1994. Establishing effective PhD supervision. Canberra: AGPS.

Cyranoski, D. Gilbert, N. Ledford, H. Nayar, A. & Yahia, M. 2011 Education: The Ph.D. factory. The world is producing more Ph.D.'s that ever before. Is it time to stop? Nature (472) 276–279.

De Beer, A. & Rossouw, D. 2012. Focus on management principles: A generic approach. 2nd Edition. Cape Town: Juta.

De Lange, N. Pillay, G. & Chikoko, V. 2011. Doctoral learning: A case for a cohort model of supervision and support. South African Journal of Education, (31) 15–30.

Delamont, S. Atkinson, P. & Parry, O. 1997. Critical Mass and Doctoral Research: Reflections on the Harris Report. Studies in Higher Education, (3) 319-31.

Delamont, S. Atkinson, P. A. & Parry, O. 2000. The doctoral experience: Success and failure in graduate school. Falmer Press, London.

Delport, C.S.L. 2002. Quantitative data collection methods. In: De Vos, A.S., Strydom, H., Fouche, C.B. & Delport, C.S.L. 2002. (eds). Research at grass roots. (2nd ed). Pretoria: Van Schaik, 165-177.

Denecke, D. D. 2006. Foreword. In Maki, P. L. & Borkowski, N. A. (eds.), The Assessment of Doctoral Education. Virginia: Stylus Publishing: xi-xii.

Denscombe, M. 2007. The Good Research Guide: for small-scale social research projects (3rd edition) Maidenhead: Open University Press

Denzin, N. K. & Lincoln, Y. S. 2003. Collecting and interpreting qualitative materials (2nd edition). Thousand Oaks, CA: Sage.

Department of Education, 2001. National plan for higher education. Department of Education, Pretoria.

Department of Education. 2002. The Restructuring of the Higher Education System in South Africa. Report of the National Working Group, 31 January.

Department of Education, White Paper 7 on e-Education: Transforming Learning and Teaching through Information and Communication Technologies (ICTs) (2004).

Department of Higher Education and Training(DHET). 2016. Report on the Second National Higher Education Transformation Summit. International Convention Centre, Durban, KwaZulu-Natal. 15 – 17 October 2015.

Department of Higher Education and Training (DHET) 2015; Vol 188.

Department of Higher Education and Training (DHET). 2013. Statistics on Post-School Education and Training in South Africa: 2011. Pretoria.

Department of Higher Education and Training. 2013. Report of the Ministerial Committee for the Review of the Funding of Universities. Pretoria.

Department of Higher Education and Training. 2014. Policy framework on differentiation in the South African post-school system.

Department of Higher Education and Training. 2015. Statistics on post-school education and training in South Africa: 2013. Pretoria: DHET.

Department of Higher Education and Training. 2018. Investment trends in post-school education and training in South Africa.

DeShields, S. Kara, A. & Spillan, O. 2005. The effect of a market orientation on business performance: A Study of smallsized service retailers using MARKOR scale, Jour. of Small Business Manag, (2) 105-18.

Dinham, S. & Scott, C. 1999. The Doctorate: Talking about the Degree. Sydney, Australia: University of Western Sydney.

Domegan, C. & Fleming, D. 2007. Marketing Research in Ireland, Theory & Practice. 3rd Edition, Gill, and MacMillan.

Down, C. Martin, E. & Bricknell, L. 2000. Student Focused Postgraduate Supervision: A Mentoring Approach to Supervising Postgraduate Students (Version 1). Melbourne: RMIT University.

Dubrin, A.J. 2004. Leadership: Research findings, practice and skills. 4th Edition. Boston, MA: Houghton Mifflin.

Du Pre, R. 2009. The place and role of universities of technology in South Africa. Bloemfontein: South African Technology Network. ––––. 2010. Universities of technology in the context of the South African higher education landscape. In Kagisano, No. 7: Universities of Technology – Deepening the Debate. Council for Higher Education. CHE: Pretoria

Du Toit, G.S. Erasmus, B.J. & Strydom, J.W. 2010. Introduction to business management. Cape Town: Oxford University Press.

Duderstadt, J. Taggart, J. & Weber, L. 2008. The Globalization of Higher Education in Weber, L.E. and Duderstadt, J.J. (ed.) The Globalization of Higher Education. London: Economica Ltd.

Duffy, J. 2000, 'Knowledge management: To be or not to be? Information Management Journal, 34 (1), 64-7.

Dunning, H. Williams, A. Abonyi, S. & Crooks, V. 2008. Social Indicators Research, Quality of Life Studies in Saskatoon: Evidence from Community- University Research Partnerships, (1) 145-158.

Dyason, K. Lategan, L.O.K. & Mpako-Ntusi, T. 2010. Case studies in research capacity-building initiatives. In: R. du Pré. Universities of technology: Deepening the debate. Kagisano No. 7. Pretoria: Council of Higher Education.

Education White Paper 3: A Programme for the Transformation of Higher Education. July, 1997.

Edwards, B. 2002. Postgraduate supervision: Is having a PhD enough? In Australian Association for Research in Education Conference. Brisbane, Australia.

Ehrenberg, R. G. Jakubson, G. H. Groen, J. A. So, E. & Price, J. 2007. Inside the Black Box of Doctoral Education: What Program Characteristics Influence Doctoral Students' Attrition and Graduation Probabilities? Educational Evaluation and Policy Analysis, (2) 134-150.

Engebretson, K. Smith, K. McLaughlin, D. Seibold, C. Teret, G. & Ryan, E. 2008. The changing reality of research education in Australia and implications for supervision: A review of the literature, Teaching in Higher Education, 13(1), 1-15.

Erasmus, A.S. & Kapp, C.A. 1998. Capacity-building through mentoring: A case study in postgraduate supervision. *South African Journal of Higher Education,* 12(3):111–119.

European Commission. Bologna.ie - Irish National Information Website on the Bologna Process. Retrieved April 9, 2008, from http://www.bologna.ie/home/default.asp.

Evans, T. & Pearson, M. 1999. Off-campus doctoral research and study in Australia: Emerging issues and practices. In A. Holbrook & S. Johnston (Eds.), Supervision of Postgraduate Research in Education, Review of Australian Research in Education, (5) 185-203.

Eyerman, R. & Jamison, A. 1991. Social Movements: A Cognitive Approach. Pennsylvania: The Pennsylvania State University Press.

Farahbakhsh, A. 2011. The Midwest Quarterly, Vol. 52, No. 2, Winter, Academic journal article.

Feilzer, M. Y. 2010. Doing mixed methods research pragmatically: Implications for the rediscovery of pragmatism as a research paradigm. Journal of Mixed Methods Research. 4. 6 – 16.

Ferman, T. 2002. The knowledge needs of doctoral supervisors. Retrieved April 3, 2008, from http://www.aare.edu.au/02pap/fer02251.htm.

Figaji, B. 1995. System Coordination. In: The National Institute for Community Education (NICE) Trust, A Framework for the Provision of Adult Basic Education and Further Education and Training.

Firth, A. & Martens, E. 2008. Transforming supervisors? A critique of postliberal approaches to research supervision. Teaching in Higher Education, 13(3), 279–289.

Fischer, C. 2004. Researching and writing a dissertation for business students. Hampshire: Prentice Hall.

Fisher, G. 2011. Improving Throughput in the Engineering Bachelor's Degree. ECSA.

Fouché, C.B. & Delport, C.S.L. eds. Research at grass roots: for the social sciences and human service professions. Pretoria: Van Schaik, 307- 327.

Fourie-Malherbe, M. Albertyn, R. Aitchison, C. & Bitzer, E. 2016. Postgraduate Supervision: Future foci for the knowledge society, Sun Media, Stellenbosch, South Africa.

Franklin, B. 1751. Experiments and Observations on Electricity. London: England.

Franklin, B. 1970. The Complete Poor Richard's Almanacks. 2 vols. Massachusetts: Imprint Society.

Fransman, H & Rowley, J. 1999. Research, scholarship and consultancy: agendas for new universities and colleges in Britain and technikons in South Africa. South African Journal of Higher Education, (3) 5-8.

Fraser, R. & Mathews, A. 1999. An evaluation of the desirable characteristics of a supervisor. *Australian Universities" Review,* (1)5–7.

Freshwater, D. & Cahill, J. 2013. Paradigms lost and paradigms regained. Journal of Mixed Methods Research, (3) 3-5.

Frick, L. McKenna, S. & Muthama, E. 2017. Death of the Ph.D.: when industry partners determine doctoral outcomes. Higher Education Research & Development, (2) 444-447.

Gardner, J. 2000. The nature of leadership. Educational leadership. San Fransicso. Jossey-Bass Inc. Publishers.

Gasson, S. & Reyes, L. 2004. Ph.D. completion within four years. In Proceedings of the Australian Association for Research in Education Annual Conference, 28. Adelaide, South Australia.

Gatfield, T. 2005. An Investigation into PhD Supervisory Management Styles: Development of a dynamic conceptual model and its managerial implications. Journal of Higher Education Policy and Management, (3) 311.

Gerson, S. M. 2000. A Teacher's Guide to Technical Writing That Works. Kansas Curriculum Center, Washburn University, Topeka, KS.

Gilbert, R. 2004: A framework for evaluating the doctoral curriculum, Assessment and Evaluation in Higher Education, (3) 299-309.

Glickman, C.D. Gordon, S.P. & Roos-Gordon, J.M. 2009. *The basic guide to supervision and instructional leadership.* 2nd Edition. Upper Saddle River, NJ: Pearson Education, Inc.

Glickman, C. D. Gordon, S. P. & Ross-Gordon, J. M. 2014. Supervision and Instructional Leadership. A Developmental Approach (9th ed.). New Jersey: Pearson Education, Inc.

