Factors influencing career choice of learners in engineering: a case of a selected university of technology in South Africa

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FACTORS INFLUENCING CAREER CHOICE OF LEARNERS IN ENGINEERING: A CASE OF A SELECTED UNIVERSITY OF TECHNOLOGY IN SOUTH AFRICA

by

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DECLARATION

I, Zelda Janse van Rensburg hereby declare that the contents of this dissertation represent my own unaided work, and that the dissertation has not previously been submitted for academic examination towards any qualification. Furthermore, it represent my own opinions and not necessarily those of the Cape Peninsula University of Technology.

Signed

2017/08/21
Date

ABSTRACT

A steady decline in student enrolment at the Tshwane University of Technology's Faculty of Engineering and the Built Environment (TUTFEBE) was seen in recent years. Small numbers of South African pupils have been matriculating with Mathematics as a subject, and most of them have been underperforming. Since there has been no scientific evidence to date on which recruitment and guidance efforts work best for attracting quality learners for courses in engineering at the Tshwane University of Technology (TUT), this study was conducted to identify the factors that influence learners' choice of engineering as a career. This information could assist in the design of an evidence-based recruitment and marketing model.

A single-case explanatory study design was used for this research, since it focused on the TUTFEBE. A quantitative and qualitative study was completed by means of inputs from first-year extended curriculum engineering programme students. The data was analysed using the Statistical Package for the Study of Social Sciences (SPSS). By studying the qualitative data from more than one viewpoint, the quantitative findings were verified and triangulated.

The influences that played a role in learners' career choices were identified. Thematic clusters emerged as stimulation or creation of an awareness of or *interest* in engineering, the influences of different *people* on learners' career choices, relevant *exposure* to careers in engineering, the huge impact of Maths and Science *teachers* on learners' career decision-making, *method of teaching*, *employability* and the *image and reputation* of an institution. It became evident that engineering faculties themselves need to assume responsibility for the recruitment of their students. Copying seems to be the main coping strategy in most institutions regarding marketing and recruitment engagements. Although many of TUTFEBE's current marketing and recruitment actions were on par with the rest of the world, alternative actions were identified and implemented in the model.

Informed consent in written format for both the quantitative and qualitative studies was obtained from the subjects after they had been informed what the purpose, risks and benefits were and which procedures would be implemented to ensure confidentiality. The subjects were informed of their right to withdraw at any stage, without any penalty or disadvantage, and were assured that withdrawal would in no way influence their continued relationship with the researcher or their academic progress at TUT.

DEDICATION

This study is dedicated to my mother, Willimina Cecilia van Wyk, who always encouraged me to be the best person I can possibly be. In Standard 8 (Grade 10) she was awarded a bursary to further her studies, but in those days women were not seen as corporate material, and her father denied her the opportunity.

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To my Heavenly Father, without whom I would not have been able to complete this dissertation.

To my husband, who stood by me, assisted me, and allowed me to pursue this challenge. To my family, who understood how important it was to me to finish this study, and who lost out on much of my time.

To my supervisor, Dr Michael Twum-Darko, who supervised my studies over a long distance and who always responded rapidly to my email messages of requesting guidance.

To so many of my colleagues at the Tshwane University of Technology, who inspired, supported and assisted me.

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LIST OF ABBREVIATIONS AND ACRONYMS

APS	Admission Point Score
COLT	Culture of Learning and Teaching
CPUT	Cape Peninsula University of Technology
DSE	Discover Science and Engineering
ECSA	Engineering Council of South Africa
EUN	European Union Nation
FCTL	Faculty Committee for Teaching and Learning
FEBE	Faculty of Engineering and the Built Environment
FET	Further Education and Training
FREC	Faculty Research Ethics Committee
FYE	First-year Experience
IET	Institute of Engineering and Technology
HEI	Higher Education Institution
HEQSF	Higher Education and Qualification Sub Framework
MS	Mathematics and Science
MST	Mathematics, Science and Technology
N Dip	National Diploma
NSFAS	National Student Financial Aid Scheme
PG	Postgraduate
PISA	Programme for International Student Assessment
RPL	Recognition of Prior Learning
SCCT	Social Cognitive Career Theory
SCT	Social Cognitive Theory
SET	Science Engineering and Technology
SPSS	Statistical Package for the Study of Social Sciences
SRS	Student Recruiting Students
STEM	Science, Technology, Engineering and Mathematics
TAMIU	Texas M&A International University
TMP	Teachers' Mentorship Programme
TOW	Teachers' Outreach Workshop
TUT	Tshwane University of Technology
TUTFEBE	Tshwane University of Technology Faculty of Engineering and the Built Environment
TVET	Technical Vocational Education and Training
UoT	University of Technology
WIL	Work-integrated Learning

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CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Learner recruitment forms a critical component of a university's business. As such, the Tshwane University of Technology (TUT) is convinced that an effective and targeted approach is essential in order to ensure that enrolment targets are met and that national skills, competency and capacity needs are addressed. In the Ministerial Statement on Student Enrolment Planning 2011 to 2014 (South Africa: Department of Higher Education and Training, 2013:10), the targeted enrolment percentage for Science, Engineering and Technology (SET) at TUT was 40%. The Faculty of Engineering and the Built Environment (FEBE) worked towards this goal with the challenge to identify information about the factors that influence learners' career decisions. In this regard, Burmeister makes the following statement (South Africa. Department of Labour, 2011):

> *Too often, schools and universities are not turning out the skills required by business. There is a critical need for research and accurate information to ensure we have enough of the right kinds of skills. When it comes to increasing scarce skills, the only real long-term solution is to increase the pipeline of entry-level skills into critical areas.*

In view of this statement, it was critical to define new marketing and recruiting methods to target learners with the right traits to study engineering at the FEBE. Hence, one of the objectives of this research was to determine whether the creation of awareness of the fields in engineering would lead to the recruitment of learners with the necessary attributes to successfully study engineering at a given university. Watermeyer and Pillay (2012:52), drawing from work done at Duke University (2005), define dynamic engineers as being people who can apply abstract thinking, are problem solvers, possess strong interpersonal skills, can work well in teams, and are innovators.

In South Africa, the government has embarked on a drive to educate the youth in Physical Science and Mathematics to increase the number of learners who can pursue engineering as a career to support its infrastructure development and economic growth. Case (2006:25) cautioned that the government would implement a funding formula to penalise institutions with low throughput rates. This reinforced the importance of this study for TUTFEBE.

To identify learners with the right attitude and aptitude to study engineering, certain factors that play a role in their career choice need to be considered. That prompted this research to investigate marketing and recruitment concepts to recruit learners with the correct profile for the FEBE. It was assumed that by applying effective messages and activities, the links between engineering and the enabling subjects, namely Mathematics and Physical Science, would be demonstrated. One such an activity referred to by Dawes et al. (2008:1) is to engage current students and learners to participate together in interesting projects addressing real-world problems. These activities enhance the profile of engineering. Youngman and Egelhoff (2003:13) argue that *multiple* recruiting strategies should be applied. The implication is that recruitment is everyone's job – university staff and students should be informed accordingly.

With national and international institutions competing for an applicant pool that is shrinking due to the current problems experienced in the education system, learner recruiting has become a critical discipline (Maringe, 2006:466). Maringe (op. loc.) argues that applicants are no longer passive and that marketing and recruiting should focus on what the learners find to be the most important aspects, as they will become consumers and their focus will shift to return on investment.

Wolhuter et al. (2003:34) did a comparative study on the education systems of two developing countries, namely South Africa and Madagascar, and concluded that students did not function on a level relevant to their real educational needs. This was because neither of the countries provided sufficient opportunities for equipping learners with the knowledge, skills and attitudes they needed.

The Technologies 2010 (a service application program), which determines what happens in real time, declares in Proven Best Practices for a Competitive Marketplace (2010:1) that:

> *For colleges and universities to survive and thrive, they must cater to the changing needs of today's students. That requires being highly effective and highly efficient across the entire student acquisition lifecycle, from marketing and first contact through acceptance and registration.*

The expected outcome of this research is the identification of the factors that contribute to learners' choice to pursue a career in engineering. With this knowledge, a contribution can be made to the design of an educationally sound and relevant multifaceted marketing and recruitment model for the TUT Faculty of Engineering and the Built Environment (TUTFEBE). The research envisaged a framework that focuses on classifying actions that are expected to stimulate increased numbers of learners to study Mathematics and Physical Science at school

level, and to encourage them to become engineering graduates and ultimately apply their qualifications in the industry.

The related factors considered were the following:

- Awareness of parents of career possibilities for their children
- Relationships with school principals
- Relationships with Mathematics and Science teachers in the top feeder schools.

1.2 RATIONALE OF RESEARCH

1.2.1 Background

Drawing on the work of ECSA (2010a), Watermeyer and Pillay (2012:47) emphasise the need for more engineers and indicate that South Africa requires ten times more engineers than it currently has to compete with the rest of the world. This is confirmed by Jian et al. (2010:147) when they state that the lack of enrolled students in engineering may lead to reduced income, financial uncertainty, instability, redundancy, and ultimately to the closing of programmes in the country and tertiary institutions. The relatively small pool of prospective engineering students makes the recruitment of these learners even more challenging. Howie (2005:175) indicates that insufficient numbers of South African pupils matriculate in Mathematics and that the majority underperform. Jawitz et al. (2000:472) point out a further complicating factor when they note that the engineering field has to compete against other professions like medicine and commerce to recruit suitable students.

According to Case (2006:27), more involvement by the engineering profession in schools should be promoted to encourage learners to consider engineering as a career. Learners who show the potential to pursue Mathematics and Physical Science should be identified and made aware of the engineering profession, and they should ultimately be assisted to gain entry into higher education institutions.

In this study, the recruitment methods currently used at TUTFEBE were studied, and the financial and human resources employed to attract students were scrutinised. It was important to identify the factors influencing learners' choice of engineering as a career, to assist with the improvement of the marketing and recruitment actions and to apply these resources optimally.

This research made a critical contribution through identifying actions to create awareness of engineering courses, highlighting the importance of Mathematics and Physical Science, and identifying resources that produced a larger pool of qualifying learners to select from.

1.2.2 Global decline in engineering student numbers

The issues related to the recruitment of learners for engineering programmes at tertiary institutions are not unique to TUT or to South Africa. High demand and lack of capacity in the engineering fields are worldwide phenomena. A similar phenomenon was evident in the Faculty's declining numbers of students from 8 066 registered students in 2008 to 7 414 in 2012 (refer to Figure 1.1 below).

The figure below indicates the headcounts of registered students in the Faculty of Engineering and the Built Environment (FEBE) at TUT. These figures indicate a steady decline in student numbers for the past five years.

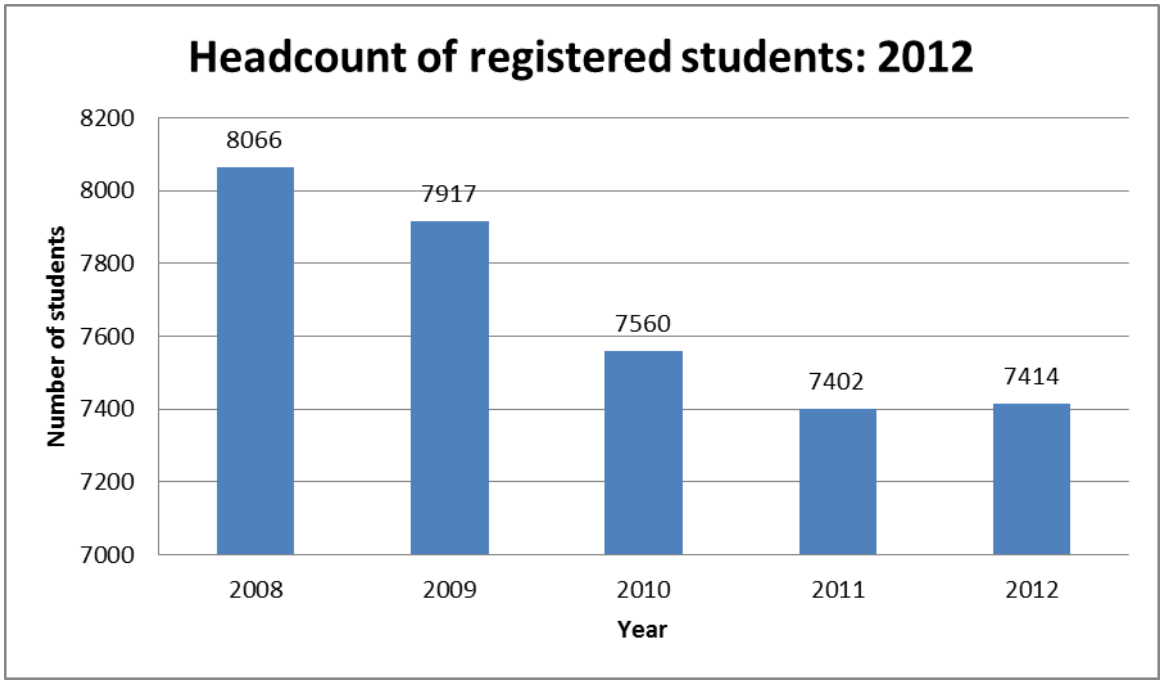

Figure 1.1: FEBE's registered students. Data from TUT Management Information System (TUT, 2012)

Johnson and Jones (2006:1) reported on a declining interest in engineering studies at a time of increased business needs, and attempted to formulate a comprehensive plan for addressing this challenge. One of the ways they suggested was to put more effort into attracting students for engineering programmes. The objective of their study was to investigate the sustainability of engineering faculties in the context of learner marketing and recruitment approaches to determine high impact modes of recruitment.

1.2.3 Local perspective on student recruitment

The international trends noted by authors such as Johnson and Jones (2006:1) have also been evident in South Africa. Headcount enrolments in Science, Engineering and Technology (SET) grew by 4.4% a year between 2000 and 2009, and graduation rates in these areas grew

by 5.5% annually. The data also indicated that qualification rates may be improving. However, the Minister of Higher Education and Training recently stated that, *despite this achievement, South Africa was still not producing enough SET graduates to meet its economic development objectives* (2012:38).

The importance of recruiting learners with suitable attributes for engineering programmes is anchored in the core principle that South Africa, as a developing country, needs skilled graduates in order to meet the infrastructural needs of the country, as explained by Case (2006:13).

Johan Pienaar, registration manager at the Engineering Council of South Africa (ECSA), declared, among others, that the lack of engineering capacity impeded development in the country (Du Toit & Roodt, 2009:3). The latter authors also refer to Lawless (2005), who stated that South Africa was experiencing one of the worst crises in years in terms of capacities and scarce skills, that is, *those skills which are in short supply but which can be obtained through short-term targeted training*. It is therefore a socio-economic imperative for higher education institutions to contribute towards recruiting and training learners in the fields where skills scarcity is experienced or expected.

In a study done by Cosser and Du Toit (2002:75), learners' choice of institution was identified as follows: 10.6% did not know which institution they preferred, 34.6% indicated that they preferred university studies, and 54.8% stated that they preferred technikon (university of technology (UoT)) education. This study also found a direct correlation between Grade 11 academic performance and the choice of institution. It was noted that the majority of respondents mentioned a UoT as their institution of choice. One of the medium-term interventions suggested by Lawless in 2005 (Watermeyer & Pillay, 2012:46) to address the shortfall of engineers in the country was to increase the number of technologists. This supports the importance of increasing the recruitment of suitable students for the TUTFEBE, as a university of technology that trains technicians and technologists.

According to The European Commission Report, 2006 (in Du Toit & Roodt, 2009:43) the major factor for students not opting for a career in engineering is a lack of information. They also confirmed that much more should be done to market engineering as an attractive career.

1.3 PROBLEM STATEMENT

There has been a steady decline in student enrolment at TUTFEBE for the past five years, from 8 066 registered students in 2008 to 7 414 in 2012. Howie (2005:176) indicated that low numbers of South African pupils were matriculating in Mathematics and that most of them

underperformed. Proposed ways for reversing this trend form part of the marketing and recruitment model. A case study was conducted, since there was no scientific evidence on which recruitment and guidance efforts worked best for attracting quality learners to TUTFEBE. Only anecdotal evidence and assumptions existed about how students made their choices to study engineering, and what factors influenced those choices.