Golde, C. & Walker, G, E. 2006 (eds). Envisioning the Future of Doctoral Education: Preparing stewards of the discipline. San Francisco: Jossey-Bass.

Golde, C. M. 2007. Signature pedagogies in doctoral education: Are they adaptable for the preparation of education researchers? Educational Researcher, 36(6): 344–51.

Govender, K.K. & Dhunpath, R. 2011. Student experiences of the Ph.D. cohort model: "Working within or outside communities of practice"? Perspectives in Education, 29(3):88-99.

Govender, K.K. & Ramroop, S. 2011. The Postgraduate Service Experience, Service Satisfaction, and Service Quality: A South African Case Study.

Gov.za. (2015). *National Infrastructure Plan* | *South African Government*. [online] Available at: http://www.gov.za/issues/national-infrastructure-plan [Accessed 8 Mar. 2015].

.

Grant, B. 1999. Walking on a rackety bridge: mapping supervision. In Higher Education Research and Development Society of Australasia. Retrieved April 6, 2008, from http://www.herdsa.org.au/branches/vic/Cornerstones/pdf/grant.pdf.

Grant, B. M. 2005. The pedagogy of graduate supervision: Figuring the relations between supervisor and student, Ph.D. thesis, University of Auckland, Auckland, NZ.

Grant, B. 2010: Negotiating the layered relations of supervision, in M. Walker and P. Thomson, (eds.), The Routledge Doctoral Supervisor's Companion, Routledge, Abingdon and New York.

Grant, K., Hackney, R., & Edgar, D. A. 2003. Managerial academia: Towards the harmonization of the profession. Journal of Informatics Education & Research, 5(2), 1-15

Green, B. & Lee, A. 1995. Theorising Postgraduate Pedagogy. Australian Universities' Review, 38(2), 40-45.

Green, P. 1996. *Dual perspectives on postgraduate supervision*. Available online at: http://www.ultibase.rmit.edu.au/Articles/dec96/green1.html [5 December 2006].

Green, W. & van Rensburg, H. 2016. Accessing higher education and succeeding in it.

Grobler, M. 2013. The Need for Digital Evidence Standardisation. Council for Scientific and Industrial Research, South Africa & University of Johannesburg, South Africa.

Grösser, M. 2007. Effective teaching: linking teaching to learning functions. South African Journal of Education, (27) 37-52.

Gruchy, J.W. & Holness, L. 2007. The emerging researcher: Nurturing passion, developing skills, producing output. Cape Town: UCT Press.

Guba, E.G., & Lincoln, Y.S. 2005. Paradigmatic controversies, contradictions, and emerging confluences. In N. K. Denzin & Y. S. Lincoln (Eds.), The Sage handbook of qualitative research (3rd ed), 191-215.

Guilar J.D. & Lorring, A. 2008. Dialogue and community in online learning: Lessons from Royal Roads University. International Journal of E-Learning & Distance Education, 22(3) 19–40.

Gurr, G. M. 2001. Negotiating the "Rackety Bridge" — a Dynamic Model for Aligning Supervisory Style with Research Student Development. Higher Education Research & Development, 20(1) 81.

Hammersley, M. 2002. Action Research: A Contradiction in Terms? University of Exeter, England.

Hanson, W.E. Creswell, J.W. Plano, C. Vicki, L. Petska, K.S. & Creswell, J.D. 2005."Mixed Methods Research Designs in Counselling Psychology". Faculty Publications, Department of Psychology, 373.

Hartley, J. 2008. Academic writing and publishing. Abingdon: Routledge.

Hattie, J. & Marsh, H.W. 2004. One journey to unravel the relationship between research and teaching. Research and teaching: Closing the divide? An International Colloquium, Winchester, March 18-19.

Hattie, J. & Timperley, H. 2007. The power of feedback, Review of Educational Research, 77(1), 81-112.

Hay, I. 2010. Qualitative Research Methods in Human Geography. Oxford: Oxford. University Press.

Hean, S. & Matthews, M. 2007. *Applying work motivation theories to articulate the challenges of providing effective doctoral supervision*. Paper presented at the 30th Higher Education Research and Development Society of Australasia Inc. (HERDSA)

Annual Conference on Enhancing Higher Education, Theory and Scholarship, Adelaide, 8–11 July 2007.

Hean, S. & Matthews, M. 2007. Applying work motivation theories to articulate the challenges of providing effective doctoral supervision. Paper presented at the 30th Higher Education Research and Development Society of Australasia Inc. (HERDSA) Annual Conference on Enhancing Higher Education, Theory and Scholarship, Adelaide, 8–11 July 2007.

Hellriegel, D. Jackson, S.E. Slocum, J. Staude, G. Amos, T. Klopper, H.B. Louw, L. & Oosthuizen, T. 2004. Management. 2nd South African Edition. Cape Town: Oxford University Press

Henard, F. & Leprince-Ringuet, S. “The Path to Quality Teaching in Higher Education”. IMHE, Paris, France, 2007-08:1-25.

Hénard, F. & Roseveare, D. 2012. Fostering Quality Teaching in Higher Education: Policies and Practices. An IMHE Guide for Higher Education Institutions. Paris: OECD.

Henning, E., Van Rensburg, W., and Smit, B. 2007. Finding your way in Qualitative Research. (3rd Impression), South Africa: Van Schaik Publishers.

Higher Education ACT 101 OF 1997

Higher Education Management Information System (HEMIS) 2012.

Higher Education South Africa. 2015. Financial statistics of higher education institutions. Pretoria: HESA.

Higgins, J. 2000b. Academic Freedom and the University. Cultural Values 4(3):352-373.

Higgins, J. 2003b. From Academic Analysis to Apparatchik Thinking: A Reply to André du Toit. Pretexts: literary and cultural studies 12(2):191-97.

Hodges, D.; Malfroy, J. & Vaughan, L. 2006. Working in the new postgraduate research environment: Supervisory challenges for workplace research (supervisor support and development). In: M. Kiley & G. Mullins (Eds.). *Quality in postgraduate research: Knowledge creation in testing times*. Adelaide: Australian National University, Centre for Educational Development and Academic Methods, 55–64.

Hodza, F. 2007. Managing the student-supervisor relationship for successful postgraduate supervision: A sociological perspective. *South African Journal of Higher Education,* 21(8):1155–1165.

Holliday, A. 2002. Doing and writing Qualitative research, London: Sage Publications.

Holloway, I. 1997. Basic Concepts for Qualitative Research. Oxford. Blackwell Science.

Holloway, I. & Wheeler, S. 2002. Qualitative research in nursing. 2nd edition. Oxford: Bleckwell publishing company.

Holtzhausen, S.M. 2005. The supervisor‟s accountability versus postgraduates‟ responsibility within the academic writing arena. *South African Journal of Higher Education,* 19(1):89–100.

Homma, H. Ikeda, N & Attalage, R.A. Strengthening University-Industry Linkage in Developing Countries Through International Cooperation: Case of Sri Lanka Through Cooperation of Toyohashi University of Technology, Japan. ICCEED.

https://chet.org.za/data/sahe-open-data

Hyland, K. 2002. Teaching and Researching Writing. Harlow: Longman Pearson.

Hyland, K. 2003. Second Language Writing. Cambridge: Cambridge University Press.

Hyland, K. 2009. Academic Discourse. Continuum, London.

Hyland, K. & Tse, P. 2004. Metadiscourse in academic writing: A reappraisal, Applied Linguistics, 25(2), 156-177.

Ibrahim, S. Yunus, M. A. M. & Khairi, M. T. M. 2017. Teaching Academic Writing for Engineering Students: Challenges and Recommendations. International Journal of Education, Psychology and Counselling, 2(5), 160-169.

IUQB (2006). National Guidelines of Good Practice in the Organisation of PhD Programmes in Irish Universities. Irish Universities Quality Board. Retrieved March 31, 2008, from http://www.iuqb.ie/info/good_practice_guides.aspx.

James, H. & Murnan, J. “Research Limitations and the Necessity of Reporting Them.” American Journal of Health Education (35) 66-67.

James, R. & Baldwin, G. 1999. Eleven Practices of Effective Postgraduate Research Supervisors. Melbourne: The Centre for the Study of Higher Education & The School of Graduate Studies, University of Melbourne.

Jankowicz, A.D. 2005. Business Research Projects. London: International Thomson Business Press 4th edition.

Jansen, J. 2003. The state of higher education in South Africa: from massification to mergers. In J Daniel, A Habib & R Southall (eds). State of the Nation. Cape Town: HSRC Press.

Jansen, J.D. 2004. How mergers shape the institutional curriculum. South African Journal of Higher Education, 18(1): 5–18.

John, L.K. Loewenstein, G. & Prelec, D. 2012. Measuring the prevalence of questionable research practices with incentives for truth telling. Psychol Sci 2012. May 1;23(5):524–532.

Jonsson, I. 2006. Universities, Research and Politics in Historical Perspective. In Neave, G., Bluckert, K. and Nybom, T. (eds.), The European University: An historical parenthesis? New York: Palgrave Macmillan: 51-60.

Johnson, R.B. Onwuegbuzie, A.J. & Turner, L.A. 2007. 'Toward a definition of mixed methods research', Journal of Mixed Methods Research, 1, 112-133.

Johnston, T. 1999. Research Supervision – Setting the Scene. In A. Holbrook & S. Johnston (Eds.), Supervision of Postgraduate Research in Education, Review of Australian Research in Education, No.5 (17-31).

Kadushin, A. & Harkness, D. 2002. Supervision in Social Work. 4th ed., New York,

Kagisano, 2010. No: 7. Universities of Technology – Deepening the Debate.

Kam, H. 1997. Style and quality in research supervision: the supervisor dependency factor. Higher Education, 34(1), 81-103.

Kamler, B. & Thomson, P. 2001. Talking down 'writing up' or ten emails make a conference paper, Australian Association for Research in Education, Annual Conference, 2-6 December, University of Notre Dame, Fremantle, Australia.

Kandiko, C.B. & Mawer, M. 2013. Student expectations and perceptions of Higher Education: Executive Summary. London: King's Learning Institute

Karlsson, J. Balfour, R. Moletsane, R. & Pillay, G. 2009. Researching postgraduate educational research in South Africa. South African Journal of Higher Education, 23(6): 1086-1100.

Katz, J., & Hartnett, R. T. 1976. Scholars in the Making. The Development of Graduate and Professional Students. Cambridge, Mass. Ballinger Publishing Company.

Keating, M. & Porta, D. 2008. Approaches and Methodologies in the Social Sciences: A Pluralist Perspective. Cambridge University Press.

Keohane, R. O. 1986. Neorealism and its Critics. New York: Columbia University Press.

Kiessling, T. & Harvey, M. 2005. Strategic global human resource management research in the twenty-first century: An endorsement of the mixed-method research methodology.

Kiley, M. & Mullins. G. 2005. Supervisors" conceptions of research: What are they? *Scandinavian Journal of Education Research,* 49(3):245–262.

Kim, Y. Y. 2001. Becoming intercultural: An integrative theory of communication and cross-cultural adaptation. Thousand Oaks, California: Sage.

Knowles, S. 1999. Feedback on Writing in Postgraduate Supervision: Echoes in Response-Context, Continuity and Resonance. Supervision of Postgraduate Research in Education, 113-128.

Kotecha, P. 2006. In name only? The case of the university (p.21-38). In Kagisano, 4, Ten years of higher education under democracy. Pretoria: CHE.

Kraak, A. 2001. Policy Ambigui ty and Slippage: Higher Educa tion under the New State, 1994- 2001 in Kraak, A. and Young, M. (ed.) Education in Retrospect: Policy and Implementation since 1990. Pretoria: Human Sciences Research Council.

Krefting, L. 1991. Rigor in qualitative research: The assessment of trustworthiness. The American Journal of Occupational Therapy, 43(3), 214.

Kreuger, L.W. & Neuman, W.L. 2006. Social work research methods: Qualitative and quantitative applications. Boston: Pearson Education.

Krueger, R. A. & Casey, M. A. 2000. Focus groups: A practical guide for applied researchers

Kumar, R. 2011. Research Methodology: A Step-by-Step Guide for Beginners. 3rd Edition. Sage, New Delhi.

Kumar, V. & Stracke, E. 2007. An analysis of written feedback on a Ph.D. thesis, Teaching in Higher Education, 12(4), 461-470.
Lannon, J. M. 1988. Technical Writing. 4th ed. Massachusetts: South-eastern Massachusetts University Press.

Lantolf, J. 2000. Sociocultural theory and second language learning. Oxford University Press, Oxford, UK.

Lategan, L.O.K. 2008. Theme 1: Why the fuss about research and postgraduate supervision? In Lategan LOK (ed.). An introduction to postgraduate supervision. Stellenbosch, South Africa: Sun Press.

Lategan, LOK. 2009. Unpacking the challenges associated with postgraduate supervision: A commentary from ethics. *Tydskrif vir Christelike Wetenskap,* 3rd Term:153–168.

Latona, K. & Browne, M. 2001. Factors Associated with Completion of Research Higher Degrees. Canberra, Australia: Government report in Higher Education Series, 37. Department of Education, Training and Youth Affairs - Higher Education Division.
Lillis, T. 2003. Student Writing as ‘Academic Literacies’: drawing on Bakhtin to move from critique to design, Language and Education, 17 (3), 192-207.

Lea, M. 2005. Communities of practice in higher education, in D. Barton and K. Tusting, Beyond Communities of Practice, Cambridge University Press, New York.

Lebakeng, T.J. & Payle, K.D. 2003. Prospects and problems of mainstreaming indigenous knowledge in South Africa: Issues in the Academy. Africa Insight, 33(4): 26-32.

Lee, A. & Murray, R. 2015. Supervising writing: helping postgraduate students develop as researchers, Innovations in Education and Teaching International, 52 (5), 558-570.

Leech, N. L. Dellinger, A. B. Brannagan, K. B. & Tanaka, H. 2010. Evaluating mixed research studies: A mixed methods approach. Journal of Mixed Methods Research, 4(1), 17-31.

Leech, N. L., & Haug C. A. 2015. Investigating graduate level research and statistics courses in schools of education. International Journal of Doctoral Studies, 10, 93-110.

Leech, N. L. & Onwuegbuzie, A.J. 2009. A typology of mixed methods research designs. Quality & Quantity, 43, 265-275.

Leedy, P.D. & Ormrod, J.E. 2010. Practical research: Planning and design. International and 9th edition. Boston: Pearson.

Lekhanya, L.M. 2014. The Level of awareness of green marketing and its managerial implications amongst selected South African Manufacturing Small, Medium and Micro Enterprises (SMMEs) in KwaZulu–Natal. Journal of Economics and Behavioral Studies. 6(8). 625-635.

Leonard, D. Becker, R. & Coate, K. 2005. To prove myself at the highest level: The benefits of doctoral study. Higher Education Research and Development 24 (2), 135-

Lessing, A.C. & Schulze, S. 2003. Postgraduate supervision: Students‟ and supervisors‟ perceptions. Acta Academica, 35(3):161–184.

Lessing, A. C. Lessing, N. 2004. The supervision of research for dissertations and theses. Acta Commercii; (1) 73-87.

Lessing, A.C. 2011. The role of the supervisor in the supervisory process. South African Journal of Higher Education, 25(5):921–936.

Lessing, N. & Lessing, A.C. 2004. The supervision of research for dissertations and theses. *Acta Commercii,* 4:73–87.

Letseka, M. & Pitsoe, V. 2014. The challenges and prospects of access to higher education at UNISA. Studies in Higher Education, 39(10):1942–1954.

Lewanika, T. & Archer, A. 2011. “Communities of Practice.” Changing Spaces: Writing Centres and Access to Higher Education. Stellenbosch, South Africa: SUNPReSS.

Lewin, T. & Mayoyo, M. 2014. Student Access and Success: Issues and Interventions in South African Universities. Cape Town: Inyatelo.

Li, S. & Seale, C. 2007. Managing criticism in Ph.D. supervision: A qualitative case study, Studies in Higher Education, 32(4), 511-526.

Lillis, T. 2001. Student Writing: Access, Regulation, Desire, Routledge, London.

Lillis, T. 2003. Student Writing as ‘Academic Literacies’: drawing on Bakhtin to move from critique to design, Language and Education, 17 (3), 192-207.

Lincoln, Y. S. & Guba, E. G. 1985. Naturalistic inquiry. Beverly Hills, CA: Sage.

Lin, L. & Cranton, P. 2005. From scholarship student to responsible scholar: a transformative process. Teaching in Higher Education, 10(4), 447-459.

Lincoln, Y. S. & Guba, E. G. 2000. Paradigmatic controversies, contradictions, and emerging confluences. In N. K. Denzin & Y. S. Lincoln (Eds.), The handbook of qualitative research, (2)163–188.

Lovitts, B. E. 2005. Being a good course-taker is not enough: a theoretical perspective on the transition to independent research. Studies in Higher Education, 30(2): 137-

154.

Luca, J. Standing, C. Adams, R. Borland, H. Erwee, R. Jasman, A. & Al, E. 2013. Developing a toolkit and framework to support new postgraduate research supervisors in emerging research areas: Final report 2013. Australian Government Office for Learning and Teaching, Sydney.

Lues, L. & Lategan, L.O.K. 2006a. Research ABC. Stellenbosch: Sun Press.

Lues, L. & Lategan, L. 2006. Research development at a South African university of technology: a case study. South Africa Journal of Higher Education, 20(3), 472-485.

Luruli, N, M. 2014. Research funding and modes of knowledge production: A comparison between NRF-funded and industry-funded researchers in South Africa. Stellenbosch: Stellenbosch University.

Luruli, N.M. & Mouton, J. 2016. The early history of research funding in South Africa: from the research grant board to the FRD. South African Journal of Science. 2016;12(5/6) 1–6.

Lusted, D. 1986. “Why Pedagogy?” Screen, (5) 2-14.

Lynch, K., Grummell, B., & Devine, D. 2012. New managerialism in education: Commercialization, carelessness, and gender. New York, NY: Palgrave Macmillan.

Maasdorp, C. & Holtzhausen, S.M., 2011, ‘Bridging the gap towards postgraduate studies at the Central University of Technology, Free State’, Interim: Interdisciplinary Journal 10(1), 38–51.

MacGregor, 2013a. Current trends in Ph.D. studies: A review of articles published on the University World News website.

Mack, N. Woodsong, C. Macqueen, K. M. Guest, G. & Namey, E. 2005. Qualitative Research Methods: A Data Collector’s Field Guide. Family Health International, North Carolina, USA.

Mackinnon, J. 2004. Academic supervision: seeking metaphors and models for quality. Journal of Further and Higher Education, 28(4), 395-405.

Maharasoa, M. & Hay, D. 2001. 'Higher Education and graduate employment in South Africa', Quality in Higher Education, 7 (2), 139-147.

Makondo, L. & Makondo, O. 2014. The Interplay between South African Higher Education Context and Academic Development Livingstone Centre for Excellence in Learning and Teaching (CELT), Midlands Centre, Durban University of Technology, South Africa. Anthropologist, 17(2): 301-309.

Malan, R. Erwee, R. Van Rensburg, H. & Danaher, P. 2012. Cultural diversity: Impact on the doctoral candidate-supervisor relationship. International Journal of Organisational Behaviour, 17(1):1–14.