The particular focus on engineering as an educational skills domain and career option was identified as a critical skill (critical skills are particular high-level skills within certain occupations) as well as a scarce skill (those skills which are in short supply but which can be obtained through short-term targeted training) in South Africa (Watermeyer & Pillay, 2012:52). Maringe (2006:470) argues that the study course tends to be closely related to the choice of institution. The factors influencing this choice were found to be the learners' secondary school results, the reputation of the course with employers, the graduate employment rate, and the approaches to teaching, learning and assessment at the institution.

In a study conducted by Merrill et al. (2008:48) it was found that significant improvement in student learning was achieved after professional development of teachers had taken place. Even though signs of engineering applications are all around us, engineering has also been referred to as the invisible profession, according to Banganayi (2012:11). The challenge was to be able to influence learners' views through the effective creation of awareness that everything manmade in the world of today has been engineered in some way. These marketing and recruitment actions for the different target groups needed to be identified. This research investigated these formats of messaging and packaging the profession as an attractive and vibrant choice. This factor was reinforced by Anderson and Gilbride (2003:87) when a Discover Engineering summer camp was presented to female Grade 10 learners. These learners, who initially had limited knowledge about engineering, were tested afterwards, and 50% of them indicated that they were 'investigating' engineering as a career choice.

A further complicating factor was pointed out by Jawitz et al. (2000:470), when they noted that the engineering field needed to compete against other professions like medicine and commerce in recruiting students. It was theorised that if learners were made aware of the career choices in engineering at a younger age, a larger pool of students interested in engineering would be created. These were some of the factors investigated to identify the contributing factors influencing the decisions of learners when they opted to register at TUTFEBE. Due to the declining numbers of students in TUTFEBE and the poor quality of students the FEBE attracted, the influences which played a role in the learners' decision to choose TUTFEBE as their institution of choice were investigated. More applicable marketing

and recruitment actions were identified. It is envisaged that these actions will assist the FEBE marketing and recruitment model to grow its own timber.

Gattis et al. (2003:71), in their study on a student-to-student recruitment approach, revealed that there was a definite increase in student enrolment, student quality, faculty allocation, quality pool for undergraduate research, and an income in the form of tuition and laboratory fees when that approach was followed. Quality interaction with an engineering faculty had a significant impact on a student's decision to pursue graduate studies, since such interaction provided the student with effective role models (May & Chubin, 2003:35).

1.4 RESEARCH OBJECTIVES

The main research objective was to determine marketing and recruitment actions that could be carried out by TUTFEBE to increase the number of prospective engineering students. The secondary objectives were:

1. To determine which actions are most effective in motivating learners and prospective students to excel in Mathematics and Physical Science.
2. To establish which primary factors influenced the career choices of current students in engineering.
3. To determine if social marketing platforms to recruit prospective engineering students at TUTFEBE are successful.
4. To recommend a general marketing and recruitment framework to assist with increasing the number of learners registering for engineering courses.

Youngman and Egelhoff (loc. cit.) suggest that recruitment strategies for learners should be direct, high-touch, high-visibility and multifaceted.

1.5 RESEARCH QUESTIONS

In order to formulate the research objectives that were derived from the problem statement, the research questions below were considered, and they were based on the objectives and the literature reviewed.

The identified objective indicated in the problem statement led to the main research question:

> *Which actions should be implemented in the marketing and recruitment efforts to attract quality learners for the Faculty of Engineering and the Built Environment at the selected university of technology (TUT)?*

To address the main research question, the following secondary research questions were answered:

1. What are the critical components or sub-strategies in an ideal marketing and recruitment model for the faculty in promoting choices for engineering as an educational and career field?
2. What actions are most effective in motivating learners to excel in Mathematics and Physical Science?
3. What were some of the primary influencing factors in the career choices of current students in engineering?
4. Are social marketing platforms appropriate resources to utilise?

The research covered a comprehensive literature review and survey on the above research questions to first-year extended curriculum students.

1.6 SUMMARY OF THEORETICAL FRAMEWORK

1.6.1 Introduction

The recruitment of suitable learners to pursue engineering qualifications at a university is a social phenomenon. As a socially constructed reality, the problem can be understood and interpreted using social theories. This research was grounded in the social cognitive theory (SCT) of Albert Bandura, and the social cognitive career theory (SCCT). Bandura's social cognitive theory mentions three *building blocks* of career development, namely self-efficacy, outcome expectations and personal goals.

Leung (2008:125) identified the SCCT theory as one of the "Big Five" career guidance and development theories. The SCCT theory is derived from Lent et al. (2003:459), who explain the responsiveness to environmental support and barriers in choice behaviour.

Barnard et al. (2008:53) refer to Stead and Watson (2006), who claim that the SCCT theory is fitting for South Africa because it addresses the concern of career barriers experienced in pursuing employment, and remaining employed, in this country. This theory addresses the broader framework in the dynamic aspects of human behaviour. It considers the following socio-cultural factors as imperatives: choices, learning environment, goals, performance, change and adjustment. Self-efficacy refers to learners' or students' beliefs in their ability to succeed. For this study, the learners' belief that they can succeed in Mathematics and Physical Science was studied (Mathematics and Physical Science efficacy).

According to SCCT, "outcome expectations" represent learners' beliefs about the outcome of performing particular behaviours, whereas "personal goals" signify the students' determination

to engage in a particular activity to effect a particular outcome (Brown & Lent, 1996). Walsh and Heppner (2006:112) suggest that SCCT is particularly concerned with

> *… specific cognitive factors that mediated the learning experiences guiding career behaviour; the interrelationships of interest, abilities and values; the paths by which contextual and individual factors influence career choice and behaviours and the processes by which individuals' exercised personal agency.*

Both the role of personal goals as *individual factors* and the role of Mathematics and Physical Science teachers as *contextual factors* in learners' decisions to follow a career in engineering were examined. Furthermore, contextual factors that might support or undermine a learner's ability to pursue a career in engineering were explored.

This study investigated how student's flawed self-efficacy beliefs, namely *their belief that they cannot succeed,* or outcome expectations, namely *their expectation that they would not complete their studies in engineering,* eliminated possible careers in engineering. The perceived support factors of and barriers to a career in engineering and technology were studied in SCT and SCCT (Brown & Lent 1996), and the relevance of those factors and barriers to this study are illustrated in Figure 1.2 below.

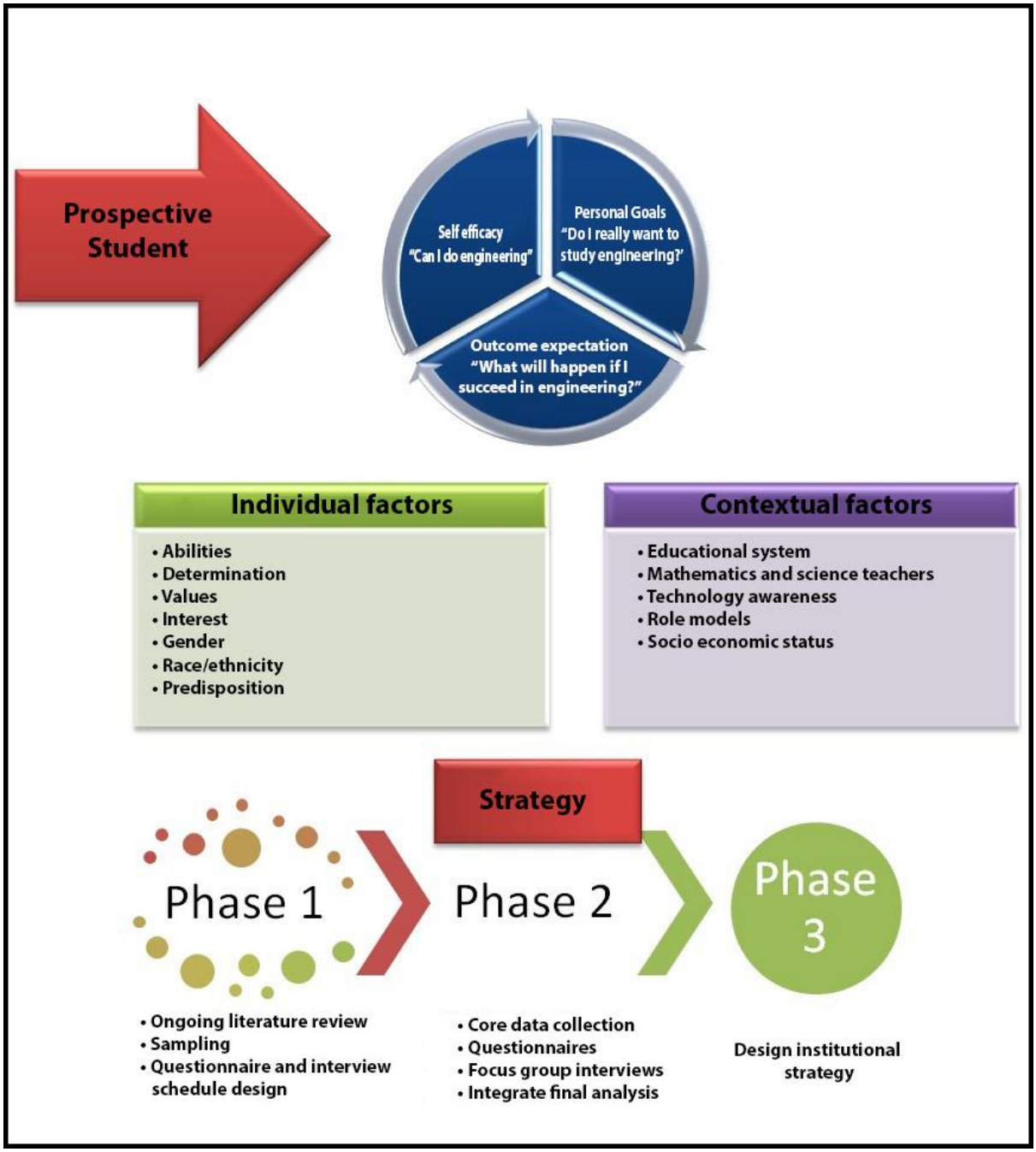

Figure 1.2: Problem conceptualisation (adapted from Lent et al., 2002)

1.6.2 Problem conceptualisation

The main variables influencing livelihood choices identified in SCCT, namely self-efficacy, outcome expectations and personal goals interwoven with contextual and individual factors, were tailored for this study and led to the identification of the factors influencing learners' career choices.

The SCCT diagram was used as a guide to design the questionnaire for the quantitative study, and directed the construction of the interview schedule in the qualitative study.

The questionnaire was designed to obtain an overview of the respondents' environment and their socio-economic status, as the environment plays a major role in the learning experiences of learners (Lent et al., 2002:36). The *what* and *where* questions assisted in determining the influences that played a role in career choices, while the *how* and *when* questions defined how decisions were made (Brown & Lent, 2013:7).

Faculty interventions, teachers, parents, friends and role models were identified as some of the variables that have a definite influence on learners' choices and students' performance (Lent et al., 2000:36). The importance of awareness creation at an earlier stage is evident in the literature. Specific questions addressing the contextual and individual factors were included in the questionnaire.

Learning experiences direct a subject's self-efficacy, outcome expectations and goals. The individual factors that played a role in career choices were determined, for example, interests, values and goals.

This data assisted in designing an empirical, multifaceted marketing and recruitment model. Interventions were applied when various interactions were adopted, based on the influences of variables on career choices of learners. It is assumed that these interactions will ultimately direct and inform learners on career choices in engineering and build a pipeline of suitable learners to recruit from for the FEBE.

1.7 SUMMARY OF LITERATURE REVIEW

1.7.1 Introduction

The importance of engineers for sustainable economic growth in a country was discussed. This highlighted the importance of technological literacy in society and the creation of awareness of careers in engineering among learners so that they could ultimately become prospective students. Ideas on how to promote awareness of engineering in the different target groups were identified. This was followed by the identification of the different influences that played a role in the career choice behaviours of prospective students. Based on identified influences and the identification of what had already been done in the past, a multifaceted evidence-based marketing and recruitment model for the FEBE was the outcome of this study.

The aim of the research was to explore the most effective methods of promoting engineering and ultimately how to disseminate the information on engineering careers at TUTFEBE.

1.7.2 Importance of the profession

Du Toit and Roodt (2009a:36, 38) explain the direct influence the skills shortage has on the development and maintenance of infrastructure as well and on the economic growth of a country. They continue as follows (2009:39):

> *According to Productivity SA and the 2007 International Institute for Management Development* ***World Competitiveness Yearbook****, South Africa has the world's highest brain drain and the worst skill shortage of 55 country studies, its productivity is plummeting and the country is ranked last on the availability of engineers.*

Edwards et al. (2004:374) conducted research in the United Kingdom on the decreasing number of civil engineers in that country, and they described the possible effects the lack of this skill (to mention only one) could have on the future of their country. One of the implications they foresaw was an inability to improve infrastructure and to meet infrastructural needs that are crucial for economic growth. According to Misran et al. (2012:568), the decrease in students entering the engineering field is a global phenomenon.

1.7.3 Factors influencing the declining interest in engineering

The different influences on career choices that play a role in the behaviour of prospective students were ranked according to importance. The knowledge thus obtained determined which actions to apply to make learners aware of engineering as a profession and which methods to utilise to attract suitable learners with the preferred aptitude to TUTFEBE.

1.7.3.1 Declining quality of Mathematics and Physical Science education

Du Toit and Roodt (2009a:41) found that the reasons for the declining number of engineering students were mostly linked to the declining quality and level of Mathematics and Physical Science knowledge of learners exiting the school system, which seems to be a universal problem. Prieto et al. (2009:184) indicate similar trends in Australia, the United Kingdom, Europe and the USA.

Christensen et al. (2014:173) support this notion and raise their concern about the negative impact on the workforce in the USA of the decline in students completing their Science, Technology, Engineering, and Mathematics (STEM) degrees.

The need for a study of this kind was brought to light by Grygo (2006:18), who identified learners' lack of knowledge of the importance of the academic preparation they need to prepare them for the career they are interested in following.

1.7.3.2 Competition for small pool of Mathematics and Physical Science students

Competing against other professions for the same limited pool of learners was also not unique to SA. In Malaysia, the top 128 Higher Certificate of Education learners in 2004 opted for the medical programme instead of engineering (Othman et al. (nd). Similar trends are experienced in South Africa. The high demand for South African graduates internationally, as a result of the excellent engineering education in this country, has been identified as an additional threat (Du Toit & Roodt, 2009b:75).

1.7.3.3 Invisible profession

When identifying the lack of information about the engineering profession as a factor influencing learners' choices, du Toit and Roodt (2009c:93) also referred to the European Commission Report 2006, which stated that even on an international scale students did not have a precise idea of what engineering careers entailed. Even though signs of engineering application are all around us, engineering has been referred to as the invisible profession (Banganayi, 2012:11). The challenge is to influence the prospective students' views through effective messaging and to make them realise that everything around us has been engineered in some way.

It was found that the frame of reference regarding engineering of most people, especially those who do not have any engineering background, was limited to consumer electronics, like cellular phones and MP3 players (Takala & Korhonen-Yrjänheikki, 2013:1562).

1.7.3.4 Possible actions to address declining engineering student numbers

Kearney (2010:11) explains the different approaches and efforts in various countries to enrich learners at school level with Mathematics, Physical Science and Technology knowledge. The programmes and initiatives vary from science clubs to mathematics centres to private-public partnerships between education and industry. France, for instance, presents competitions for secondary-level students.

Many of the activities that are utilised internationally have also been applied at TUTFEBE, for example, competitions in the different engineering fields and interactive partnerships. This was one of the major recruitment actions used to inform learners of the different options in engineering. However, there is no evidence of how effective these events were towards securing students for the FEBE. Learners' exposure to TUT was a strong persuader for them to form their views and were assisted in their decision on the institution of their choice (Misran et al., 2012:573).