Malfroy, J. 2005. Doctoral supervision workplace research and changing pedagogic practices. Higher Education Research and Development, 24(2):165-178.

Manathunga, C. 2005. Early Warning Signs in Postgraduate Research Education: A Different Approach to Ensuring Timely Completions. Teaching in Higher Education, 10(2), 219-233.

Manathunga C 2012. Supervisors watching supervisors: The deconstructive possibilities and tensions of team supervision. Australian Universities' Review, 54(1):29–37

Manathunga, C. 2014. *Intercultural Postgraduate Supervision: reimaging time, place and knowledge.* London: Routledge.

Mapesela, M. & Hay, H.R. 2005. Through the magnifying glass: A descriptive theoretical analysis of the possible impact of the South African higher education policies on academic staff and their job satisfaction. Higher Education, Springer 2005 (50): 111-128.

Mapasela, M.L.E. & Wilkinson, A.C. 2005. The pains and gains of supervising postgraduate students at a distance: The case of six students from Lesotho. *South African Journal of Higher Education,* 19(Special Issue):1238–1239.

Marginson, S. & Van der Wende, M. 2009. The new global landscape of nations and institutions. Higher education to, 2030. Paris: OECD, 17-57.

Marotta, D. Mark, M. Blom, A. Thorn, K. 2007. Human capital and university-industry linkages' role in fostering firm innovation: an empirical study of Chile and Colombia (English). Policy Research working paper; no. WPS 4443. Washington, DC: World Bank.

Maree, K. & Pietersen, V.L. 2007. In Creswell, J.W., Ebersohn, L., Eloff, I., Ferreira, R., Ivankova, N.V., Jansen, J.D., Nieuwenhuis, J., Pietersen, V.L., Plano Clark, V.L. & van der Westhuizen, C. First steps in research sampling. RSA, Pretoria: Van Schaik Publishers.

Martin, Y. M. Maclachlan, M. & Karmel, T. 1999. Postgraduate Completion Rates 2001D Occasional Paper Series. Higher Education Division, Department of Education, Training and Youth Affairs.

Martin, E. Drage, N. Sillitoe, J. & Clingin, D. 2006. Knowledge creation and research training: Meeting the academic development needs of postgraduate students and their supervisors in small and new universities. In: M. Kiley & G. Mullins (Eds.). *Quality in postgraduate research: Knowledge creation in testing times*. Adelaide: Australian National University, Centre for Educational Development and Academic Methods, 95–104.

Mashau, S. Steyn, E. Van der Walt, J. & Wolhuter, C. 2008. Support services perceived necessary for learner relationships by Limpopo educators. South African Journal of Education, (28) 415-430.

Matthews, D. 2014. South African mergers fail to deliver change. Times Higher Education. World University Rankings.

Maxwell, T.W. & Smyth, R. 2010. Research supervision: The research management matrix. Higher Education, (59) 407–422.

McAlpine, L. & Amundsen, C. 2009. Identity and agency: pleasures and collegiality among the challenges of the doctoral journey, *Studies in Continuing Education,* 31 (2), 109-125.

McAlpine, L. & Amundsen, C., (eds.) 2011. *Doctoral Education: Research-based Strategies for Doctoral Students, Supervisors and Administrators,* Springer, London.

McAlpine, L. & Amundsen, C. 2012. Challenging the taken-for-granted: how research analysis might inform pedagogical practices and institutional policies related to doctoral education, *Studies in Higher Education,* (6), 683-694.

McCallin, A. & Nayar, S. 2012. Postgraduate research supervision: a critical review of current practice. Teaching in Higher Education (1): 63-74.

McClure, P. 2005. Reflection on Practice www.science.ulster.ac.uk/nursing/mentorship/docs/ learning/reflectiononpractice.pdf (Accessed 31st October 2011)

McCormack, C. 2004. Tensions between student and institutional conceptions of postgraduate research. Studies in Higher Education, 2(3), 319-334.

McCormack, C. 2005. Is non- completion a failure or a new beginning? Research noncompletion from student's perspective. Higher Education Research & Development, 24(3): 233-247.

McCormack, C. 2012. Is non-completion a failure or a new beginning? Research on non-completion from a students' perspectives. Higher Education Research & Development, 24(3):233–247.

McGagh, J. Marsh, H. Western, M. Thomas, P. Hastings, A. Mihailova, M. & Wenham, M. 2016. Review of Australia's research training system. Australian Council of Learned

Academies (ACOLA). Melbourne, Australia.

McKenna, S. 2012. Interrogating the academic project. In L. Quinn (Ed.), Reimagining academic staff development: Spaces for disruption, 15–26.

Mckenna, S. Clarence-fincham, J. Boughey, C. Wels, H. Van den Heuvel, H. 2017. Strengthening Postgraduate Supervision. SUN PRESS.

McMillan, J. H. & Schumacher, S. 2010. Research in education: Evidence-based inquiry (7th ed.). New York, NY: Pearson.

McPhail, J. & Erwee, R. 2000. Developing professional relationships between supervisors and doctoral candidates. *Australian Journal of Management and Organisational Behaviour,* 3(1):76–90.

Melucci, A. 1989. Nomads of the Present: Social Movements and Individual Needs in Contemporary Society. London: Century Hutchinson.

Menchaca, M. Bischoff, M. & Dara-Abrams, B. 2004. A model for systemic change management in education, Journal of Systemics, Cybernetics and Informatics, 2(1).

Migiro, S.O. & Magangi, B.A. 2011. Mixed methods: A review of literature and the future of the new research paradigm. African Journal of Business Management, 5(10):3757-3764.

Mihyo, P.B. 2013. University–industry linkages and knowledge creation in Eastern and Southern Africa: some prospects and challenges. Africa Review, (1) 43–60.

Mills, G. & Walter, J. 1980. Technical Writing, 4th ed. New York: Holt.

Moll, I, 2004. Curriculum responsiveness: The anatomy of a concept. In Griesel, H (ed.), Curriculum Responsiveness Case Studies in Higher Education. Pretoria: South African Universities' Vice-Chancellors' Association (SAUVCA).

Moore, J. Sanders, J. & Higham, L. 2013. Literature review of research into widening

participation to higher education. ARC Network.

Moraka, T.S. & Hay, H.R. 2007. The implementation of a capacity development system for academic staff in higher education: The case of the Central University of Technology, Free State. Journal for New Generation Sciences, (2) 218–234.

Morgan, D.L. 2007. Paradigms lost and pragmatism regained — methodological implications of combining qualitative and quantitative methods. Journal of Mixed Method Research, (1) 48-76.

Morrison, M. 2012. Understanding Methodology. (In Briggs, A.R.J., Coleman M. & Morrison M., eds. Research methods in educational leadership and management. 3rd ed. London: SAGE.

Mosley, D.C. Pietri, P.H. & Mosley, D.C. Jr. 2008. *Supervisory management: The art of inspiring, empowering and developing people.* New York, NY: Thomson.

Motala, S. 2001. Quality indicators and quality in South African education: A critical appraisal. International Journal of Educational Development, (21) 61–78.

Motshoane, P.L. & McKenna, S. 2014. "More than agency: the multiple mechanisms affecting postgraduate education" in Pushing Boundaries in Postgraduate Supervision.

Motshoane, P. & McKenna, S. 2014. More than agency: The multiple mechanisms affecting postgraduate education. In: E Bitzer, R Albertyn, L Frick, B Grant & F Kelly (eds). Pushing boundaries in postgraduate supervision. Stellenbosch: SUN MeDIA. 185-202.

Mouton, J. 2001. How to succeed in your master‟s and doctoral studies: A South African guide and resource book. Paarl: Van Schaik.

Mouton, J. 2007. Post-graduate studies in South Africa: Myths, misconceptions and challenges. (21)1. 1078-1090. South African Journal of Higher Education.

Mouton, J. 2011. Doctoral production in South Africa: statistics, challenges and responses. Perspectives in Education, 29(1):13–29.

Mouton, J. Van Lill, M. Botha, J. Boshoff, N. Valentine, A. Cloete, N & Sheppard, C. 2015. A study on the Retention, Completion and Progress rates of South African postgraduate students. Stellenbosch. CREST.

Mouton, N; Louw, G.P. and Strydom, G.L. 2013. Present-Day Dillemas and Challenges of the South African Tertiary System. International Business & Economics Research Journal, 12(3), 285-300.

Mthembu, T. 2013. Towards distinctive and developmental curricula at UoTs: The STEPS process at CUT. SAJHE 26(2) 214–231.

Murphy, N. W. 2004. Orientations to Research Higher Degree Supervision: The Interrelatedness of Beliefs about Supervision, Research, Teaching and Learning. Griffith University, Brisbane.

Murray, R. 1996. Research Supervision. Glasgow, UK: University of Stratclyde.

Mutula, S.M. 2009. Challenges of Postgraduate Research: Global Context, African Perspectives. Presented at the University of Zululand, 10th DLIS Annual Conference, from 9 - 10 September 2009. South Africa.

Mutula, S. M. 2011. Challenges of postgraduate research: case of developing countries. South African Journal of Library & Information Science, 77 (2): 184.

Myers, M. D. 2009. Qualitative Research in Business and Management. Sage, London.

Nayyar, D. 2008. Globalization: What Does It Mean for Higher Education? In: Luc Weber and James Duderstadt (eds) Globalization in Higher Education. Paris: Economica, forthcoming.

National Development Plan (NDP). (2011b) – Vision for 2030. Pretoria: National

Planning Commission.

National Development Plan. (NDP). 2012. Vision for 2030. Pretoria: National Planning Commission.

Nerad, M. 2009. The context for increasing the quantity and assuring the quality of doctoral education in South Africa: What we know about the increase in Ph.D. production and reform of doctoral education worldwide. Pretoria: ASSAf.

Ngcongo, R.P. 2001. Supervision as transformative leadership in the context of university goals. South African Journal for Higher Education, 15(3):53-57.

Neave, G. 1989. The EEC and Education. Stoke on Trent, Trentham Books. Foundation or Roof? The Quantitative, Structural and Institutional Dimensions of Higher Education. European Journal of Education, (3) 211–222.

Ngibe, M. & Lekhanya, L. M. 2016. Perceptions of research structures and service quality within various faculties at Durban University of Technology: staff and students' perspective. Problems and perspectives in management. 14 (1): 63-71.

Niven, P.M. 2012. Narrating emergence in the curious terrain of AD research: A Realist perspective. Unpublished doctoral thesis. Rhodes University, Grahamstown.

Nkunya, M. 2013. Ph.D. crisis in Uganda's private universities.

Nsibande, R. 2007. Using "currere" to re-conceptualise and understand best practices for effective research supervision. *South African Journal of Higher Education,* 21(8):1117–1125.

O'Brien, D. 2015. 'The social life of cultural value' in MacDowall, L. Badham, M. & Blomkamp, E. (eds) Making Culture Count: The Politics of Cultural Measurement London: Palgrave.

O'Cathain, A. Murphy, E. & Nicholl, J. 2008. The quality of mixed methods studies in health services research. Journal of Health Services Research Policy, 13(2), 92-98.

O'Cathain, A. Murphy, E. & Nicholl, J. 2010. Three techniques for integrating data in mixed methods studies, 341.

Odhiambo, N. & Ntenga, L. 2014. Financing Research in Higher Education for an Equitable Sharing of National Revenue.

Okeke, C.I.O. 2014. Learning from 'good' practice: what could African [universities] possibly learn from the bologna process and European students' mobility? African Journal of Pedagogy and Curriculum, 1(1): 58-71.

Olivier, M.A.J. 2007.Postgraduate supervision: For better or for worse? South African Journal of Higher Education, 21(8):1126.

Olsen, J. P. 2000. Political engineering in the name of the people? Journal of European Public Policy. 05 Nov. 2010 - 17(3), 231.

Olsson, A. & Cooke, N. 2013. The Evolving Path for Strengthening Research and Innovation Policy for Development.

Onwuegbuzie, A. J. & Collins, K. M. 2007. A Typology of Mixed Methods Sampling Designs in Social Science Research. *The Qualitative Report*, *12*(2), 281-316.

Onwuegbuzie, A. J. & Leech, N. L. 2005a. On becoming a pragmatist researcher: The importance of combining quantitative and qualitative research methodologies. International Journal of Social Research Methodology: Theory & Practice, 8, 375-387.

Onwuegbuzie, A. J. & Leech, N. L. 2006. Linking Research Questions to Mixed Methods Data Analysis Procedures 1. *The Qualitative Report*, *11*(3), 474-498.

Pansiri, J. 2005. Pragmatism: A methodological approach to researching strategic alliances in tourism. Tourism and Hospitality Planning & Development, 2(3), 191-206.

Parahoo K. 2007. Nursing research: principles, process and issues. Basingstoke:

Macmillan.

Park, C. 2005. New Variant PhD: The Changing Nature of the Doctorate in the UK. Journal of Higher Education Policy and Management, 27(2), 189-207.

Parsloe, P. 1993. Supervising Students for Higher Degrees by Research in a Social Work Department. Journal of Further and Higher Education, 17(3), 49.

Patton, M. Q. 2002. Qualitative Research & Evaluation Methods. 3rd edition. Sage Publications, Inc.

Patton, M.Q. & Horton, D. 2009. Utilization-Focused Evaluation for Agricultural Innovation. International Labor Accreditation Cooperation (ILAC) Brief No. 22. ILAC, Bioversity, Rome.

Patton, M. Q 2015. Qualitative Research and Evaluation Methods. Sage, Thousand Oaks, CA.

Pearson, M. & Brew, A. 2002. Research training and supervision development. Studies in Higher Education, 27(2), 135-150.

Pearson, M. & Kayrooz, C. 2004. Enabling critical reflection on research supervisory practice. International Journal for Academic Development, 9(1), 99.

Pearson, M. 2005. Framing research on doctoral education in Australia in a global context. Higher Education Research and Development 24(2): 119–134.

Penceliah, Y. 2003. Emotional intelligence for public manager/ administrators to meet the challenges of the future. International association of schools and institute of administration.

Petersen, E. 2007. Negotiating academicity: postgraduate research supervision as category boundary work, Studies in Higher Education, 32(4): 475–88.

Petrie, K. Lemke, G. Williams, A, P. Mitchell, B, G. Northcote, M. Anderson, M. & de Waal, K. 2015. Professional development of research supervisors: A capacity-building, participatory approach. In Baguley, M (ed.), Australian Association for Research in Education (AARE) Conference 2015. University of Notre Dame Australia, Fremantle, Western Australia, Australian Association for Research in Education (AARE), 1-11.

Philip, L. J. 1998. Combining Quantitative and Qualitative Approaches to Social Research in Human Geography; An impossible mixture? Environment and Planning. 30(2) 261 – 276.

Phillips, E. & Pugh, D. 2000. How to Get a PhD: A Handbook for Students and Their Supervisors? (3rd Ed). Maidenhead: Open University Press.

Pillay G & Balfour RJ 2011. Post-graduate supervision practices in South African universities in the era of democracy and educational change 1994-2004. South African Journal of Higher Education, 25(2):358-372.

Pillay, D. & Karlsson, J. New spaces for researching postgraduate Education research in South Africa. South African Journal of Education; 2013; 33(3).

Pilot, D.F. Beck, C.T. & Hungler, B.P. 2001. Essentials of Nursing Research: Methods, Appraisal and Utilization. 5th Edition, Lippincott. Williams &Wilkins, Philadelphia.

Pont, B. Nusche, D. & Moorman, H. 2008. Improving School Leadership, Volume1: Policy and Practice, OECD, Paris. (August 2008).

Pont, B., D. Nusche and D. Hopkins (eds.) (2008), Improving School Leadership, Volume 2: Case Studies on System Leadership, OECD, Paris. (August 2008).

Powles, M. 1989. How's the Thesis Going? Former Postgraduates' and Their Supervisors' Views on Completion Times and Dropout. Centre for the Study of Higher Education, University of Melbourne.

Raimes, A. 1983. Techniques in Teaching Writing. Oxford University Press, New York.

Ramsden, P. 1998. Learning to lead in higher education. London: Routledge.

Ramsden, P. 2003. Learning to teach in higher education, 2nd edition. Routledge Falmer, London.

Reddy, N. 2014. Perceptions and expectations of IT service delivery Post Migration to a Microsoft Platform at a university of technology in South Africa. Unpublished master's dissertation, Department of Information Technology, Faculty of Accounting and Informatics, Durban University of Technology. South Africa.

Republic of South Africa. Department of Education. 1997. Education White Paper 3: A Programme for Higher Education Transformation. Pretoria: Department of Education.

Republic of South Africa. Ministry of Education. 200I. National Plan for Higher Education Transformation. Pretoria: Department of Education.

Reyneke, M. Meyer, L. Nel, C. 2010. School-based assessment: the leash needed to keep the poetic 'unruly pack of hounds' effectively in the hunt for learning outcomes. South African Journal of Education, (2) 277-292.

Roberson, S. 2012. Defying the default culture and creating a culture of possibility. Education, 131, 4: 885-904.

Robbins, S.P. & De Cenzo, D.A. 2001. *Supervision today! The ultimate guide to front-line management.* 3rd Edition. Upper Saddle River, NJ: Prentice Hall.

Robson, C. 1997. Real world research: A resource for social scientists and practitioner researchers. Oxford: Blackwell.

Rocco, T. S. Bliss, L. A. Gallagher, S., & Perez-Prado, A. 2003. Taking the next step: mixed methods research in organizational systems. Information Technology, Learning, and Performance Journal, (21) 19-29.

Rodwell, J. & Neumann, R. 2007. Predictors of Timely Doctoral Student Completions by Type of Attendance: The Utility Pragmatic Approach. Sydney, Australia: Macquarie Graduate School of Management.

Roxa, T. Martensson, K. & Alveteg, M. 2011. Understanding and influencing teaching and learning cultures at university: a network approach. Higher Education, (62) 99-111.

Rudd, E. & Simpson, R. 1975. The Highest Education: A Study of Graduate Education in Britain. London: Routledge and Kegan Paul.

Samara, A. 2006. Group supervision in graduate education: A process of supervision skill development and text improvement. Higher Education Research and Development, 25(2) 115–139.

Sandoval, L. 2012. The effects of education on Brazil's economic development. Global Majority EJournal, 3(1):4–19.

Sanderson, S. E. & Redford, K. H. 2003. Contested Relationships between Biodiversity Conservation and Poverty Alleviation, (4) 1-2.

Saunders, M. N. K. Lewis, P. & Thornhill, A. 2012. Research methods for business students (6th eds) Harlow, England: Pearson Education.

Scevak, J. Cantwell, C., Bourke, S., & Reid, A. 2007. A metacognitive profile of doctoral students. InEARLI 12th Biennial Conference for Research on Learning and Instruction: Developing Potentials for Learning. Budapest.

Schermerhorn, J.R. Jr; Hunt, J.G. & Osborn, R.N. 2008. Organizational Behavior. 10th Edition. Hoboken, NJ: John Wiley & Sons.

Schostak, J. & Schostak, J. 2008. Radical Research. Designing, developing and writing research to make a difference. New York, New York Routledge.