1.8 OVERVIEW OF RESEARCH APPROACH

1.8.1 Introduction

The phenomenological method of enquiry was used for this study. According to De Vos et al. (2011:316), such an approach enables the researcher to gain an understanding of the subject's *life setting*. This method suited the purpose of the study, namely to understand and interpret the factors, dimensions and realities that influence learners' decisions, and to determine how this knowledge can be utilised to recruit learners into career fields in engineering. As a result, the researcher followed a mixed approach with a combination of quantitative and qualitative methods. This allowed the researcher to use the data in the design of the *marketing and recruitment* model (Leech et al., 2010:19). Patton (1990) declared that:

> *a phenomenological study is one that focuses on descriptions of what people experience and how it is that they experience what they experience.*

In order to understand the elements in question, various practical steps were applied and the research strategy was structured into three main phases, as demonstrated in Table 1.1.

Table 1.1: Summary of research strategy

Research strategy and purpose	Practical steps
Phase 1: Literature review Sampling Development of questionnaire	 Ongoing literature review. Convenience sampling: accessible group of engineering students. A structured questionnaire was developed based on factors identified through literature and the researcher's own experience as well as knowledge of the various elements of marketing and recruitment.
Phase 2 (a): Structured analysis of perceptions and experiences – core data collection	 Structured questionnaire and statistical analysis (SPSS).
Phase 2 (b): Focus group interviews – verification of findings	 Qualitative analysis of data was captured manually after the interview sessions. Triangulated outcomes with findings from structured questionnaire.
Phase 2(c): Integration and final analysis	Combined quantitative and qualitative findings.
Phase 3: Reported and formulated elements to impact on a marketing and recruitment plan. Formulated aspects to inform the action plan for influencing career decisions of learners towards engineering careers.	

A mixed-method approach was used. A phenomenological framework directed the study to focus on an increased understanding and ultimately identification of the specific elements that had an influence on *when* and *how* learners made decisions about possible careers in engineering.

Further and complementary to the quantitative approach, qualitative data was collected by means of a smaller sample of focus group style interviews conducted with first-year students who also completed the questionnaire. Savenye and Robinson (2004:1047) asserted that interacting with the subjects would affect the understanding of human behaviour and their opinions. This qualitative data was used to both verify and triangulate quantitative findings to ensure a proper in-depth understanding of the behaviour by studying it from more than one

standpoint, as demonstrated by Cohen et al. (2007:141). With the verified and collated information it was possible to identify and formulate specific actions to design a multifaceted marketing and recruitment model.

1.8.2 Nature of the approach

An analytical approach was deemed suitable, as the study aspired to identify specific influencing factors in the career choice of learners to assist with the identification of suitable marketing and recruitment actions to obtain engineering students for the FEBE. With the new knowledge gained in this study the effectiveness of the current marketing and recruitment actions can be identified.

1.8.3 The reliability of the method

The mixed-method approach gave a more detailed and holistic view of the phenomenon, namely which influences played a role in career choices. By using a mixed-method approach, both an objective quantified view and more in-depth qualitative perspectives were gained. This data established a platform for the design of a marketing and recruitment model for the FEBE. These methods complemented each other and balanced out their respective shortcomings (Mouton, 2006:156).

1.9 OVERVIEW OF UNIT ANALYSIS

1.9.1 Population

Blaikie (2009:172) defines a population as follows:

> *A population is an aggregate of all cases that conform to some designated set of criteria.*

The extended curriculum students at the FEBE, representing civil, electrical, industrial and mechanical engineering students, were used as a convenient and accessible sample for this study. The sample size was 437 students as representative of the entire population (994 in the first semester), that is, 44% of the first-year entering students in engineering.

1.9.2 Reasons for decision-making

Pearson and Young (2002:110) refer to decision-making as a process of assessing the pros and cons, risks and benefits, knowns and unknowns of a choice; in this case, a career in engineering. They confirm the importance of decision-making in a democracy, as it influences the health and welfare of a nation. This knowledge about the processes learners follow to

make decisions and the factors they consider when choosing a career helped determine the way in which engineering programmes should be marketed (New Zealand Ministry of Education, 2005:7).

Powell et al. (2012:542) identifies the following reasons for career-related decisions: socialisers (peer influences), rewards (salaries), ability in certain subjects, social identity (to contribute to society), practical activities (various projects and problem-solving challenges) and employability. Hussain and Rafique (2013:72) confirm the important role that expected income plays when they refer to research done by Bennett et al. (1992).

Parental and peer influences were identified as *not* being the primary influences on career choices of learners, depending on the specific relationships the learners have with their parents or peers. Alika (2012:542) emphasises the major role of career guidance.

Another factor that was identified as contributing to increasing learners' interest in engineering was the practical understanding of the mathematical relationships that have to be applied when designing and building projects. Curriculum developers assist by keeping this factor in mind when they design educational material (Mentzer et al., 2014:314).

The importance of these variables was determined in this study, to determine the importance of the different influences and also to determine the implementation of actions in the marketing and recruitment model.

1.9.3 Sampling

According to Cohen et al. (2007:113), non-probability sampling is adequate if a study does not intend to generalise the findings beyond the sample in question. The particular group targeted for this study was the first-time entering students enrolled in the extended curriculum at the FEBE.

Purposive sampling was used, as these students enrolled at the FEBE were considered a valuable source of information, since they represented diverse perspectives on the issue of career choices. It was expected that they would be able to specify and elaborate on the reasons why they chose to study specifically at the Tshwane University of Technology FEBE.

1.10 OVERVIEW OF DATA COLLECTION

The master study questionnaires were circulated to the sample population via electronic platform utilising the Survey Monkey software package (http://www.surveymonkey.com). In addition to the above quantitative data collection, certain qualitative data was collected during the interviews conducted.

1.10.1 Questionnaires

According to Cohen et al. (2007:317), questionnaires are useful instruments when used in a structured way. They are often administered in the absence of the researcher and should be straight forward to analyse. The primary objective of the questionnaire in this study was to identify the resources and aspects that affected career choice in learners, so that the learners' behaviour in terms of career choices would be understood. The information obtained assisted in the identification of effective actions and messages to influence learners' career choices and to motivate them to choose TUTFEBE for their studies.

The administration of the questionnaires started with a pilot study. In the pilot study 400 paper-based questionnaires were distributed to students in the extended curriculum programme. The final construction of the questionnaire was guided by the outcome of the pilot study. The master study questionnaires were circulated to the sample population via electronic platform using the Survey Monkey software package (http://www.surveymonkey.com).

1.10.2 Interviews

Cohen et al. (2007:349) describe an interview as a flexible tool for data collection. In this study, interviews were used to access student groups to verify the quantitative findings and to further explored the phenomenon of the declining number of engineering students. Thus, multi-sensory channels were used in a verbal, non-verbal, spoken and heard manner.

Interviews were conducted in a semi-structured way and detailed information was collected on values, opinions and attitudes. This method assisted in reducing the interviewees' experiences to numeric positions. The subjective reasoning of students was the most important aspect that had to be understood in order to determine the appropriate actions to implement in a proposed marketing and recruitment model for the FEBE.

A smaller random sample of the identified population was invited for focus group discussions. The focus group interviews were time-consuming, but the major advantages, as explained by Denzin and Lincoln (2011:529), were the accessibility and exploration of the subjective experiences and attitudes of the former learners who became students at the FEBE.

1.11 OVERVIEW OF DATA ANALYSIS

The data analysis focused on the main questions to be answered. The targeted outcomes were based on *why* and *what* and *who* questions, such as, why learners chose to study engineering at TUT and what influenced their career choices. Who encouraged the learners

or had an influence on their career choice? Explanatory analysis was used to determine the learners' reasons for choosing to study at the FEBE.

Quantitative analysis – the SPSS (Statistical Package for the Study of Social Sciences, available at http://www.dummies.com/how-to/content/how-spss-statistical-package-for-the-social-scienc.html) was used to process the data into the design of an effective evidence-based marketing and recruitment model. This statistical package has been identified as one of the most popular statistical packages because of its simplicity of use in answering research questions (Kim & Mallory, 2013:50).

Qualitative analysis – interviews were conducted and recorded. This data was captured after the interview sessions. The recording was used as a reference to ensure that information was not missed. The information shared at interviews was verified and triangulated with the captured quantified data.

1.12 SIGNIFICANCE OF THE STUDY

The goal of this study was to identify the influences, images and messages about engineering that were predominant in learners' ultimate career choices and why TUTFEBE was their preferred place of study. A sound multifaceted marketing and recruitment model was designed to effectively recruit students with the potential to succeed in engineering studies. It is theorised that this model will assist in creating a pipeline of quality learners interested in studying engineering.

As voiced by Fisher (2011:42), universities should aim for a more "joined-up" school outreach strategy to promote engineering as a career. These actions should support the development of thinking, analytical problem-solving, independent learning and life skills, which are key factors in university and ultimately workplace success. It is hoped that, after this study, marketing and recruitment resources will be more efficiently allocated to more relevant actions, as identified in the marketing and recruitment model.

The FCTL (Faculty Committee for Teaching and Learning) members and the marketing team members of the Faculty were informed of the findings, and the implementation of the findings was discussed.

1.13 ETHICAL CONSIDERATIONS

Cohen et al. (2007:58) refer to Caven, who defined ethics as a matter of principled sensitivity to the rights of others, and who stated that *while truth is good, respect for human dignity is*

better. Ethical clearance was given by the University Ethics Committee via the Faculty of Business and Management Sciences Ethics Committee (FREC). The study was conducted in accordance with the ethical regulations stipulated by the FREC.

Permission to use the students in the extended curriculum was received from the faculty administrator in charge of the extended curriculum programme at the FEBE. The participants were clearly informed that it was a voluntary exercise and that they were not obliged to complete the questionnaire. The questionnaires were accessed online by an identified link at a computer laboratory. The students targeted were finished with their syllabus and had a free period available. Permission was granted in the form of a letter of consent from the academic management of the FEBE to access students to participate in the survey and in the interviews.

Participating students in focus groups completed an informed consent form (Addendum E). Furthermore, a post-interview worksheet was furnished to participants so that they could make final comments and mention aspects they might not have wanted to share with other participants. This worksheet served as a way to verify the data as it was communicated by the participants (Barbour, 2013).

1.13.1 Informed consent

A letter of consent attached to the questionnaire (Addendum B) was signed by the participants. The letter clearly explained the purpose of the study, namely that they would not reap any benefit from it, but that it would help the FEBE to understand learners' choices. This knowledge and understanding assisted the FEBE in the design of a sound evidence-based multifaceted marketing and recruitment model. Participants were informed that involvement was totally voluntary.

1.13.2 Anonymity

To ensure anonymity, the identities of the participants were protected by taking the following measures: the data was kept safe, and the names of the participants did not appear in field notes and transcripts.

1.14 SUMMARY OF RESEARCH CONTRIBUTION

The outcome of this study contributed to an educationally sound and relevant multifaceted marketing and recruitment model to guide the implementation of the identified actions in this model. This study made a critical contribution by creating an awareness of engineering courses, highlighting the importance of Mathematics and Physical Science to learners, and identifying possible recruitment and marketing actions. The outcome resulted in the formation

of a larger pool of qualifying learners to select from. Those students finally apply their qualifications in the industry.

Related factors, such as awareness amongst parents of career possibilities for their children as well as the establishment of relationships with school principals and Mathematics and Science teachers in schools, formed part of this marketing and recruitment model.

1.15 LIMITATIONS

As declared by Cozby and Bates (2012:305):

> *Case studies present descriptions and interpretations of research with a specific individual, group or organization.*

This study was limited to the TUTFEBE's first-time entering extended curriculum students, and therefore cannot be generalised to all engineering students or other first-year students at TUT.

1.16 SUMMARY

It became evident that creative and innovative marketing and recruitment efforts would have to be developed and implemented to counteract the declining numbers of engineering students. The actions and messages used in the past were not optimally effective and therefore it was necessary to critically reflect through structured analysis to assist in the design of a marketing and recruitment model. This model addressed the actions that would most effectively recruit learners and market the programmes offered at the FEBE. This resulted in a more effective multifaceted marketing and recruitment model for TUTFEBE.

In the next chapter, current and previous research conducted in the area of recruiting suitable students to pursue university education will be reviewed; particularly regarding engineering qualifications. The influences that affect career choice behaviours will be discussed.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In the previous chapter the importance of technological literacy was discussed. Opinions on *how* and at *what* stages in a learner's education awareness of careers in engineering should be created in the various target groups were investigated. This was followed by the identification of the different influences that played a role in the career choice behaviours of prospective learners. The objective was to identify the most effective methods of promoting engineering and ultimately of recruiting students for engineering courses at TUTFEBE.

Engineering skills are required to transform new ideas into products and processes that benefit humans. Technology is described as the process by which humans modify nature to meet their needs and wants (Pearson & Young, 2002:14). This study focused on engineering technology.

In view of the global skills shortage, and the demand for technological skills in Africa, it is assumed that the generation of a skills pipeline would assist with economic growth. Skilled professionals could then contribute to job creation, thereby addressing the unemployment challenges in South Africa (South Africa, 2011:54). When learners are made aware of the necessity to study the enabling subjects, the pool of appropriately qualified people should increase and general employability should be enhanced (United Kingdom, 2014:9).

Du Toit and Roodt (2009a:88) determined that although there was an annual growth of 0.7% in engineering professionals, the need for engineering professionals was expected to increase as a result of the huge infrastructure investment by government.

This chapter discusses current and previous research conducted on the recruitment of learners with the aptitude to pursue university education, particularly engineering qualifications. Therefore, the following topics will be addressed:

1. Research objectives as indicated in Chapter 1, page 7 item 1;
2. Factors influencing learners' career decisions;
3. Worldwide strategies on recruiting learners;

Issues facing engineering education in South Africa and the role of the FEBE will be discussed. Based on the identification and influences of what has already been done in the past, a multifaceted evidence-based marketing and recruitment model will be designed for the FEBE.

2.2 IMPORTANCE OF LEARNERS' DECISION-MAKING STAGES

Career choice is a concerted decision-making effort followed by goal setting. In the design of the marketing and recruitment model, research was conducted on the important stages of the decision of learners.

Decision-making is defined as a process of *assessing* the pros and cons, risks and benefits, knows and unknowns of a choice, in this case, engineering (Pearson & Young, 2002:110). These authors focused on the importance of decision-making in a democracy, since it influences the health and welfare of a nation.

Maringe (2006:468) argues that recruiters needed to capitalise on the early decision-making stage, since this is when learners' attitudes and views are developed. To benefit from this early decision-making period, recruiters need to know when it takes place. In a study done in Southampton with five sixth form groups at schools and colleges he concluded that career choice was a problem-solving process categorised as pre-search behaviour, search behaviour, application stage, choice decision and then registration. He found that the course of study was closely related to institutional choice and was influenced by the reputation of the course with employers.

Focused and early interventions (16 years old is too late) to motivate tomorrow's engineers are necessary (United Kingdom, 2013:17). It is theorised that direct and interactive activities at schools should form part of TUTFEBE's marketing and recruitment model.

2.3 CULTURAL INFLUENCE

To support the statement that *one model does not fit all*, the influences on career choices in decision-making of different cultures were researched. The model addressed various avenues to ensure that cultural preferences were catered for when marketing and recruitment actions were identified.

Jian et al. (2010b) studied the cultural factors influencing Eastern (Taiwanese) and Western (Norwegian) engineering students. Consistent with Ogawa and Shimode (2004:11), this study found a link between interest, *internal factor* and choice of engineering in both groups. The universal preferences were identified as *the university should present relevant education, the programmes should prepare them for a career, the course content should meet the industry needs, and that the curriculum should focus on skills rather than theory*. They also suggested

that recruitment through advertising was unimportant and promoted the use of alumni in a recruitment model.

A university of technology (UoT), producing technicians and technologists, meets the above requirements. Advisory committees consisting of *industry representatives* ensure that UoTs' qualifications are structured specifically to industry needs. The theory learned is supplemented with practical experience through laboratory projects where practical skills are acquired. Practical experience in industry, a compulsory component, forms an integral part of the courses.