Schreiber, L. M & Valle, B. E. 2013. Social Constructivist Teaching Strategies in the Small Group Classroom. Small Group Research, 44(4), 395-411.

Schwandt, T. A. 2007. Dictionary of qualitative inquiry. 3rd ed. London: SAGE.

Scott, I. 2009. Academic development in South African higher education. In: E. Bitzer (Ed.). Higher education in South Africa: A scholarly look behind the scenes. Stellenbosch: Sun Media, 21–49.

Seagram, B. C., Gould, J. & Pyke, S. W. 1998. An Investigation of Gender and Other Variables on Time to Completion of Doctoral Degrees. Research in Higher Education, 39(3), 319-35.

Sesay, A. A. 2011. Educational Research. A Beginner's guide. United States: Xlibris Corporation.

Shen, G. 2013. Building world class universities in China from the view of national strategies. Available at Global University Network for Innovation: http://www.guninetwork.org/ resources/he-articles/building-world-class-universities-in-china-from-the-view-of-national-strategies/ [accessed 3 July 2013]

Siegel, D. S. & Phan, P. H. 2005. Analyzing the Effectiveness of University Technology Transfer: Implications for Entrepreneurship Education, in Gary D. Libecap (ed.)

University Entrepreneurship and Technology Transfer (Advances in the Study of Entrepreneurship, Innovation & Economic Growth, Volume 16) Emerald Group Publishing Limited, 1-38.

Simon, R. 1992. Teaching Against the Grain: Texts for a Pedagogy of Possibility, New York, Bergin & Garvey.

Simon, M.K. & Goes, J. 2013. Dissertation and Scholarly Research: Recipes for Success. Seattle, WA: Dissertation Success LLC.

Simpson, R. 1983. How the PhD Came to Britain? A Century of Struggle for Postgraduate Education. Guilford: Society for Research in Higher Education.

Sisson, K. & Crawford, K. 2016. Developing a framework for high quality supervision in doctoral education. UK Council for Graduate Education: Achieving Excellence in Masters and Doctoral Education. Liverpool Town Hall.

Smith, R.A. 2010. Feeling supported: curricular learning communities for basic skills courses and students who speak English as a second language. Community College Review, 37(3):261-284.

South African Technology Network (SATN), 2007. Report of the committee on: “The status of universities of technology” – Position of the SATN board on the current status and recognition of Universities of Technology in the restructured higher education landscape. Available at: www.SATN.co.za

South African Technology Network (SATN), 2008a: Final Report – The development of Performance Indicators for Universities of Technology (UoTs) and UoT related parts of Comprehensive Universities (CUs). Available at: www.SATN.co.za

South African Technology Network (SATN). 2008b: Report - Research output committee. Available at: www.SATN.co.za

South African Technology Network (SATN) 2016. The revised strategic objectives of the South African Technology Network trust (2016-2021). www.satn.org.za/satn-annual-report-2016

Speckman, M. & Mandew, M. 2014. Perspectives on Student Affairs in South Africa

Cape Town: African Minds.

Stewart, D. W., & Shamdasani, P.N. 1990. Focus groups: Theory & practice. Newbury Park, CA: Sage.

Steyn, H.J. & Wolhuter, C.C. 2008. Education systems: Challenges of the 21st century. Potchefstroom: Keurkopie.

Strauss, A. & Corbin, J. 1998 Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. Thousand Oaks, CA: Sage.

Streubert, H. & Carpenter, D. 1999. Qualitative Research in Nursing: Advancing the Humanistic Perspective (2nd ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Struwig, F.W. & Stead, G.B. 2001. Planning, designing and reporting research. Cape-Town: Pearson Education South-Africa, 279.

Strydom, H. 2005a. Ethical aspects of research in the social sciences and human service professions. In De Vos A.S., Strydom, H, Fouché C.B. & Delport CSL. Research at the grass roots for the social sciences and human service professions. 3 rd ed. RSA, Pretoria: JL Van Schaik Publishers.

Strydom, H. 2005b. The pilot study. In De Vos A.S., Strydom, H, Fouché C.B. & Delport CSL. Research at the grass roots for the social sciences and human service professions. 3rd ed. RSA, Pretoria: JL Van Schaik Publishers.

Sussex, R. 2008. Technological options in supervising remote research students. Higher Education, 55(1):121–137

Swanepoel, C.H. 2010. Master degree studies: expectations versus reality. South African Journal of Higher Education, 24(1):132–144.

Swanepoel, C.H. & Moll, A.M. 2004. Honours degree performance as predictor of achievement in Master's degree level. SAJHE/SATHO 18(1): 290-302.

Swedish Coordinating Centre. 2006. International Postgraduate Students Mirror Catalonia, Finland, Ireland and Sweden. Stockholm: Swedish National Agency for Higher Education. Retrieved from

http://www.hsv.se/reports/2006/internationalpostgraduatestudentsmirrorcataloniafinlandirelandandsweden.5.539a949110f3d5914ec800071541.html.

Tahir, I.M. & Bakar, N.M.A. 2009. An evaluation of lecturers' perceptions towards research, The Social Sciences, 4 (5) 416-423.

Tashakkori, A. & Teddlie, C. 2003. Handbook of Mixed Methods in Social & Behavioral Research. Thousand Oaks: Sage.

Tashakkori, A. & Teddlie, C. 2008. "Quality of Inferences in Mixed Methods Research: Calling for an Integrative Framework," in Advances in Mixed Methods Research: Theories and Applications, M. Bergman (ed.), London: Sage Publications, 101- 119.

Taylor, S. 2006. Thinking of research supervision as a form of teaching. Durham University. Retrieved April 4, 2008, from http://luvle.lancs.ac.uk/CELT/supervision.nsf/f/D66890F4600E0D7C802571F60064DD13/$File/StanTaylor.pdf.

Taylor, S., & Beasley, N. 2005. A Handbook for Doctoral Supervisors. New York: Routledge.

Technikons Act, 1993 (N. 125 of 1993). Country: South Africa. Subject (s): Education, vocational guidance and training.

Teddlie, C. & Tashakkori, A. 2009 Foundations of Mixed Methods Research Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences. Thousand Oaks.

Taylor, A.M. 2002. A century of purchasing power parity. Review of Economics and Statistics, 84 (2002), 139-150.

Thompson, D.R. Kirkman, S. Watson, R & Stewart, S. 2005. Improving research supervision in nursing *Nurse Education Today*, (25) 283 –290.

Tinto, V. & Pusser, B. 2006. Moving from theory to action: Building a model of institutional action for student success. USA: National Postsecondary Education Cooperative.

Tinto, V. 2006-2007. Research and practice of student retention: What next? Journal of College Student Retention, 8(1):1-19.

Tremblay, K. Lalancette, D. & Roseveare, D. 2012. Assessment of Higher Education Learning Outcomes, AHELO Feasibility Study Report, Volume 1: Design and Implementation. Organistion for Economic Co-operation and Development.

Trivett, N. Skillen, J. & James, B., 2001: New partnerships in supporting postgraduate research, Proceedings of 24th International HERDSA Conference, 8-11 July, Newcastle, Australia.

Tyatya, K. 2017. Transformation is an integral part of decolonising higher education. 26 June 2017.

United Nations Educational, Scientific and Cultural Organization 2008. Trends and Issues in Postgraduate Education: Challenges for Research. Dublin: Ireland.

United Nations Educational, Scientific and Cultural Organization. Inclusive education: the way of the future" International Conference Centre, Geneva. 25-28 November 2008.

Van Buuren, A. & Edelenbos, J. 2004. Why is joint knowledge production such a problem? Science and Public Policy, 31:289-299.

Van der Schyf, D.B. 2008. "Five recent developments' impact on the traditional academic culture of departments of accounting at South African universities", Meditari Accountancy Research, (2) 1-12.

Van der Westhuizen, P.C. & De Wet, J.J. 2003. The training needs of supervisors of postgraduate students in the social sciences and humanities. *South African Journal of Higher Education,* 16(3):85–195.

Van Laren, L., Pithouse-Morgan, K., Chisanga, T., Harrison, L., Meyiwa, T., Muthukrishna, N. & Naicker, I. 2014. 'Walking our talk': Exploring supervision of postgraduate self-study research through methaphor drawing. South African Journal of Higher Education 28 (2): 639-659.

Van Zyl, E. 2009. Leadership in the African context. Cape Town: Juta.

Vasquez, John A. 1997. The realist paradigm and degenerative versus progressive research programs: an appraisal of neotraditional research on Waltz's balancing proposition. American Political Science Review 91 (4 (December)):899-912. 1998. The Power of Power Politics: From Classical Realism to Neotraditionalism. Edited by Steve Smith, Cambridge Series in International Relations. Cambridge: Cambridge University Press.

Vasquez, John A. 1998. The Power of Power Politics: From Classical Realism to Neotraditionalism. Cambridge: Cambridge University Press

Venkatesh, V. Brown, S. A. & Bala, H. 2013. Bridging the qualitative-quantitative divide: Guidelines for conducting mixed methods research in information systems. MIS Quarterly, 37(1), 21-54.

Vilkinas, T. & Cartan, G. 2001. The behavioural control room for managers: the integrator role. Leadership and Organization Development Journal, 22(4), 175-181.

Vilkinas, T. & Cartan, G. 2006. The integrated competing values framework: Its spatial configuration. Journal of Management Development, 25(6), 505-521.

Vilkinas, T. 2002. The Ph.D. process: The supervisor as manager. Journal of Education and Training, 44(3):129–137.

Vilkinas, T. 2008. An exploratory study of the supervision of Ph.D./Research students" theses. Innovative Higher Education, (32) 297–311.

Volbrecht, T. & Boughey, C. 2004. Curriculum responsiveness from the margins? A

reappraisal of academic development in South Africa. In H. Griesel (Ed.), Curriculum Responsiveness: Case Studies in Higher Education. Pretoria: SAUVCA.

Wadee, A. A. Keane, M. Dietz T. & Hay, D. 2010. Effective Ph.D. supervision mentoring and Coaching. 2nd Edition. South Africa-Netherlands research Programme on Alternatives in Development SANPAD. Amsterdam: Rosenberg Publishers.

Wadesango, N. & Machingambi, S. 2011. Post graduate students' experiences with research supervisors. *Journal of sociology and social anthropology, 2*(1), 31-37.

Wadesango, N., Maphosa, C. & Moyo, G. 2014. An Academic Development Agenda for Postgraduate Research Students, Mediterranean Journal of Social Sciences, (11) 49-56.

Wakeling, P. & Kyriacou, C. 2010. Widening Participation from Undergraduate to Postgraduate Research Degrees: A Research synthesis. Swindon: NCCPE and ESRC.

Wakeling, P. & Hampden-Thompson, G. 2013. Transition to higher degrees across the UK: an analysis of national, institutional and individual differences (Higher Education Academy).

Walford, G. 1981. Classification and Framing in Postgraduate Education. Studies in Higher Education, 6(2), 147-58.

Walker, M. 2010. Doctoral education as 'capability' formation, in M. Walker and P. Thomson (eds.), *The Routledge Doctoral Supervisor's Companion: Supporting Effective Research in Education and the Social Sciences,* Routledge, Abingdon and New York.

Welman, J.C. Kruger, S.J. & Mitchell, B. 2005. Research Methodology. (3rd edn.). Cape Town: Oxford University Press Southern Africa.

Wiersma, W. 2000. Research methods in education: An introduction. Boston, MA. Allyn and Bacon.

Williams, R. 1983. Keywords: A Vocabulary of Culture and Society. London: Fontana.

Willems, J. Farley, A. Ellis, A. McCormick, D. & Walker, D. 2011. Supervising higher degree research (HDR) candidates at a distance: What do emerging virtual world of technologies have to offer? Paper presented at the Education 2011–2012 Summit, Sydney, 15–18 February.

Winberg, S. 2014. The ethics of curriculum development. Engineers and technicians in a context of development. Cape Town.

Wisker, G. & Sutcliffe, N. 1999. Good practice in postgraduate supervision, Staff and Development Association Paper, No 106, January.

Wisker, G. 2001. *The postgraduate research handbook: Succeed with your MA, MPhil, EdD and Ph.D.* Basingstoke: Palgrave.

Wisker, G. Robinson, G. Trafford, V. Creighton, E. & Warnes, M. 2003. Recognising and overcoming dissonance in postgraduate student research. Studies in Higher Education, 28(1):91–105.

Woodward, R. J. 1993. Factors affecting research student completion. In15th annual forum of the European Association for Institutional Research. Turhu, Finland.

Wright, T. & Cochrane, R. 2000. Factors Influencing Successful Submission of PhD Theses. Studies in Higher Education, 25(2), 181-195.

Zeleza, P. 2014. The Development of STEM in Africa: Mobilizing the potential of the diaspora. Paper presented at the third annual conference on ‘Effective US Strategic for African STEM Collaborations, Capacity Building, and Diaspora Engagement.’ University of Michigan, Michigan, 1–4 April 2014.

Zenger, J. Ulrich, D. & Smallwood, N. 2002. The new leadership. Training and Development, 54(3):22–28.

Zenger. J. Ulrich, D. & Smallwood, N. 2002. The new leadership. Training and Development, 54(3):22–28.

Zhao, F. 2003. Transforming quality in research supervision: A knowledgement-management approach. Quality in Higher Education, 9(2): 187-197.

Zhao, G. 2001. A cross-cultural approach toward students with disabilities. *The Journal of Educational Foundations, 15*(1), 25.

Zuber-Skerritt, O. & Ryan, Y. 1994. Quality in Postgraduate Education. London: Kogan Page.

Zikmund, W.G. 2003. Business Research Methods. 7th Edition, Thomson South Western, Ohio.

Vilkinas, T. 2002. The Ph.D. process: The supervisor as manager. Journal of Education and Training, 44(3):129–137.

Annexure A Consent Letter

Faculty of Education
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CONSENT TO PARTICIPATE IN THIS STUDY

I, confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet. I have had sufficient opportunity to ask questions and am prepared to participate in the study. I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable). I am aware that the findings of this study will be anonymously processed into a research report, journal publications and/or conference proceedings.

☐ I agree to the recording of the insert specific data collection method.

☐ I have received a signed copy of the informed consent agreement.

Full Name(s) of Researcher(s): Sehlabaka Motsie

Signature of Researcher:  Date: _____

Annexure B Request for permission to conduct research

REQUEST FOR PERMISSION TO CONDUCT RESEARCH

Dear Vaal University of Technology and Central University of Technology

I am/We are doing research and would like to request permission to conduct our research at your institution.

DATE 27/11/2018

TITLE OF THE RESEARCH PROJECT

"A framework for the enhancement of postgraduate engineering student supervision at universities of technology: perspectives from the faculty of engineering"

PRINCIPLE INVESTIGATOR / RESEARCHER(S) NAME(S) AND CONTACT NUMBER(S):

SJ Motsie	1998571416	0832336870
Name of student/researcher	Student number	Contact number

FACULTY AND DEPARTMENT:

Faculty of Education
Higher Education Studies

STUDYLEADER(S) NAME AND CONTACT NUMBER:

Dr Nixon Teis
051 401 2693 Cell 0833094959

WHAT IS THE AIM / PURPOSE OF THE STUDY?

The aim of this research study is to develop knowledge that is beneficial to Universities of Technology by developing a supervision framework that will stimulate and enhance postgraduate supervision, increase throughputs and outputs at UoTs.

WHO IS DOING THE RESEARCH?

Sehlabaka Motsie, I am a Faculty Research Officer at Vaal University of Technology and manage the implementation of research systems, policies and procedures that require Faculty participation and understanding. I co-ordinate with deans, heads of department and support services to determine the research training needs of departments for students and staff.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

This study has received approval from the Research Ethics Committee of UFS. A copy of the approval letter can be obtained from the researcher.

Approval number: Insert approval number

WHY ARE YOUR INSTITUTION/ORGANISATION/COMPANY INVITED TO TAKE PART IN THIS RESEARCH PROJECT?

As a Research Officer at the Vaal University of Technology, experiences about change or transformation of this institution, particularly an environment from teaching and learning to research is seen as a major goal to achieve given the history of these UoTs. The main reason for this research study is to attempt and achieve conclusions that depend on respondents"/participants" (postgraduate engineering students and supervisors) encounters and perspectives about postgraduate studies at two UoTs in the Faculty of Engineering.

WHAT IS THE NATURE OF PARTICIPATION IN THIS STUDY?

The study will a voluntary nature of participation and the participants' confidentiality and anonymity will be maintained throughout the study. The feelings of postgraduate engineering students, supervisors and all relevant stakeholders including postgraduate research studies at two UoTS will be explored through questionnaires and interviews. The primary purpose behind utilizing a questionnaire as a part of this study is to draw in various institutions to take an interest in the foundation of a supervision framework or model for the Faculty of Engineering. There will be 15 master's students from each UoT, 10 doctoral students from each UoT, 5 supervisors from each UoT with specific focus in the Faculty of Engineering, who will participate in this research study, there will be 1 research manager from each UoT who will also be interviewed, which brings a total of 62 participants. Perspective into the approach in this study will be pragmatic and objective in nature and techniques that will be utilized as a part of this research will likewise constitute a mix method strategy which comprises of quantitative and qualitative research methods. The questionnaires that will be utilized to assemble data from every respondent amid the information accumulation prepare by a method for closed-ended and open-ended questions, and the anonymity of the respondents/participants will be ensured. Care will be thought about keeping in mind the end goal to guarantee that the interview is easy to understand for the respondents/participants. The researcher will urge postgraduate supervisor to concentrate on the presentation, design, style, wording, and substance of every question, and they will all things considered give helpful proposals in the semi-structured interviews, after which the questionnaires will be adjusted before being conveyed to postgraduate engineering students and supervisors. Permission to utilize the recording device will be asked before the interview so as to get consent from the interviewee. The use of a recording device will empower the researcher to keep eye contact with the participant.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

The aim of this research study is to develop knowledge that is beneficial to UoTs by developing a supervision framework that will stimulate and enhance postgraduate supervision, increase throughputs and outputs at UoTs. In considering whether to approve a proposed research study, researcher must make judgments about the importance of the knowledge that is likely to result from research studies. The importance of the knowledge to be gained may increase when significant new findings are expected; when it may result in new products, treatments, or cures; or when it is applicable

to many different social groups. Targeting specific institutions such as UoTs with supervision capacity to produce more masters and doctoral graduates and advocating for public support amongst the public for a better understanding of the value of the postgraduate qualifications. It is also about creating an institutional culture that values the development of all human capacities within the institution, embedding a lifelong learning organization and promoting a quality culture not only limited to research but also to teaching, learning and community service learning activities. This study will focus on the contribution of supervision at UoTs with specific focus on the Faculty of Engineering as a process that influences many factors, including settings, the personalities of the supervisor and postgraduate engineering student, the relationship that develops between them, the expertise of the supervisor, and the problems varied among postgraduate engineering students. Confidentiality means that the respondent's identity will be known to the researcher but protected from public exposure. The researcher will keep any identifying information out of published reports. Confidentiality is particularly important when people's statements or actions would cause them some embarrassment if they became known.

WHAT IS THE POTENTIAL RISKS TAKING PART IN THIS STUDY?