In an annual survey conducted in the United Kingdom by the Institute of Engineering and Technology (IET) (2014:5), the importance of interaction between tertiary institutions and schools for promoting careers in engineering was confirmed. This emphasises the necessity of a targeted, multifaceted marketing and recruitment model for the FEBE.

2.4 SIMILARITIES AND DIFFERENCES

In a comprehensive literature study an in-depth review revealed the similarities and differences experienced worldwide in the challenge of the declining numbers in engineering. The aspects where the FEBE marketing and recruitment model could make a difference were addressed.

Van Langen and Dekkers (2005:329) studied the influences on participation in Science, Engineering and Technology (SET) courses cross-nationally. They identified similarities as well as differences. The similarities in the study were the quality and shortage of teachers in the enabling subjects and insufficient rewards in engineering jobs (Van Langen and Dekkers, 2005:337). STEM courses were stereotyped as difficult, and there was a perception that these professions were for males only. In addition, the influence of government policy determining the education and labour legislation played a role (Van Langen and Dekkers, 2005:335). The differences identified were that some countries had multiple entry levels, high study cost as a result of the drop-out risk, and a broad-based curriculum versus early specialisation. These similarities and differences are also evident in South Africa.

To address the quality of Mathematics and Physical Science teachers, hands-on workshops where teachers were introduced to practical projects have been presented at the FEBE laboratories. It is anticipated that learners will benefit from the teachers' extended knowledge of how to execute projects in their laboratories.

Langen and Dekkers (2005:344) suggested different entry points in the fields of study and a not too restricted curriculum to assist in addressing the problem of motivating more students

to study engineering. The UoT qualifications in South Africa are currently incorporating a new qualification structure with multiple entry levels. This revised qualification structure allows students to start at the lowest level after secondary school and permits them to proceed to the highest level of their engineering studies, should they wish to.

A strong drive to recruit females in engineering is active at FEBE. A Females in Engineering Chapter (FEMENG) was established with the specific goal of promoting engineering amongst females. This drive forms part of the marketing and recruitment model for the FEBE.

2.5 STRATEGIES WORLDWIDE

A broad spectrum of worldwide strategies was scrutinised to identify the activities that addressed similar challenges in other countries. After examining the results achieved with those strategies, and their relevance to South African circumstances, ideas on stimulating career choices of learners in the FEBE were captured in the marketing and recruitment model.

Kearney (2010:8) mentions in a publication, *INSIGHT observatory for new technologies and education,* regarding a survey of 16 European member countries on how to increase students' interest in pursuing Mathematics and Physical Science and Technology (MST), that there are various means of addressing problems. The strategies below were reflected on the following countries:

2.5.1 Australia and New Zealand

Woods-McConney et al. (2013:234) compared indigenous and non-indigenous high-school learners in Australia and New Zealand in terms of their scientific literacy performance, measured by the Programme for International Student Assessment (PISA). They identified a significant gap between the groups, although both groups had experienced science teaching, which was qualitative and similar in terms of teaching and learning activities in the science classes. They concluded that there was no globally accepted characterisation of what science engagement means, but a reasonable agreement that a lack thereof could be problematic. The universal preferences identified in this study were that the students preferred to design their own experiments, and to investigate and test their own ideas.

2.5.2 The Netherlands

The Dutch Ministry of Education and Science designed the *Delta Plan Science and Technology* with the aim to promote MST to increase future employees to contribute to innovation. This plan was divided into five sub-plans, of which the Platform Delta Techniek was specifically targeted to increase enrolment and throughput of MST students. The sectors

targeted were the education and labour market. Schools, institutes, training centres, universities and businesses collaborated when they implemented their objectives in the Mathematics and Science (MS) field through providing advice, monitoring, auditing, conducting expert meetings and constructing focus groups (Kearney, 2010:8).

2.5.3 Ireland

Ireland designed a *Discover Science & Engineering* (DSE) programme. This was an interrelated action through the presentation of awareness programmes through activities. These included STEM career guidance and primary teachers' training, and involved students at all levels, their parents and teachers, and the wider public. The overall objectives were to stimulate an interest in engineering and motivate the increase of engineering student enrolment numbers (Kearney, 2010:9).

2.5.4 Israel

In Israel the *Scientific and Technological Reserves* programme, a pilot programme, was initiated by the Ministry of Education. They targeted students who followed their normal school curriculum and provided them with additional supplementary programmes that focused on STEM content. This programme aimed to identify, as early as possible, students in lower socio-economic backgrounds who excelled in MST. The schools that participated in this programme received additional funding from the government to achieve these goals. Israel also had a *Young Friends Initiative* between higher education and the Ministry of Education, focussing on non-formal education in science and technology. This initiative included after-school classes, out-of-school seminars, special projects, research workshops and summer camps. The overall objective was also to increase students' interest in STEM (Kearney 2010:9).

2.5.5 Italy

Italy set up an interdepartmental working group representing the Ministry of Education, the Ministry of Universities and Research, the Ministry of Cultural Heritage and the Ministry for Reforms and Innovation within Public Authority to enhance Italy's scientific and technological culture. They focused on teachers and students from primary school through to secondary school and were also concerned with the MST subjects in the curriculum (Kearney, 2010:8).

2.5.6 Mexico

A study done in Mexico by Goonatilake and Bachnak (2012:15) showed that the higher education authorities as well as the federal and state governments were concerned about the

decline in STEM students. They found that the existing programmes at schools did not produce the desired results, similar to the South African situation.

The Texas M&A International University (TAMIU) services a primarily Hispanic and academically disadvantaged population along the Texas-Mexico border. It was found that students in the service region were vastly underrepresented in STEM programmes and lacked the required preparation.

To create an awareness of careers in engineering, a one-week programme was presented on campus to elevate engineering education. The participants were selected to represent the demographic diversity, the minorities and females. Although TAMIU realised that that programme alone would not solve the problems unique to the engineering discipline, the objectives of the programme were achieved beyond expectations.

In the TUTFEBE marketing model a vocational week was introduced and implemented by the marketing team.

2.5.7 Malaysia

Othman et al. (n.d.) surveyed 395 learners who participated in a *Student Guided Motivational Programme* presented by 70 undergraduates of the University of Tun Hussein Onn in Malaysia. The programme had three phases. The first phase focused on developing learning awareness of learners by addressing the following: self-esteem development, respect and being grateful to one's peers, spiritual learning, and ultimately the development of a clear ambition for the future. The second phase focused on the development of Mathematics and Science skills, and in the third phase an interest and awareness of engineering was created by interesting learning activities. The results of this programme were staggering: in the pre-survey only 8.4% of students indicated an interest in engineering, and after the programme 67.8% of them opted for engineering. It was clear that the participation of the engineering undergraduates heightened the interest in that profession among learners. The undergraduate students also benefited by assisting with this outreach programme.

These phases formed part of the vocational schools' programme at TUT, and were integrated in the marketing and recruitment model.

2.5.8 Norway

Norway focused on creating synergy between the education of children and the world of work. This strategy included awareness of the importance of the quality of the MST teachers. They also encouraged gender balance. Once again, the importance of the quality of Mathematics and Science teachers was highlighted (Kearney, 2010:8).

2.5.9 Switzerland

Switzerland had a policy in place from 2008 to 2011 called *Promotion of young scholars in the fields of Maths, Science and Technology*. This policy focused on the partnerships between industry and the education sector, teachers, teachers training, and specifically females.

Gattis et al. (2003:71) confirmed that various factors influenced a learner's choice of a career. A student-recruiting-student (SRS) recruiting model was applied with the recruitment of industrial engineers at the University of Arkansas. The one-year programme had four phases: programme development, off-campus recruiting phase, on-campus recruiting, and then finally the post-admission recruitment phase. Due to this successful programme the pool of quality prospective industrial engineering students doubled the number of students in the Industrial Engineering programme. This programme therefore also increased that university's income from tuition and laboratory fees.

The curriculums of universities of technology (UoTs) contain material that is orientated to the real world. This approach complements the Australian and New Zealand findings that students prefer hands-on practicals. The South African government is actively involved with tertiary institutions in addressing the decreasing numbers of MST learners, as is the case in the Netherlands. Ireland and Norway made similar conclusions and identified the need for interactive engagement with schools and institutions as well as the development of Mathematics and Science teachers.

TUTFEBE is already engaged in these activities by presenting focused interventions such as competition days and workshops to enhance Mathematics and Physical Science teachers' skills. Israel, Italy and Qatar have identified the dire need to engage with the lower socio-economic population. TUTFEBE has been presenting robotics courses at five schools in Attridgeville in Pretoria for a number of years to stimulate awareness of the careers in engineering, with the specific aim of developing the attributes in learners that are necessary to proceed with engineering studies.

Mexico and Malaysia are involved in vocational schools. This was one of the interventions identified and included in the FEBE model. Switzerland concluded that career/work shadowing was a useful intervention to showcase engineering careers to learners. This was one of the additional interventions included in the FEBE marketing and recruitment model.

2.6 APPROACHES TO LEARNER RECRUITMENT

2.6.1 Multifaceted approach

The worldwide strategies that were researched showed that a multifaceted approach should be followed to achieve the most effective outcome. By identifying the major influences that play a role in career choices of learners, it became clear how to execute marketing and recruitment interventions that would promote TUTFEBE and stimulate an interest in learners to choose TUTFEBE as their institution to study engineering. The research revealed at which stages those actions should be implemented to achieve the best outcomes.

In a multifaceted approach, females are targeted, and workshops, summer camps and conferences are presented (Anderson & Gilbride, 2003:87). The importance of faculty involvement in students' career choices was again emphasised by May and Chubin (2003:35). If engineering faculties are actively involved in the presentation of events, they can build relationships with schools and provide learners with role models with whom they can identify.

Remarkable similarities were identified when Youngman and Egelhoff (2003:11) studied two models. Model A attracted academically qualified students. Model B targeted top achievers in economically impoverished and educationally deficient schools, on aptitude and attitude. The activities presented were high touch, highly visible and multifaceted. They presented open houses similar to an open day at TUT, where students showcased their projects to prospective students and their parents. They also used multiple recruiting strategies like campus visits, conferences and specific events for learners to participate in.

They concluded that the engineering programme assumed responsibility for recruiting its students, presented opportunities outside the traditional engineering courses, provided academic flexibility, established student-centred facilities, and presented multiple routes to success and student support through a respectful culture and environment (Youngman & Egelhoff, 2003:15).

In conclusion, TUTFEBE considered these actions when drawing up its marketing and recruitment model. Most of these recruitment actions are currently in place, for example, the open day, competition day and campus visits. The FEBE took responsibility for addressing the decreasing student numbers in the Faculty by preparing suitable learners to opt for a career in engineering at TUT. It is theorised that the throughput rate should eventually increase with better prepared learners selected for engineering programmes.

2.6.2 Social marketing

Social media was recently introduced as one of the recruitment actions at TUTFEBE after investigating the effectiveness of this approach. Wood (2012:97) refers to the definition of social marketing and explains the confusion between social media marketing and social marketing. Social marketing refers to behaviour change and relationship building to make the world a better place via environmental improvement and health equality. This study refers to social media marketing, also referred to as social media technology,

> *which includes web-based and mobile applications which allow individuals and organizations to create, engage, and share new user-generated or existing content, in digital environments through multi-way communication* (Davis et al. (2012:1).

Lewis (2009:1) researched strategic communication through the use of social media. Although youth experience their world through multimedia and social media form a part of their lives, professionals cannot assume that learners, regardless of status, are able to use social media. This confirms that it is necessary to use social media, but not to the exclusion of all other strategic communication methods. The scope of the findings of this research is limited due to purposive sampling, which decreased the generalisability of the findings.

The following social media tips were proposed by Syracuse University (2011): *Make it personal, keep it real, deliver exclusively, add value and stay ahead of the curve.* By following these guidelines corporations stay in touch with their employees. This route was followed in TUTFEBE's marketing and recruitment model.

2.6.3 Interrelatedness of partnerships

The literature study showed that interrelatedness and partnerships were the most popular actions used for connecting with aspiring engineers. Dawes et al. (2008:2) investigated active partnerships with schools. University students identified projects linked to the curriculum and worked with three partnering schools with learners in Grades 9 and 10. The goal of the project was to demonstrate links between engineering and the subjects Mathematics and Physical Science. The Technology teachers, working with the students, underwent professional development in the practical applications of the projects.

Industries were involved in a supportive capacity, and thereby built a beneficial relationship with learners and institutions. Unfortunately, because of tracking, the measurement of such programmes was difficult. In the post-evaluation of this study, 83% of students indicated that they would consider engineering as a career. Other benefits were the professional

development of the teachers in the practical applications, and that the university students enhanced their generic skills such as communication and teamwork. The learners associated with the students and accordingly experienced engineering as “cool”. These relations were built into the FEBE marketing and recruitment model.

2.7 FACTORS INFLUENCING LEARNERS’ CHOICES

The factors that play a role in career choice decisions were identified. The literature was studied to determine how to integrate those factors into the marketing and recruitment model, as indicated in the subsections below.

2.7.1 Language proficiency

Makgato and Mji (2006:253) found that language, in other words, the means of communication (in this case English) was one of the main problems when they conducted a research study in Soshanguve, one of TUT’s primary feeder areas. They did a survey at seven schools with poor performance rates in Mathematics and Physical Science, in District 3 of Tshwane North. This conclusion supported Howie (2005:183), whose findings are discussed under the critical components. A lack of language proficiency leads to an inability to comprehend the subject matter, including problems that have to be solved as part of the curriculum.

Language proficiency and the lack thereof cannot be addressed in the FEBE model, but its importance should be noted. Once learners are accepted as students at TUT they have access to the Student Development and Support Division (SDS) where they are helped to improve their language proficiency.

2.7.2 Teachers’ role

One of the basic premises of this research was that teachers play an important role in a learners’ learning process by explaining concepts and principles of subjects that lead to career choices. Lethoko et al. (2001:311) focused on the principals, teachers and students to restore a culture of learning and teaching (COLT) in 30 black secondary schools in Pretoria. This research highlighted the importance of the relationships between the Department of Education (DoE), the teachers, parents, and the community at large.

Some teachers lack the patience to explain problems. Lethoko (2001:311) points out that teachers need assistance to boost their self-confidence in the STEM subjects and ultimately improve the quality of their teaching. This underlines what Horak and Fricke (2004:28) mentioned: The focus should be on the Mathematics and Science teachers. This has been

done at FEBE with the presentation of workshops on the optimal utilisation of science laboratories to Mathematics and Physical Science teachers in Mpumalanga.

2.7.3 Learning environment important role players

When the recruitment actions in the marketing and recruitment model for the TUTFEBE were developed, as discussed in Chapter 5, the influence of the learners' learning environment was taken into consideration. May and Chubin (2003:31) argue that the achievement and participation of the underrepresented minority learners in Mathematics and Science were influenced by, amongst others, the lack of educational resources at secondary schools. More needs to be done to uplift the learning environment. It is arguable that parents should be motivated to be more involved in their children's performance (Makgato & Mji, 2006:261). Dias (2011:367) supports this view and encourages parents to be involved with their children, teachers to take responsibility, and principals to set the example to encourage teachers and learners.

Dias (2011:374) also discusses the relationship between internal and external pressures. She refers to the *inheritors,* claiming that learners from a higher income background will most likely proceed with tertiary studies whereas those from lower income homes were dependent on the influence of their family and friends.

2.7.4 The influence of self-concept

Self-concept, defined as the *level of satisfaction with self,* is recognised as being very important to a learner's career choice behaviour (Nathan & Hill, 2006:22). Dias (2011:367) agrees and adds the following influencing factors: social status, perception of their own intelligence, competencies, values and interests.

Wolhuter et al. (2003:94) compared the education systems of South Africa and Madagascar. They identified similar phrases in the visions for education of the two countries, namely democratisation, liberalisation, non-discrimination, career orientation, equal provision and high academic quality. Unfortunately they found that the ideals were not achieved to a satisfactory level. They concluded that the learners of the two countries were not provided with opportunities to equip themselves with the competencies to function effectively according to their educational needs.