The assessment of whether risks are reasonable in relation to the potential gain in knowledge is difficult to make, because those who participate in research and who will be exposed to the risks are often not the same individuals who stand to benefit from the research. Thus, the researcher must be able to clearly identify what might be learned from the research and decide whether the gain in knowledge justifies the exposure of participants to harm. The decision to participate in a research study begins with a process known as informed consent. Informed consent is referred to as a process because continued review and education must be offered throughout every stage of participation in a study, and consent to continue participation is ongoing. Through this process, participants are continually informed about the requirements of their participation, any known risks associated with participation, and any potential benefits (to themselves or to a larger community) that may result from their participation Once risks have been identified, IRBs and investigators must ensure that they are minimized to the extent possible within the limitations imposed by the nature of the research study. Risks may be reduced in a variety of ways, for example, by assuring that the study design is valid; the researcher is qualified to conduct a study; the necessary infrastructure is in place to conduct the research and deal with any harmful sequelae; participant privacy and confidentiality are adequately protected; participants are properly monitored; criteria for participant enrollment and withdrawal are appropriate; a timely treatment plan is in place; and prospective participants at undue risk of harm are excluded.

WILL THE INFORMATION BE KEPT CONFIDENTIAL?

Confidentiality pertains to the treatment of information that an individual has disclosed in a relationship of trust and with the expectation that it will not be divulged to others without permission in ways that are inconsistent with the understanding of the original disclosure. During the informed consent process, participants will be informed of the precautions that will be taken to protect the confidentiality of the data and be informed of the parties who will or may have access (e.g., research team). This will allow participant to decide about the adequacy of the protections and the acceptability of the possible release of private information to the interested parties. Primary concerns of the researcher will be threats to privacy and breaches in confidentiality. Privacy and confidentiality risks related to psychological, social, and legal harms are heightened. Protocols will be designed to minimize the need to collect and maintain identifiable information about research subjects. If possible, data will be collected anonymously or the identifiers will be removed and destroyed as soon as possible and access to research data will be based on a “need to know” and "minimum necessary" standard. When

it is necessary to collect and maintain identifiable data, the researcher will ensure that the protocol includes the necessary safeguards to maintain confidentiality of identifiable data and data security appropriate to the degree of risk from disclosure.

HOW WILL THE INFORMATION BE STORED AND ULTIMATELY DESTROYED?

Feedback from researchers who have had to gain permission from participants to conduct a research suggests that universities sometimes place extreme demands on researchers. These demands have included gaining consent for each step of the research and ensuring data are destroyed on completion of a project, without exploring other avenues to "protect" participants. The data will be stored on a USB and computer folder, both encrypted. All questionnaires and interviews will be securely stored in a locked cabinet in the researcher's office at all times. Access to raw data will be limited to the research team and, potentially, examiners. Data will be retained for 3 years. Following this period, all electronic copies of the data will be deleted from all storage sites and all paper copies will be shredded. It is recommended that data containing personal details that would lead to the identification of participants (e.g. participants' email addresses, consent forms) should be deleted/destroyed as soon as possible. So if participants provide a researcher with their contact details in order to be contacted about taking part in the study, this should be retained only until they have participated in the study, or until they have informed you that they do not wish to take part. However, if a participant says they would like to receive a summary of the research at the end of the study, it would be appropriate to retain their contact details until this summary has been sent out.

WILL THERE BE PAYMENT OR ANY INCENTIVES FOR PARTICPATING IN THIS STUDY?

Incentives for and payments associated with participation in research (e.g., remuneration for transportation, childcare, or lost work time) should not be considered much as potential benefits to research participants. Such potential benefits to research participants make it feasible to participate, but they do not result directly from study procedures in which the individuals participate. Including such incentives as potential benefits in the research would inappropriately skew judgments concerning risks and potential benefits, because nearly any level of research risk could be offset by such gains if they were significant enough, for example, if participants were promised large sums of money for participating in research. Although the researcher should not consider such incentives or payments as benefits, they should recognize that prospective participants might consider them as such. Thus, the researcher will determine whether incentives or payments are set so high that they induce prospective participants to enroll without carefully considering the risks involved in participation. Prospective participants might have an economic vulnerability when they have the cognitive capacity to consent but are disadvantaged in the distribution of social goods and services such as income, housing, or health care. This type of vulnerability heightens the risk that the potential benefits from participation in the research study might constitute undue inducements to enroll, threatening the voluntary nature of the choice and raising the danger that the potential participants distributional disadvantage could be exploited. For example, offers of large sums of money as payment for participation or access to free health care services (for conditions not related to the research) could lead some prospective participants to enroll in a research study when it might be against their better judgment and when otherwise they would not do so. To safeguard against this vulnerability, the researcher will make certain that research offers a reasonable choice to prospective participants. This might be an easy assessment for the researcher reviewing a research study in which payment is involved, and the amount of payment could be reduced. However, it can be more difficult for the researcher when the potential benefits include access gifts or funds. Describe any payment or reward offered, financial or otherwise. Any costs incurred by the participant should be explained and justified.

HOW WILL THE INSTITUTION / ORGANISATION / COMPANY BE INFORMED OF THE FINDINGS / RESULTS OF THE STUDY?

If you would like to be informed of the final research findings, please contact Mr Sehlabaka Motsie on Tel: 0169507639 Cell: 0832336870 fax 016 950 9779 email address: sehlabakam@vut.ac.za or website www.vut.ac.za. The findings are accessible for 3 years. Should you require any further information or want to contact the researcher about any aspect of this study, please contact Mr Sehlabaka Motsie on Tel: 0169507639 Cell: 0832336870 fax 016 950 9779 email address: sehlabakam@vut.ac.za. Should you have concerns about the way in which the research has been conducted, you may contact Supervisor of the study Dr Nixon Teis, 051 401 2693 Cell 0833094959 email address: TeisNJP@ufs.ac.za. Researchers and Human Research Ethics Committees (HRECs) are required to determine the existence, likelihood and severity of these risks based on the research methodology and design, participant population and research activity. The probability or magnitude of harm or discomfort anticipated in this research is not greater in itself than that ordinarily experienced in daily life. • The participants will be adults and not considered to be a vulnerable research population. • The research will collect information that would generally be regarded as non-sensitive. • The information can generally be collected anonymously or participants may not insist on keeping the collected information strictly confidential. • Use of questionnaires (that do not involve sensitive questions) sent to non-vulnerable adult participants, and returned anonymously so that participants cannot be identified.

Yours sincerely

Sehlabaka Motsie

Annexure C UFS GENERAL/HUMAN RESEARCH ETHICS COMMITTEE (GHREC)

04-Mar-2019

Dear Mr Motsie, Sehlabaka SJ

Application Approved

Research Project Title:
A framework for the enhancement of postgraduate engineering student supervision at universities of technology: perspectives from the faculty of engineering.

Ethical Clearance number: **UFS-HSD2018/0012**

We are pleased to inform you that your application for ethical clearance has been approved. Your ethical clearance is valid for twelve (12) months from the date of issue. We request that any changes that may take place during the course of your study/research project be submitted to the ethics office to ensure ethical transparency. furthermore, you are requested to submit the final report of your study/research project to the ethics office. Should you require more time to complete this research, please apply for an extension? Thank you for submitting your proposal for ethical clearance; we wish you the best of luck and success with your research.

Yours sincerely

Dr. Petrus Nel

Annexure D Central University of Technology, Free State

INSTITUTIONAL PLANNING AND QUALITY ENHANCEMENT

Central University of Technology, Free State

MR SEHLABAKA JOHANNES MOTSIE sehlabakam@vut.ac.za

PERMISSION FOR MR SEHLABAKA JOHANNES MOTSIE TO CONDUCT RESEARCH AT CUT FOR HIS PH.D. RESEARCH ENTITLED "A FRAMEWORK FOR THE ENHANCEMENT OF POSTGRADUATE ENGINEERING STUDENT SUPERVISION AT UNIVERSITIES OF TECHNOLOGY: PERSPECTIVES FROM THE FACULTY OF ENGINEERING"

Dear Mr Sehlabaka Johannes Motsie

This is to confirm that you have been granted permission to conduct research at CUT for his Ph.D. research entitled "A Framework for The Enhancement of Postgraduate Engineering Student Supervision at Universities of Technology: Perspectives from The Faculty of Engineering"

The conditions of the conditional permission are:

- The survey will not interrupt any of the official activities at the CUT;
- You will supply us with the copy of your report;
- The cost of all related activities will be covered by yourself:
- Recruitment of participants is the sole responsibility of yourself;
- Voluntary nature of the potential participant's decision to consent to participate should be strictly observed;
- You should not disclose a potential participant's decision to participate or otherwise to any other party;
- Permission does not compel, in any sense, participation of staff members or students in your survey.

ACTING DIRECTOR: PLANNING AND QUALITY ENHANCEMENT

Prof. A Szubarga

08 March 2019

Annexure E Vaal University of Technology, Vanderbijlpark

Vaal University of Technology

Your world to a better future

Memorandum

RESEARCH DIRECTORATE Tel: +27(0)16 950 9573 Fax: +27(0)16 950 9898

To: Mr S Motsie

cc: Director Research: Dr SM Nelana

From: The Registrar: Dr TD Mokoena

Date: 01 April 2019

Subject: Research Ethics Permission Approval Dear Mr Motsie

Thank you for your recent application wishing to conduct research within our Institution. It is with great pleasure that we would like to inform you that your request to conduct research in the Vaal University of Technology has been approved subject to your assurance that any information obtained will not be divulged or identifiable in any published results.

You are therefore required to sign a confidential letter of acknowledgement.

Dr TD Mokoena

Registrar

Research and Innovation Ethics Private Bag X 024 VANDERBIJLPARK ' 1900 Vaal University of Technology