2.7.5 Finances

Aamodt (2001:5) conducted research on the influence of finances on career choice behaviours. He studied different models with the student perspective as the main objective. The economic model investigated how individuals differ according to identified variables in

their career choices. He concluded that because people do not behave rationally as assumed, this is not a reliable indicator. The status-attainment model was a more interactive model but still did not provide explanations for enrolment decisions. Therefore, a combined model, economic and status-attainment was investigated. This combined model showed the constraints that influence career choice as well as the activities that affect decision-making. Aamodt concluded that financial incentives had only a limited influence on career choice. The lower-income families and cultural or racial minorities were more responsive to tuition and grants offered.

In a study done by Field (2007:7), the psychological responses to educational debt on career choices in law were investigated. She determined that students who received tuition subsidies, were more relaxed by knowing that their financial obligations were catered for.

2.8 OVERVIEW OF MARKETING AND RECRUITMENT MODEL

2.8.1 Introduction

Martin (1996:5) refers to the definition of marketing by Litten et al. (1983), namely:

> *… a powerful set of concepts, principles and practices designed to increase the effectiveness with which the organizations relate to their public to achieve the desired social responses.*

He also refers to Chapman (1981) who created a model of student college choice where he focused on the learners' decision process rather than on the institution, although the two were intertwined.

Through the identification of the different influences on career choice of potential students a targeted marketing and recruitment model was developed for TUTFEBE, where the interrelated efforts between university, industry, schools and government were recognised.

It is evident from the literature that university, industry and government actions should be integrated to assist with increasing the number of skilled engineering professionals to contribute in the economic growth of the country. Such integrated efforts were included in the marketing and recruitment model. The South African Development Policy Research Unit (2007:15) identifies the shortage of engineers and engineering technicians in South Africa as a shortage of critical scarce skills. This survey brought to light a shortage of engineers of

previously disadvantage backgrounds, who were in high demand. A focus on Mathematics and Physical Science in schools is a priority to assist in meeting the demand for these skills.

Case (2006:13) discusses the complexity of career choice. She confirms the urgency of creating a larger pool of prospective students to address the skills shortage in South Africa. This is addressed in the current National Plan for Higher Education. To stress South Africa's dire need, she refers to the Third International Mathematics and Science Study, where South Africa came last. She promotes the participation of industry and says more research is necessary on *what can be done* to stimulate a larger pool of qualified learners to become students. Johnson and Jones (2006:6) underline the importance of coordinated action between government leaders, business and universities to supply the industry with well-equipped graduates to promote national competitiveness.

Frölich et al. (2009:227) did a study in Norway where they investigated the relationship between higher education institution (HEI) market position and recruitment strategies in general after the Norwegian government had implemented a quality reform in 2002. They discovered that, regardless of the institution, the recruitment efforts of HEIs were surprisingly the same. Copying seemed to be the main institutional coping strategy. Instead of focusing on their individual uniqueness, all the institutions applied the same recruitment strategy.

Although worldwide strategies were investigated in this study, only those applicable to the TUTFEBE scenario were incorporated in the marketing and recruitment model to rule out the copying situation.

Kearney (2010:11) investigated how to improve science education in Europe, and 16 European Union Nations (EUN) member countries participated in the research. Once again the interrelatedness of industry, university and schools was identified. He concluded that the progression from school to tertiary education plays an important role and confirms the importance of the continuous development of teachers and the curricula.

2.8.1.1 Creating awareness of technology

Awareness of technology has an influence on factors like science, engineering, politics, ethics and law, to mention a few (Pearson & Young, 2002:5). Incentives by the National Science Foundation in collaboration with industry partners to motivate and promote the improvement of the technological literacy of students and public at large were suggested. Events like the Baja Bug and the Solar Car races were identified as ways of creating technology awareness, attracting parents and persuading learners to participate in the events. It was also suggested that an award for excellence in technology teaching should be offered. This has already been

put into practice at TUTFEBE, where the staff member who does the most to promote engineering is identified on an annual basis.

Woods-McConney et al. (2013:236) analysed the reasons why indigenous and non-indigenous students in New Zealand and Australia study science, and support the statement that engagement and literacy serve as barometers of the growth and the development of national economies. They concluded that *one size fits all* was not relevant for the different target groups.

Prieto et al. (2009:183) identified the following as influencing factors in the 20th century: *Investment of the private sector and the government, the importance of guidance teachers, the influencing role played of parents and the media, relevant and updated curricula, teacher education, and last but not least, the perception of the nature of engineering*. All these factors are still relevant today, as discussed earlier. The prominence of awareness creation and the importance of the core subjects, Mathematics and Physical Science, to learners were the objectives in the marketing and recruitment model. One of the proposed ways to do this was by keeping the content of the subjects relevant to the real-world challenges.

Jawitz et al. (2000:470) explain the difficulty for female learners, in particular, to associate and identify with engineering, because these careers are not visible to the public eye. This void is addressed by the FEMENG chapter at TUTFEBE with the sole purpose of making female learners aware of engineering programmes. Jawitz et al. (2000:470) confirm the relevance of the teachers' and parents' influence on career choices of learners. An added factor, the *type* of school, referring to schools taking an interest in their learners' future, was identified as playing an important part in students' career choices.

2.8.1.2 Teachers

As teachers have been identified as a major influencing factor, Horak (2003:81) surveyed the effect the Teachers' Outreach Workshops (TOW) had on teachers' attitudes and saw that in some cases there was limited success. To ensure continuous focus and sustainability, the three-year Teachers' Mentorship Programme (TMP) was designed. He argued that the most cost-effective area of involvement was teachers. The teachers of seven schools in the Soshanguve area with poor performance rates in Mathematics and Science were investigated. Horak and Fricke (2004:28) argued that investing in the teachers, restoring their self-esteem and teaching them to apply the right techniques to assist learners, and to be more responsible and professional, led to a more sustainable solution. Due to the cost-effectiveness of this action, FEBE capitalised on this mode of intervention.

2.8.1.3 Quality and role models

Howie (2005:183) maintains that poor quality stands out as one of the main contributors to bad performance. Drawing from Case's (2006:13) work, it can safely be assumed that a *no tolerance approach* at schools would ensure better performance by teachers and principals. Thus, a more demanding school environment that leads to an expectation of higher performance levels by staff and learners should be encouraged.

The message about Physical Science and Mathematics should change from them being *difficult subjects* to *subjects that are just different*. When learners participate in the annual Competition Day at TUT, they apply mathematical and scientific principles without realising it. This is one of the means used to assist in changing their perception that these subjects are difficult (Horak & Fricke, 2004:28).

The lack of role models, the level of the parents' understanding and the socio-economic environment were identified as factors contributing to the problem.

2.8.1.4 Relevant content

Ogawa and Shimode (2004:4) use the ROSE Guidelines and Practicalities (Sjöberg & Schreiner, 2002) to assist science teachers in understanding learners' attitudes to studying science. They created a framework for *School Science Preference* in the following categories: Specific priority, other priority, poor priority and not-positive priority. They concluded that if the content of the subjects is applied to real everyday applications like "how does a mobile phone operate?" and "what are the possible radiation dangers of mobile phones?" it creates a positive attitude towards science.

It is evident from the above research that when students are able to perceive the relevance of their science projects to their daily lives, it adds enjoyment and promotes interest in the subject. Students also prefer having some more control over the kind of projects they would like to work on. Woods-McConney et al. (2013:236) believe that by employing these methods, the potential social and educational inequalities identified in this study would be addressed.

The mixed-method, quasi-experimental pre-test and post-test approach was used by Merrill et al. (2008:48). They focused on teaching learners three concepts: *constraints, optimisation and predictive analysis*. Although students' learning improved significantly, they recommended the development of curriculum activities that taught these concepts and ensured that teachers were trained to do so. Unfortunately, due to the project not being included in the learners' semester grades, they were not motivated to do well.

2.8.1.5 Image of the profession

While opportunities and benefits for well-prepared technical graduates are very attractive, a shortage still exists (Yurtseven, 2002:17). He states that the lack of information plays a huge role and makes a very interesting observation, namely that image plays a role. He compares the images of the cartoon character, Dilbert, which portrays a dull engineer, with Leonardo da Vinci, who is renowned for his technological ingenuity.

Edwards et al. (2004:374) investigated the shortage of civil engineers in the United Kingdom. The decline in numbers was ascribed to the unpopular image of engineering, especially in the case of women and ethnic minorities. They saw the environment as a chaotic workplace with poor working conditions and a poor safety record. The decline in members of this profession has a detrimental effect on the provision of infrastructure. The lack of local human resources poses a threat to foreign competition. The researchers perceived it as a challenge to promote civil engineering as an attractive career.

2.8.1.6 The integration of social media

Wood (2012:94) refers to the definition of social marketing and explains the confusion between social media marketing and social marketing. The former is related to behaviour change and relationship building to make the world a better place, and the latter has to do with environmental improvement and health equality. In this study social media marketing is discussed.

Lewis (2009:1) researched strategic communication through the use of social media. Although the youth experience their world through multimedia and social media, which form part of their lives, it cannot be assumed that all students, regardless of status, will be able to use social media. This fact does not rule out the integration of well-planned social media marketing and recruitment actions for FEBE.

The Syracuse University Career Services (2011) provide the following media guidelines: *Make it personal, keep it real, deliver exclusively, add value and stay ahead of the curve*. By following these guidelines, companies stay in touch with their employees. It is hypothesised that TUTFEBE might motivate learners and attract students by implementing the guidelines. Social media technology is also used to stay in touch with current students. They are informed of events, job opportunities, test weeks and other relevant information.

Erdoğmuş and Çiçek (2012:1354) conducted a study in Turkey on the impact of social media marketing on brand loyalty. The criterion used was that a person should use or/and follow a specific brand on social media more than once a week. Turkey was chosen because it reached

41.6% penetration with approximately 30 million people and was ranked 12th among countries in the world in terms of Internet usage. Social media marketing is identified as a growing platform to grow relationships and to create a positive image of the brand. The drivers recognised were that the information should be advantageous, the content should be relevant and the platforms should be popular with friends. They state that the different platforms needed to be available to the consumer, in this case, learners and TUTFEBE's registered students.

Thackeray et al. (2012:165) adopted Li and Bernhoff's (2008) POST model. *People*: identify the people you are targeting. *Objective*: listen to what they want, share ideas (word of mouth), identify influential officials to act as advocates, and provide an outlet for audiences to support one another. *Strategy*: identify the strategy and adhere to policies and procedures, tell the audience the benefits of participating and determine how this process will be measured. *Technology*: select the appropriate media application to the target market identified.

A comparative analysis conducted at seven major universities on social media in higher education by the University of Rhode Island (Learning Ace, 2014:36) concluded that the following stages should be integrated into social media marketing in the recruitment plan. Stage 1: Design a university-wide strategic plan, create a social media directory on the main web page, and put together a social media team and implement a mobile web site. Stage 2: To stimulate participation, create a first-year experience (FYE) for incoming first years, to enhance a social media presence design contests and promotions, integrate the social media into the traditional marketing efforts. In 2016 the FYE was put in place for the first time. Social media marketing actions are essential for success. Social media should satisfy current and prospective students and be constantly monitored and enhanced.

TUT presented its first FYE year (2016) and is optimistic that this experience made a positive impression and assisted the first-time entering students with their integration. The Faculty Committee for Teaching and Learning (FCTL) members of the Faculty and the marketing team members of the Faculty were informed of the findings and of how this model would be executed.

2.9 PROBLEM CONCEPTUALISATION

2.9.1 Introduction

In an endeavour to understand human behaviour, in this case career choice behaviour, existing knowledge on the influences on career choice was studied. The findings were then

combined with the data retrieved in the survey to design an evidence-based marketing and recruitment model for the TUTFEBE.

Brown and Lent (2013:132) refer to Hackett and Betz (1981) as being the first scholars who investigated social cognitive theory (SCT) when they researched women's career development. Social cognitive career theory (SCCT) was identified as a suitable framework for gaining an understanding of the interactions which determine career choice. SCCT explains the influences on human behaviour. Brown and Lent (2013:101) discuss the frameworks of previous career theorists (Super et al.), which assisted in learning how vocational interests are formed, career choices are made, and career success is achieved.

The basic theoretical elements, self-efficacy, outcome expectations and goals, are intertwined with individual factors such as gender and race in combination with contextual factors like socio-economic status and educational system, to mention a few (Brown & Lent, 2013:106). They explained that interest is formed in concurrence with self-efficacy and outcome expectations. This leads to the development of goals to achieve the desired outcomes.

In Figure 2.1 the interactions between people and their environment which affect the development of career choices and the different variables contributing to interest and career outcomes are shown (Brown & Lent, 2013:107).

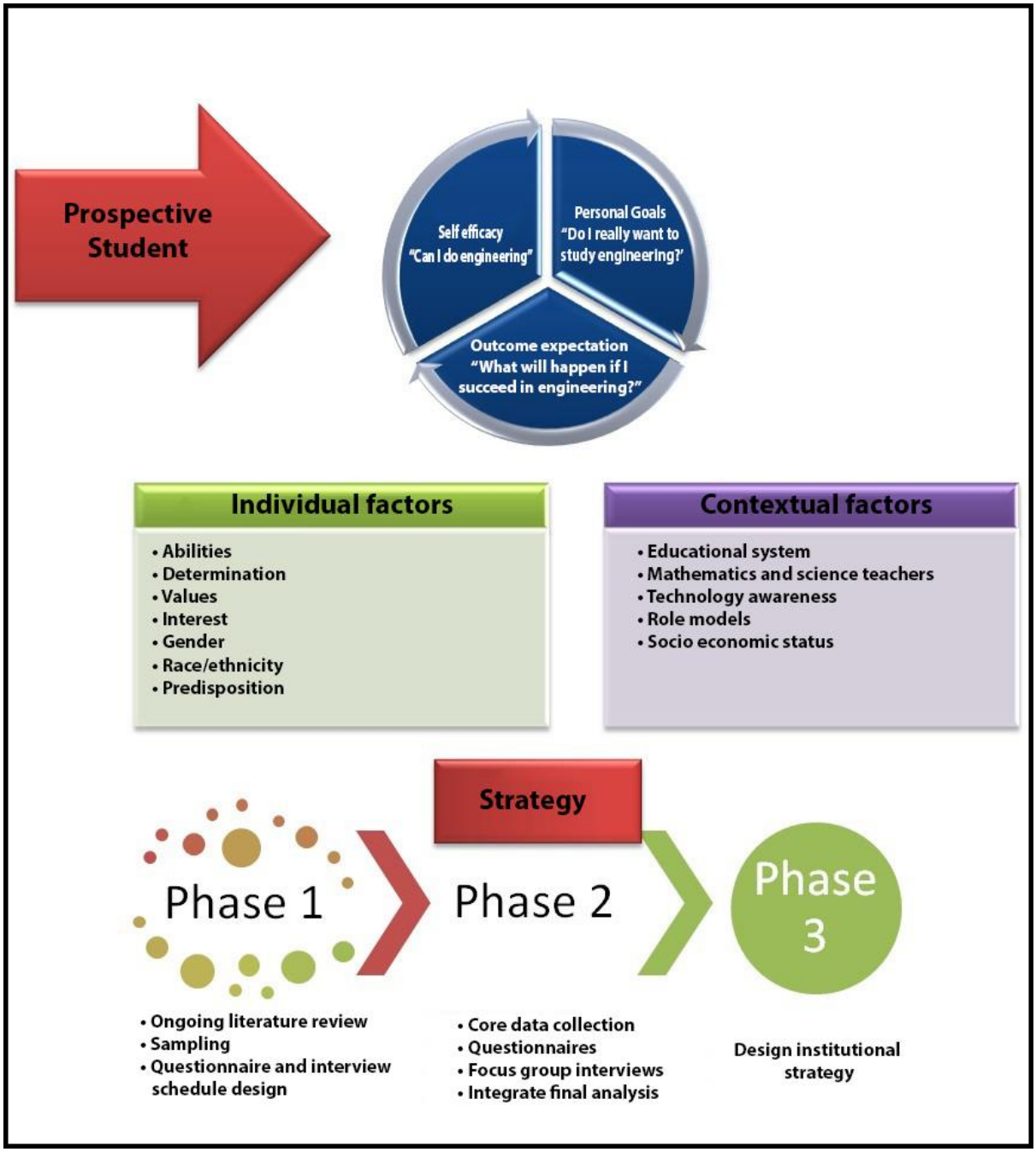

Figure 2.1: Problem conceptualisation (adapted from Lent, Brown & Hackett, 2002)

2.9.1.1 Self-efficacy

Self-efficacy, defined as believing in oneself (Barnard et al., 2008:55), is influenced by factors like previous performance, social persuasion, different interpretations of information.

Dias (2011:374) concurs with the SCCT theory of Lent et al., namely that decisions are mainly influenced by self-efficacy. Influences on people are formed through social status, perception of their own intelligence, individual factors like competencies, values and interests. These

perceptions are acquired during childhood through parents, siblings, family, guidance counsellors and teachers as well as peer group pressure.

Bandura (1997) concluded that people's level of motivation, effective states, and actions are based more on what they believe than on what is objectively the case. He states that strong efficacy and determination can overcome most obstacles, regardless of the predisposition and environmental influences.

The factors identified above and their interaction in influencing career choice had to be understood before they could assist with the design of relevant marketing and recruitment actions.

After learners had been informed of career possibilities in engineering, and an interest*, normally a dependable predictor of career choice* (Brown and Len, 2013:143) in engineering had developed, interventions to keep the learners motivated to persevere to achieve the desired outcome were added to the marketing and recruitment model.

2.9.1.2 Outcome expectations

Outcome expectations, defined as *the imagined consequences of whether one engages, or not, in certain actions,* are subject to factors like information on career fields, what kind of reward to expect when following an identified career path, *intrinsic and extrinsic rewards*, social perception, gender roles and socialisation, among others (Barnard et al., 2008:55). In other words, outcome expectations are physical, social and self-evaluative expectations. Past experiences, observations by family friends, and media play a role in the formation of expectations (Brown & Lent, 2013:118).

FEBE's main objective is to create an awareness of the career fields offered at the TUTFEBE and to promote TUTFEBE as the preferred institution. The competition day, one such recruitment action in the marketing and recruitment model, ensures accurate exposure to assist learners in choosing career options.

2.9.1.3 Personal goals

Barnard et al. (2008:55) define personal goals as the determination to engage in a particular activity, or to effect a particular future outcome. It is clear that self-efficacy and outcome expectations play a dynamic role in the identification of personal goals. These variables are intertwined with both contextual and individual factors.

In the marketing and recruitment model the objective to positively influence suitable learners to pursue a career in engineering at TUTFEBE certain support building actions were included.

To prepare prospective students to ensure that they adhere to the minimum admission requirements was one of the main factors.

2.9.1.4 Contextual factors

Various contextual factors, referred to as the circumstantial impacts on learners' decision-making, are addressed in the SCCT theory. These factors include Mathematics and Science teachers, technical awareness, role models and socio-economic status. Prieto et al. (2009:184) states that it is essential to make learners aware of the importance of Mathematics.

The contextual factors in which TUTFEBE played a role are recognised. Workshops for Mathematics and Science teachers are presented, awareness creation is continuously addressed, and role models are identified in the marketing and recruitment model.

2.9.1.5 Individual factors

Although individual factors like gender, personal interest and contacts, play a role in career decisions, Salami (2007:662) concluded that interaction between the different variables predicts career choices. The importance of individual factors and their interaction play a role in career choices. This assisted in the identification of suitable marketing and recruitment actions.

2.10 SUMMARY

Decision-making, engineering, and various strategies worldwide and locally were discussed in this chapter. Strategies and recruitment models are influenced by various factors, such as technology awareness, language proficiency, teachers, image of the profession, and socio-economic status.

The theoretical framework that underpins this study was reviewed and used to conceptualise the problem of how to recruit suitable learners for engineering at TUTFEBE as a social phenomenon. Interventions to develop an interest in engineering were recognised. The importance of exposure to career information and the tools learners needed were addressed.

CHAPTER 3: RESEARCH APPROACH

3.1 INTRODUCTION

Jennings (2001:445) defines research methods as the practices used to gather and scrutinise data for research. This study focused on *how* and *why* questions, the behaviour of the participants that could not be manipulated and the contextual conditions relevant to the phenomenon of the lack of learner interest in engineering studies.

The case study design was the method utilised for this research (Yin, 2014:3). Yin recommends starting with a quantitative survey to determine the focal points for the qualitative study. The two sets of data (quantitative and qualitative) were triangulated to determine the final outcome. The design allows for a description, analyses and interpretation of the case study design. To determine *why* and *how* learners chose TUTFEBE as their institution (the single-case design) was identified as the most appropriate method, since this study focused on TUTFEBE, a single case (Yin, 2014:240).

The research objective was to determine marketing and recruitment actions that could be applied to increase the number of prospective engineering students for TUTFEBE. In order to achieve this, the inventory and participating actions applied were identified (De Vos et al., 2011:95):

1. What are the critical components or sub-strategies in an ideal marketing and recruitment model for the faculty in promoting choices for engineering as an educational and career field?
2. What actions are most effective in motivating learners to excel in Mathematics and Physical Science?
3. What were some of the primary influencing factors in the career choices of current students in engineering?
4. Are social marketing platforms appropriate resources to utilise?

The previous chapters outlined the background of the study, including the literature study on decision-making strategies, recruitment models, and various factors that influence learners' career decisions. In this chapter the research philosophy, design and methods of this empirical investigation are described.

The main aim of the study was to explore which actions stimulated an interest in engineering as a career, and how to effectively engage learners to become prospective students in

engineering-related career choices. To address this, the following secondary research questions were posed:

1. What constitutes the critical components of a marketing and recruitment model for the TUTFEBE to attract prospective engineering students?
2. Which strategies are most effective in motivating learners to excel in Mathematics and Physical Science?
3. Which factors influence prospective students' decision to pursue a career in engineering?
4. How successful are social marketing platforms to recruit learners to become prospective engineering students at TUTFEBE?

3.2 RESEARCH DESIGN

3.2.1 Introduction

To understand how and why learners chose TUTFEBE as their institution, the *explanatory case study design* was applied (Yin, 2014:238). With this knowledge, an evidence-based marketing and recruitment model was designed.

3.2.2 Questionnaire

The first section, headed *Biographical information*, aimed at identifying the social status and the environment of the respondents, which play a vital role in the design of a model to recruit students (May & Chubin, 2003:26). The second section, *Study decisions*, determined the influencing factors. To give the respondents an opportunity to express their opinions, this section concluded with open-ended questions. The third section, Marketing influences and institution choice, focused on why TUTFEBE was their preferred choice, or not. The final section, *Career counselling experience*, was dedicated to finding a more targeted approach to recruiting engineering students for TUTFEBE by identifying the actions to include in the marketing and recruitment engagements.

3.2.3 Focus group interviews

The questionnaire was followed up with semi-structured interviews. This gave the subjects an opportunity to explain their experiences, which provided a better understanding of the reasons why they decided to study engineering at TUT. Insight was gained, which assisted with the design of a targeted marketing and recruitment model.

3.3 METHOD

3.3.1 The triangulation mixed-method design

Tashakkori and Creswell (2007:207) refer to Creswell and Clark (2007), who introduced the multilevel design, and proceed to explain the benefits of the execution of both qualitative and quantitative methods. Bernardi et al. (2007:42) agree that these methods complement each other. They add that with the triangulation of the results, the cross-referencing of data validated the results.

A more detailed and holistic view of the phenomenon concerned was gained by using this approach, and the influences that played a role in the career choice of the learners were clearly identified. An objective quantified view and a more in-depth qualitative perspective were obtained. Cohen et al. (2007:141) argue that by studying quantitative and qualitative data from more than one angle, and triangulating the results, a more in-depth understanding of the research question (in this case, the career choice behaviour of learners) is brought about. Mouton (2006:156) states that the mixed method cancels out the shortcomings of the respective methods. This data created a platform for an evidence-based marketing and recruitment model for the FEBE.

The existence and the importance of the physical world and the reality of the influence of human experiences on *our subjects* were the significant factors in this study (Östlund et al., 2011:370). This information enabled a better understanding of the influence of human experiences on the career choices of learners.

Denzin (1989), referred to by Green et al. (2002:135), first used the term “triangulation” and clarified it as a multi-method way of studying the same phenomena. Onwuegbuzie and Leech (2005:383) state that triangulation allows a better understanding of links between empirical findings and challenges theoretical assumptions in the development of new theory. The explanatory mixed-method design used was straightforward and easy to report on (De Vos et al., 2011:442).

3.3.1.1 Quantitative approach

According to Maree (2007:153), quantitative research is defined as the systematic analyses of collected numerical data. This approach is used as the first source of evidence for assessing students. The necessary approval to access these students (first-time entering students at TUTFEBE) was obtained. The collection of the data was done in a structured quantifiable manner by using a designed questionnaire which the students completed using SurveyMonkey.

3.3.1.2 Qualitative approach

Focus group interviews were conducted as the second source of data collection, to complement the quantitative findings (Ivankova et al., 2010:259). Qualitative research is defined as *an enquiry process to explore and understand participants' experience with the central phenomenon.* Harper and Thompson (2011:5) add that *qualitative approaches enable understanding of experiences and processes* to develop an understanding of the phenomena.

During the interviews, the smaller sample focus group students shared their views on their experiences of influences on their career decision-making in preparation for their engineering study. The intimacy between the role players (interviewer and interviewee) assisted in the formed interpretations. In the integration of quantitative and qualitative data, thematic clusters were identified. The interaction with subjects assisted positively with understanding human behaviour and the interpretation of their opinions (Savenye & Robinson, 2004:1047).

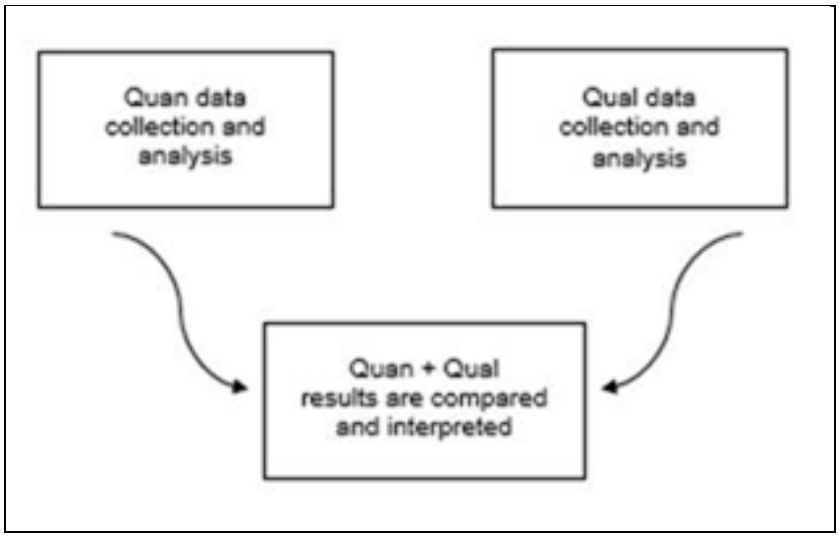

Figure 3.1: Triangulated mixed method design (adapted from Maree, 2007:275)

3.4 DATA COLLECTION

Data collection refers to a series of interrelated activities aimed at gathering good information to answer emerging research questions (Creswell, 2013:118). Due to the convenient access to the subjects, who had experience of the phenomenon being studied, purposeful sampling was used to identify the participants. The first-year extended curriculum, first-time entering engineering students of the TUTFEBE were identified. The site was identified as the TUT Pretoria Campus where the Faculty of Engineering and the Built Environment is located.

The sample size was 437 students as representative of the entire population of 944 students in the first semester, which presented an aggregate of 44%.

3.4.1 Population

De Vos et al. (2010:193) define a population as *individuals in the universe who possess specific characteristics,* whereas Blaikie (2009:172) views population as *an aggregate of all cases that conform to some designated set of criteria*. The population identified for this study was the first-year students in the FEBE at TUT. The first-year extended curriculum students fit the same criteria as first-time entering engineering students at the TUTFEBE and were identified as the population due to the convenience of accessing them.

3.4.2 Sampling: quantitative study: non-probability sampling

Since the findings of this study were not intended to be generalised, the non-probability sampling was recognised as an adequate sampling method (Cohen et al., 2007:113). The particular group targeted were the first-year students enrolled in the extended curriculum at the FEBE. The first-time entering students in the extended curriculum division at TUTFEBE were identified as an excellent source to assist in identifying the influences they experienced on their career choice.

3.4.3 Sampling: qualitative study: stratified random sampling

Due to the accessibility and the suitability of the students, a proportional stratified random sampling method was used to select the focus group (De Vos et al., 2010:200). This sampling method established a true reflection of the subgroups. A sample of ten students per programme was randomly selected to participate in the focus group interviews. The groups were a heterogeneous population percentagewise and their experiences were relevant to the problem researched (Cozby & Bates, 2012:146).

3.4.4 The data collection strategy

Data collection and analysis occurred interactively. The data collection strategy, purpose and practical steps are explained in the table below.

Table 3.1: Summary of research strategy

Research strategy and purpose	**Practical steps**
Phase 1: Literature review Sampling Development of questionnaire	 Ongoing literature review Non-probability sampling: accessible group of engineering students. Based on factors identified through literature, own experience as well as knowledge of the various elements of recruitment, a structured questionnaire was developed.
Phase 2(a) Structured analysis of perceptions and experiences – core data collection	 Structured questionnaire and statistical analysis (SPSS)
Phase 2(b) Focus group interviews – verification of findings	 Qualitative analysis of data captured manually after the interview sessions. Proportional stratified random sampling method was used to identify the focus group. Triangulated outcomes with findings from structured questionnaire.
Phase 2(c) Triangulation and final analysis	 Combined quantitative and qualitative findings.
Phase 3: Reported and formulated elements that impacted on the marketing and recruitment plan of action. Formulated aspects to inform the action plan for influencing career decisions of learners towards engineering careers.	

The research strategy is summarised in the figure below.

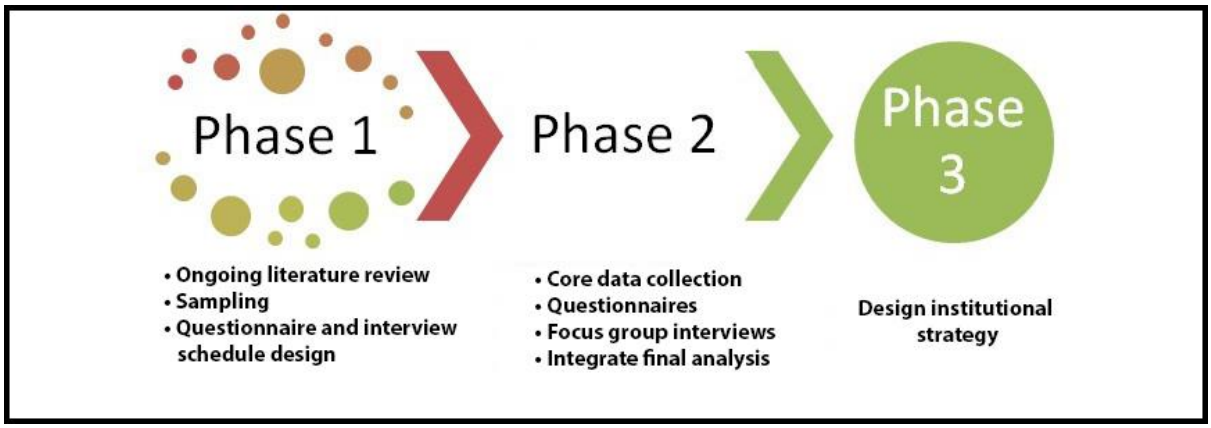

Figure 3.2: Research strategy

3.4.5 Data collection instruments

The data was collected through an online questionnaire (see Addendum A), followed by semi-structured interviews (see Addendum B).

3.4.5.1 Questionnaire

The questionnaire was uploaded on SurveyMonkey, a web-based survey solution program used to collect data. This program assists with gathering biographical information, factors that influenced the participants' decisions to study engineering, their decision to study at TUT, the career counselling they received, as well as the strategies they acted on to choose engineering as their career choice.

With the approval of the extended curriculum section head, and the support of the computer laboratories administrators in charge of these groups, access to these students was granted during one of their free periods.

A standardised questionnaire was administered to the different groups who attended their Computer Skills lecture during the second semester of 2015. The purpose of the study was explained to the entire group before they logged onto the electronic questionnaire. The participants were clearly informed that it was a voluntary exercise. They *(the sample of students)* were identified as being the *ideal type* and therefore it was not necessary to disclose their identities, and their anonymity was assured (Yin, 2014:197). The computer laboratory administrators made sure that the students were logged on and able to proceed with the completion of the questionnaire. Each participant received a hard copy of the information leaflet explaining the purpose of the survey, with two consent forms attached. The one consent form was for their own perusal and safekeeping and the second consent form was collected

as evidence of their consent to willingly participate in this study. The questionnaire was divided into four categories, namely *Biographical information*, *Study decisions*, *Marketing influences and Institution of choice*, and *Career counselling experience*. A summary of the categories of the questionnaire appears below.

Table 3.2: A summary of the categories evaluated in the questionnaire

Category	Justification	Question number
BIOGRAPHICAL INFORMATION	Biographical information was required to: - contextualise the study; - identify the respondents; and - identify the relationship between the independent variables and the dependent variables (Mouton, 2006:93). These independent variables played a role in the career choices of the students. The questions assisted with the identification of the social status and environment of the respondents, which influenced the design of the marketing and recruitment model (May & Chubin, 2003:26).	1-14
STUDY DECISIONS	The study decision variables were used to: - determine the influencing factors in learners' study choices; - identify the window of opportunity when learners were mostly inclined to choose their course of study (Maringe, 2006:468); - identify the factors that influenced students' career choices (Jian et al., 2010:159a); - establish why the TUTFEBE was the preferred institution for their course (May & Chubin, 2003:35); and	15-24

Category	Justification	Question number
	- detect the significant people who played a role in the career choice of the students. This information assisted in the design of an effective marketing and recruitment model (Makgato & Mji, 2006:261). The open-ended questions gave the respondents the opportunity to express their views.	
MARKETING INFLUENCES & INSTITUTION CHOICE	This category focused on: - how, when and why participants decided to study at TUTFEBE; - the role that different people played in participants' decisions to choose TUT as the university of their choice (Youngman & Egelhoff, 2003:F2D-13); - the influence of advertisements (and which mode of advertisements) on career choices (Jian et al., 2010:159b); and - what role the reputation of the TUT and in particular that of the FEDE played in the career choice (Case, 2006:159).	25-31
CAREER COUNSELLING EXPERIENCE	The fourth category focused on: - additional information regarding the influence of the Mathematics and Physical Science teachers on the respondents' career choice (Makgato & Mji, 2006:259; Lethoko et al., 2001:311); and - determining what could be done to motivate learners to excel in Mathematics and Physical Science. The responses directed the design of the marketing and recruitment model and addressed the following:	32-45

Category	Justification	Question number
	- Mathematics and Physical Science teachers' interventions in the macro model; - determined which social media platform were most appropriate and ultimately most effective. - why respondents decided to change from Mathematics to Mathematical Literacy, where applicable.	

3.4.5.2 Semi-structured focus group interviews

An interview is a two-way conversation, according to Maree (2007:87), who states that respondents are asked questions with the aim to access rich information. This information sheds light on how the respondents construct knowledge. Curtis and Curtis (2011:100) define the word *focus* as a limited area of interest and the word *group* as participants with a common interest. In this study, the focus was on students studying engineering and the group was the first-time entering students registered in the extended curriculum of the FEBE.

The focus group interviews gave insight into the respondents' experiences and attitudes, which would not have been accessible otherwise (Denzin & Lincoln, 2011:529).

A group of 50 students from the sample of first-year extended curriculum students who participated in completing the questionnaires was invited for interviews. Semi-structured interviews were used to verify the data obtained from the questionnaires to clarify the answers (Maree, 2007:87). The interviews elicited participants' experiences, opinions and understanding of decision-making and the factors that influenced their career decisions.

3.4.5.3 Field notes

Field notes are recorded notes taken during the research process (McMillan & Schumacher, 2010:350). Detailed field notes were made of the reflections regarding the conversations, interviews and any comments provided by the participants. The field notes were recorded in the form of a reflexive journal (see Addendum F).

3.5 DATA ANALYSIS

De Vos et al. (2005:340) define data analysis as the process of providing structure and meaning to a mass of collected data. The quantitative data was first analysed, and then used to help design the qualitative data in the second phase (see Figure 3.1). The quantitative data, collected by means of questionnaires, was captured on an Excel spreadsheet and analysed using the SPSS software program.

The focus group interview data was transcribed. The transcriptions and field notes were studied to obtain a clear understanding of the information. The data was coded and a content theme analysis done. Themes were coded and sub-themes identified.

Once the data had been collected, captured, processed and the results condensed, the findings were triangulated from the quantitative *questionnaire* and qualitative *focus group interviews*. Themes generated within the quantitative data were compared with themes from the qualitative data to recognise the influences on career choice of learners.

Access to different groups was made possible through careful planning, support and cooperation by the departmental administrators.

3.6 QUALITY CRITERIA

3.6.1 Trustworthiness (reliability, dependability)

The trustworthiness of data includes aspects from the quantitative and qualitative approaches. In the mixed method approach, the term *trustworthiness* refers to the presentation of results in a manner that the reader believes and that convinces him or her of the outcome (Bailey, 2007:181).

During the interviews the researcher verified the accuracy of the respondents' interpretation of the questions in the questionnaire. *Dependability* defines the degree to which the reader can be convinced that the findings indeed occurred as indicated in the research report (Blanche et al., 2006:64). Trustworthiness is used in qualitative research to describe the validity of the data (Gay et al., 2011:392).

To ensure a truthful reflection of the themes *identified during the interviews,* a more collaborative approach was followed to make sure that there was equality in the questioning, interpreting and reporting (Creswell, 2013:173). Maree (2007:147c) defines *reliability* as the instrument's ability to measure a certain result consistently and repeatedly. If the same

participants are measured under the same circumstances, an identical *or nearly identical* measurement should be produced.

3.6.2 Validity (credibility)

Maree (2007:87c) refers to *validity* as the extent to which a question measures what it is supposed to measure. One way to 'validate' a non-standardised questionnaire is via a pilot study which was mentioned in 1.10. The items in the questionnaire were validated by interpretations made from the literature study, by the supervisor and by a group of subject specialists in the field of study concerned. According to Bailey (2007:181) *internal validity* is the assurance that the researcher gave an accurate representation. By triangulating the analysis of the collected data, *credibility* was ascertained. This assisted with the identification of any discrepancies in the findings.

3.7 SUMMARY

This chapter elucidated the research design and methodology of the study. The qualitative and quantitative data collection, population and sample selection were discussed. The use of the SPSS software program to analyse quantified results as well as the identification of the themes identified in the qualitative results were acknowledged. Finally, the ethical considerations were addressed.

The following chapter will focus on the interpretation and triangulation of the captured data.

CHAPTER 4: DATA ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

The previous chapter discussed the rationale of the research approach, namely the research design, the method, sampling and means of data collection. The critical factors that should be evident in the quality of the analyses were specified as trustworthiness, reliability, dependability, validity and credibility.

Chapter 4 addresses the analyses of the captured data and the interpretation and triangulation thereof. With the recognition of the most important factors in the career choice of learners the research question, that is, which actions should be implemented in the marketing and recruitment efforts to attract learners for TUTFEBE, were identified. A multifaceted evidence-based marketing and recruitment model was designed.

4.2 ETHICAL CONSIDERATIONS

Ethical clearance is required when research involves human and/or non-human participants. The ethical clearance application specified the purpose of the research, and specifically which influences, images and messages influenced career decisions of learners to study at TUTFEBE. Ethical clearance for the quantitative and qualitative study was granted by the Faculty of Humanities at TUT (Reference number FREC Ref #: FREC/EDU/STF/2013/02) and the Faculty of Business and Management Sciences of the Cape Peninsula University of Technology (CPUT).

4.2.1 Informed consent and voluntary participation

Informed consent in written format was obtained from the subjects after they had learnt what the purpose, risks and benefits were and which procedures would be implemented to ensure confidentiality (Johnson & Christensen, 2008:107). They were informed of their right to withdraw at any stage without any penalty or future disadvantage (McMillan & Schumacher, 2010:118) and were assured that withdrawal would in no way influence their continued relationship with the researcher or their academic progress at the University.

4.2.2 Anonymity and confidentiality

In this study anonymity was maintained (Jennings, 2001:109). The questionnaires revealed no names or any other kind of identification. Confidentiality refers to a situation where the names can be matched with the responses, but the participants know that their names will not

be revealed. The participants were assured that all the information provided would be anonymous.

Before the interviews were conducted with the focus group participants, they were informed that their responses would be recorded but that they had the right to withdraw, should they feel uncomfortable or intimidated by the presence of the data recorder. All the participants signed an informed consent form prior to the interviews.

To enable the participants to mention aspects they did not feel comfortable sharing in the group, they were given a post-interview worksheet. This worksheet served as a way to verify the data as intended by the participants (Seymour, 2004:20). The worksheets could then be submitted in an easily accessible sealed post box available at the entrance of the ground floor of Building on the Pretoria Campus of TUT. Unfortunately the participants did not use this opportunity and no completed confidential worksheets were received.

The stratified random sampling method application did not allow matching the responses with the participants. The data were kept safe and field notes, transcripts and recordings contained no names.

4.3 BACKGROUND INFORMATION

To address the problem statement, scientific evidence was gathered on the methods to apply to recruit suitable learners for TUTFEBE. Maringe (2006:470) indicates that the course of study chosen tends to be closely related to the institutional choice decision. The factors influencing career and institution choice were therefore identified.

The factors influencing career decisions were rated according to importance. The marketing and recruitment actions were then ranked according to available *human and financial* resources. As mentioned in the literature review, Mathematics and Physical Science teachers who *influenced engineering education* were scrutinised to indicate their ability to motivate learners to succeed in these enabling subjects. As identified earlier, *one model does not fit all*, thus strategies were observed worldwide to determine which actions were relevant to TUTFEBE's environment, which actions were already executed, and, most importantly, which actions could be implemented at TUTFEBE.

Similarly to the situation in the Netherlands (section 2.5.2), South Africa is also challenged to promote Mathematics, Science and Technology (MST) to improve employability to stimulate economic growth. In Ireland's engineering awareness programme, the targeted population included a broad spectrum of subjects. Both primary teachers and the wider public were part

of their target audience. This is not currently the case at TUTFEBE and therefore awareness creation of engineering to a wider audience was introduced in the TUTFEBE marketing and recruitment model. With the robotics programmes offered at lower socio-economic schools to motivate learners to excel in MST, TUTFEBE is on par with what is done in Israel (section 2.5.4). Mexico (section 2.5.6) presents vocational schools, while Malaysia (section 2.5.7) offers an awareness programme in a manner that addresses the holistic development of learners. A vocational school programme was suggested in the marketing and recruitment model with different models to focus on the holistic development of the learner. It is envisaged that this programme will assist learners in the identification of their ambitions.

4.4 STATEMENT OF RESULTS

4.4.1 Quantitative approach

To contextualise the study and gain a better understanding of the learners TUTFEBE attract, the questionnaire started with a section on Bibliographical Information.

4.4.1.1 Questionnaire – Section One

4.4.1.1.1 Overview of biographical information

Most respondents were male and in the 17-20 age group. It is clear that a more targeted approach should be identified to promote engineering careers to attract females to these programmes. The Females in Engineering (FEMENG) chapter was recently established at TUTFEBE with the main purpose of motivating females in engineering. Additional actions were identified to complement FEMENG to excel in its efforts. The majority of respondents came from rural and urban townships, with an average household income of R6 000 to R9 000 per month. Ramdass (2009:117) mentions various challenges facing education in South Africa, one of which is the recognition of UoTs as major national assets in the South African educational environment. In light of this, TUT can be recognised as a national asset for this country, as the majority of learners TUTFEBE attracts are from rural and urban townships, lower cultural regions (section 2.7.3), where the need for information on career choices is most important.

The Gauteng, Limpopo and Mpumalanga provinces stood out as the main footprint provinces for TUTFEBE. English was recognised as the second language for the mainstream of students, with Northern Sotho ranked second highest with 21% and isiZulu placed third with16%. Remarkably, the statistics revealed that the females (mothers) were the most influential people in the learner's households and it is reassuring to note that both parents are guardians of the majority of learners. Surprisingly, the mothers are the highest qualified and mostly employed full-time.

4.4.1.1.2 Registered programme

The sample of extended Curriculum students targeted comprised the following programmes: Civil Engineering (17%), Electrical Engineering (48%), Industrial Engineering (11%) and Mechanical Engineering (24%).

4.4.1.1.3 Age, gender and year matriculated

Table 4.1: Summary of age, gender and year matriculated

Age in years	17–20		21-23		24+							
	325	74%	105	24%	7	2%						
Gender	Male		Female									
	331	76%	106	24%								
Year matriculated	Prior to 2009		2009		2010		2011		2012		2013	
	10	2%	17	4%	25	6%	35	8%	184	42%	166	38%

It is clear from Table 4.1 that the ration of male to female in the sample is 3:1. Most of the learners in the sample matriculated at the following schools: Moridi Secondary School, President Mangope Technical and Commercial High School, Pretoria Technical High School, Bokgoni Technical Secondary School, Harry Oppenheimer Agricultural School and John Vorster Technical High School. It is noteworthy that three of these schools are participants in the annual FEBE Competition Day. This confirms that that recruitment action is effective.

4.4.1.1.4 Residence of learners

The statistics show that TUTFEBE attracts students from the following locations: 42% rural, 38% urban township, 19% urban suburb, while 7% did not specify their place of residence see Figure 4.1.

Dias (2011:374) discusses the connection between internal and external pressures (section 2.7.3). She refers to the *inheritors* when claiming that learners from a higher income background will most likely proceed with tertiary studies whilst those learners from lower income homes were dependent on the influences of their family and friends. At TUTFEBE the majority of learners are from lower income homes, contrary to the circumstances in Mexico, where the disadvantage learners were underrepresented at the time of this research (section 2.5.6). This does not rule out the necessity for TUTFEBE to implement additional interactions in lower socio-economic areas to promote engineering education. On the contrary, targeted marketing and recruitment actions are crucial in the lower socio-economic areas. TUTFEBE

is offering a Robotics programme in Attridgeville, which is similar to Israel's initiative of presenting additional supplementary programmes focusing on STEM content (section 2.5.4). This serves to encourage learners to excel in Mathematics, Science and Technology and it is expected that they would choose to study engineering at TUTFEBE as a result.

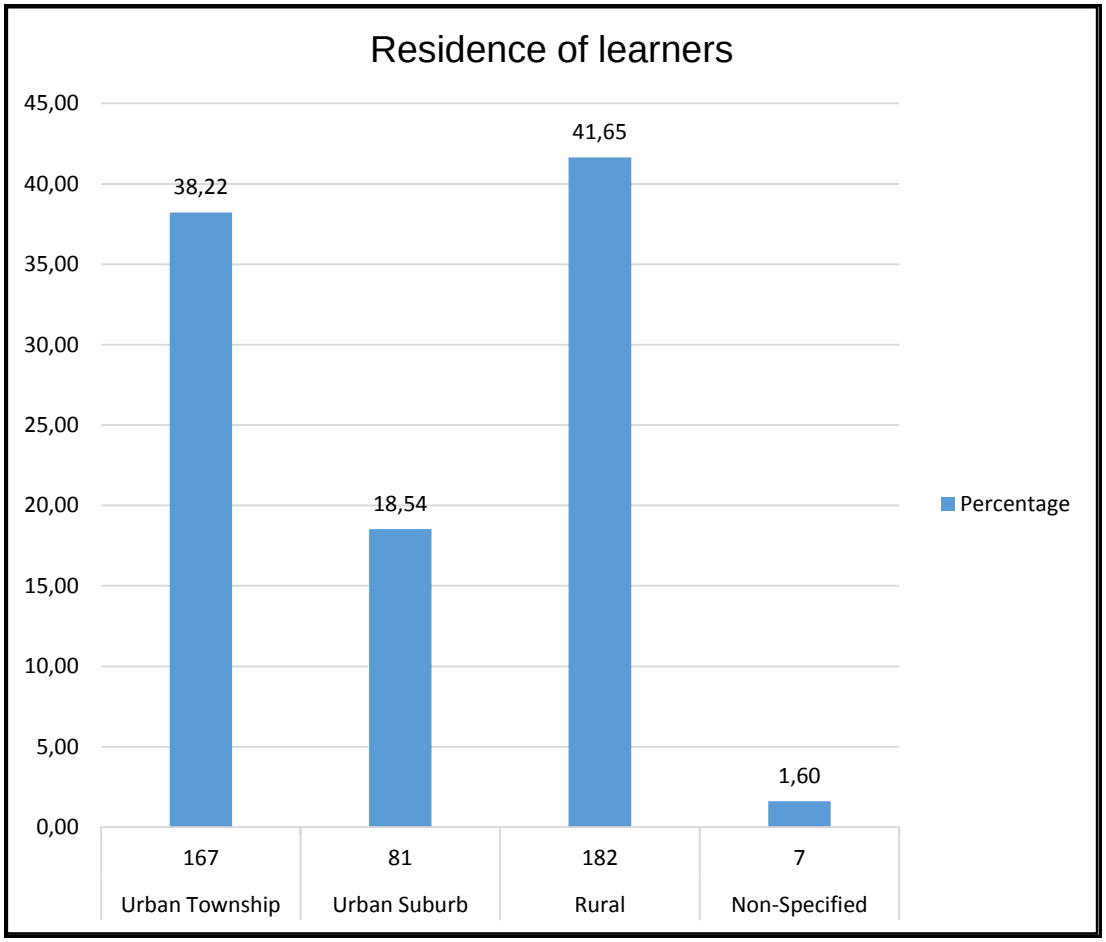

Figure 4.1: Residences of learners

4.4.1.1.5 Residential province

The main feeder provinces were revealed as Limpopo with 32%, followed by Gauteng with (31%) and Mpumalanga (19%) as shown in Figure 4.2. The only academic institutions available in the Limpopo Province are the University of Limpopo and the University of Venda. Neither of them present engineering programmes and that might be why most of TUTFEBE's students come from Limpopo (University of Limpopo, n.d.; University of Venda, n.d.).

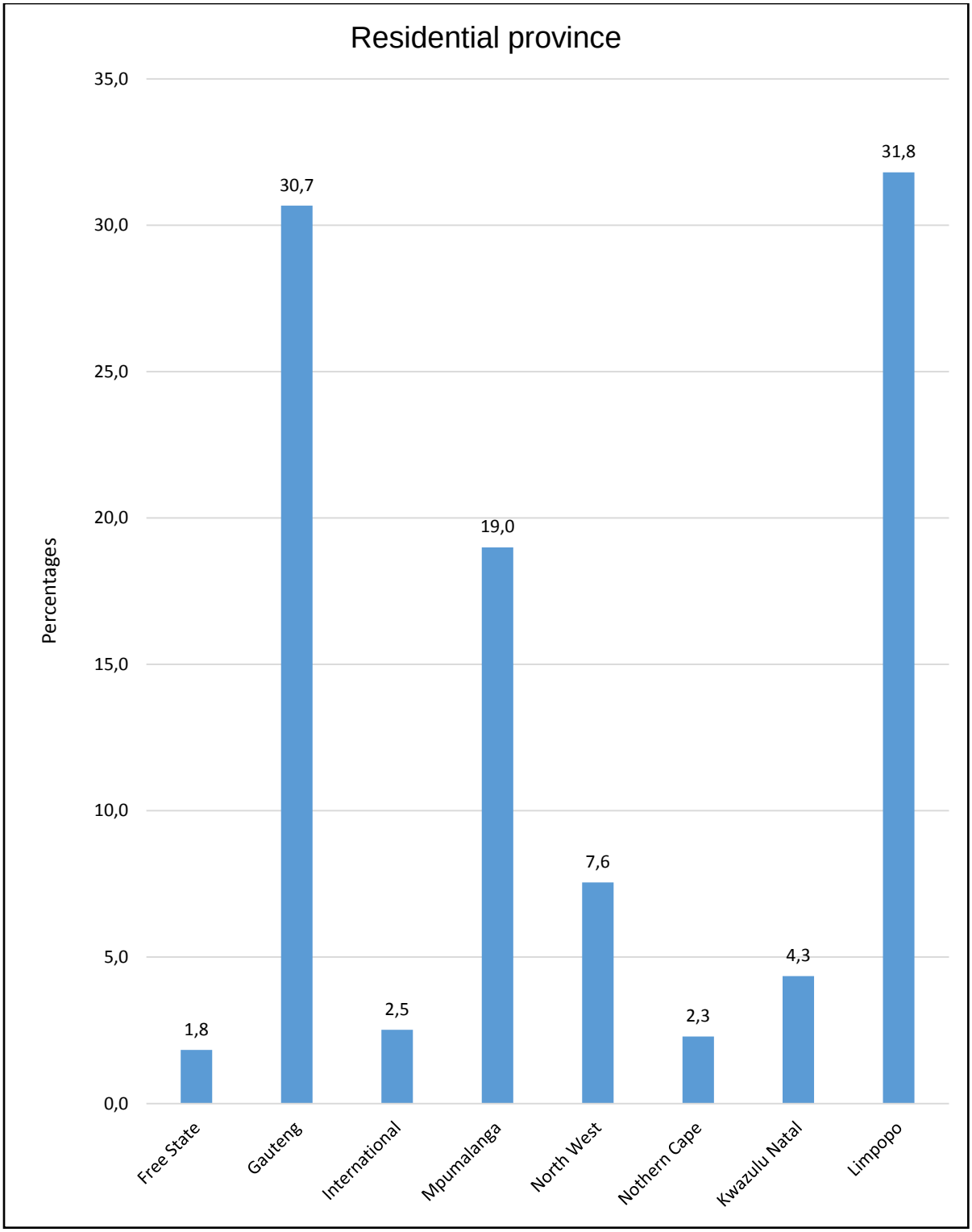

Figure 4.2: Residential province

4.4.1.1.6 Learners' mother tongue

Language is an important requirement for education, according to Magogwe and Oliver (2007:350), and a condition for tertiary education (Magogwe & Oliver, 2007:339). The results of this study as shown in Figure 4.3 indicated that only 2% of TUTFEBE's students were

English mother tongue speakers. This supports Makgato's finding (section 2.7.1) that English proficiency is one of the main problems experienced in education, and confirms Howie's conclusion that inadequate comprehension of information results in poor academic performance. The languages spoken in the main feeder provinces were revealed in the South African Census (2011:23) as, in Limpopo, Sepedi followed by Xitsonga and Tshivenda. Gauteng's main spoken language isiZulu, followed by English and Afrikaans. In Mpumalanga isiZulu is the language spoken the most. Statistics obtained from the quantitative results in this study revealed Northern Sotho (21%), IsiZulu (16%) and Setswana with 12% as the mother tongues of our students. Since most of TUTFEBE's students come from Limpopo where Northern Sotho is the mother tongue of most of the population, it stands to reason that it would be the language spoken by most of the students at TUTFEBE. The distribution of languages at TUTFEBE is presented visually in Figure 4.3. (University of Limpopo, n.d.; University of Venda, n.d.).

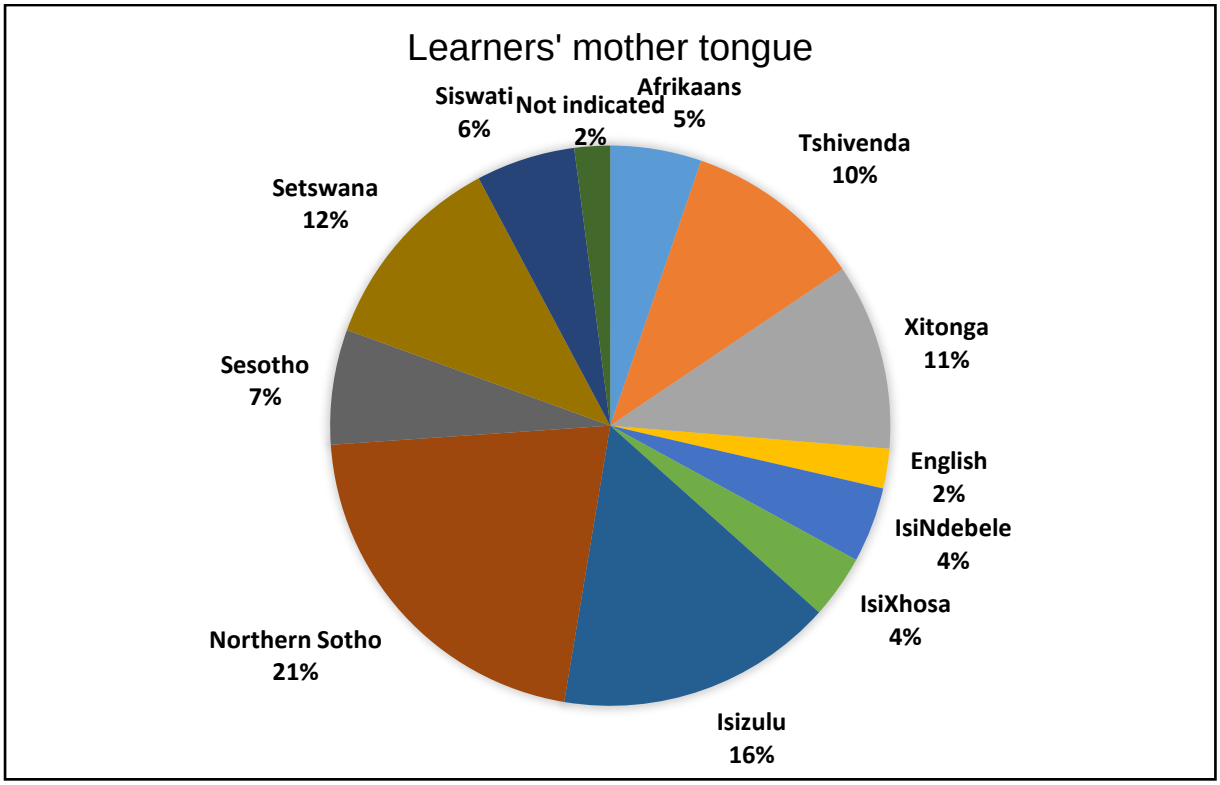

Figure 4.3: Learners' mother tongue

4.4.1.1.7 Primary guardian

It was satisfying to note that the highest percentage (45%) of learners have both parents in their household, but disturbing to discover that the primary guardian of a large percentage (35%) of students was the mother only as displayed in Figure 4.4.

The importance of parents' and guardians' influence on career choices was clearly identified in the literature (section 2.7.3). The literature on individual factors revealed that perceptions are acquired during childhood through *parents*, siblings, family, guidance counsellors and teachers, as well as peer group pressures (section 2.9.1 (a)). The contextual factors support this notion when the importance role-models (of whom parents are the most important) is discussed (section 2.9.1 (b)).

It also became evident from the literature study that *technology awareness* should be stimulated in the public at large, but specifically in parents (section 2.8.1 (a)). It is arguable that parents should be motivated to be more involved in their children's performance (section 2.7.3).

One way in which the TUTFEBE addressed this need was by inviting parents and the public at large to events like the Baja Bug and the Solar Car races to introduce them to technology innovation.

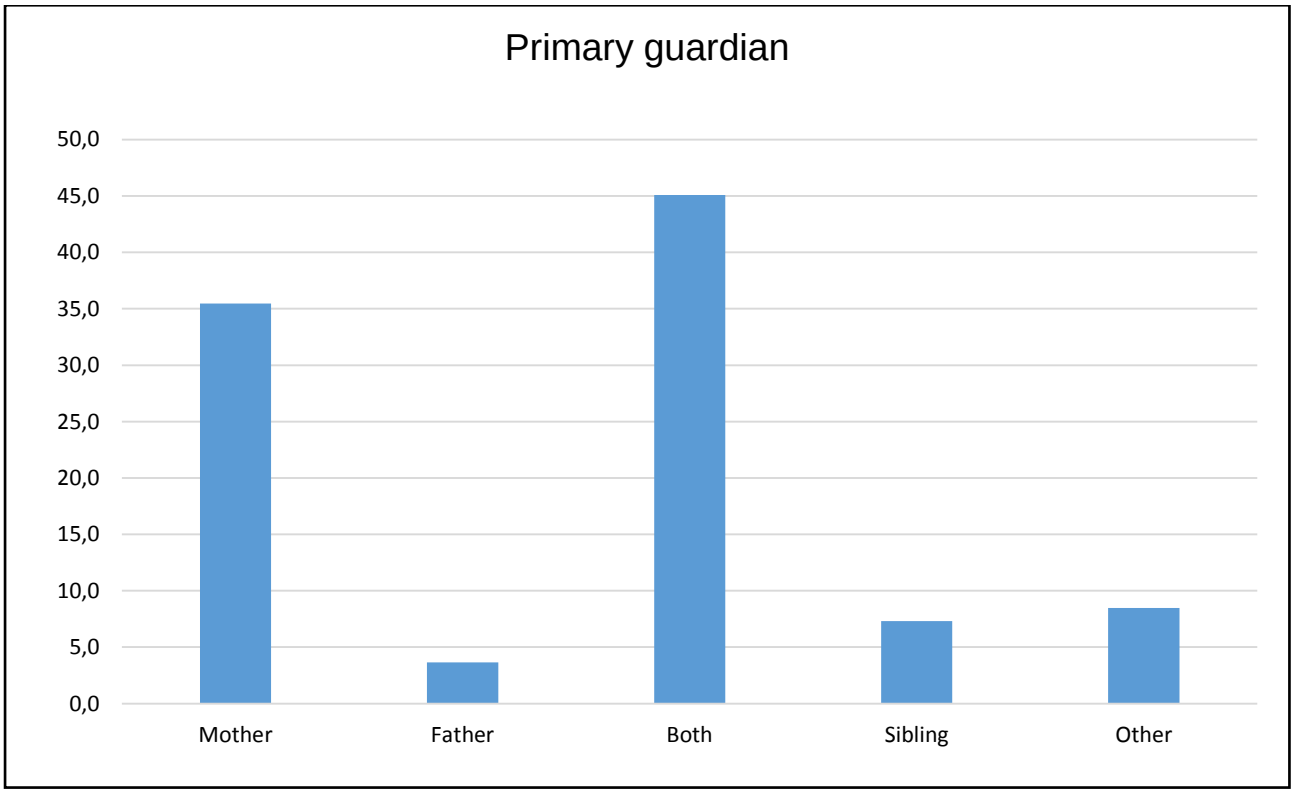

Figure 4.4: Primary guardian

4.4.1.1.8 Level of education of male and female guardian

Figure 4.5 revealed that in the majority of cases the female guardian of the student was the highest qualified in the guardian relationship, with 10% completed matric, 10% completed secondary school and 13% with a tertiary qualification (N Dip, degree and postgraduate qualification combined). This is satisfying to know, as it is assumed that learners, specifically female learners, will follow their female guardians.

The fact that the female guardian often has the highest qualifications may be advantageous, as engineering is traditionally regarded as being a suitable profession for men only (section 2.4). Mexico has also made a concerted effort to include females in engineering by selecting learners who represented the demographic diversity, the minorities and females to participate in their week-long programme on campus (section 2.5.6). Norway supports and encourages gender balance in the programmes it offers (section 2.5.8).

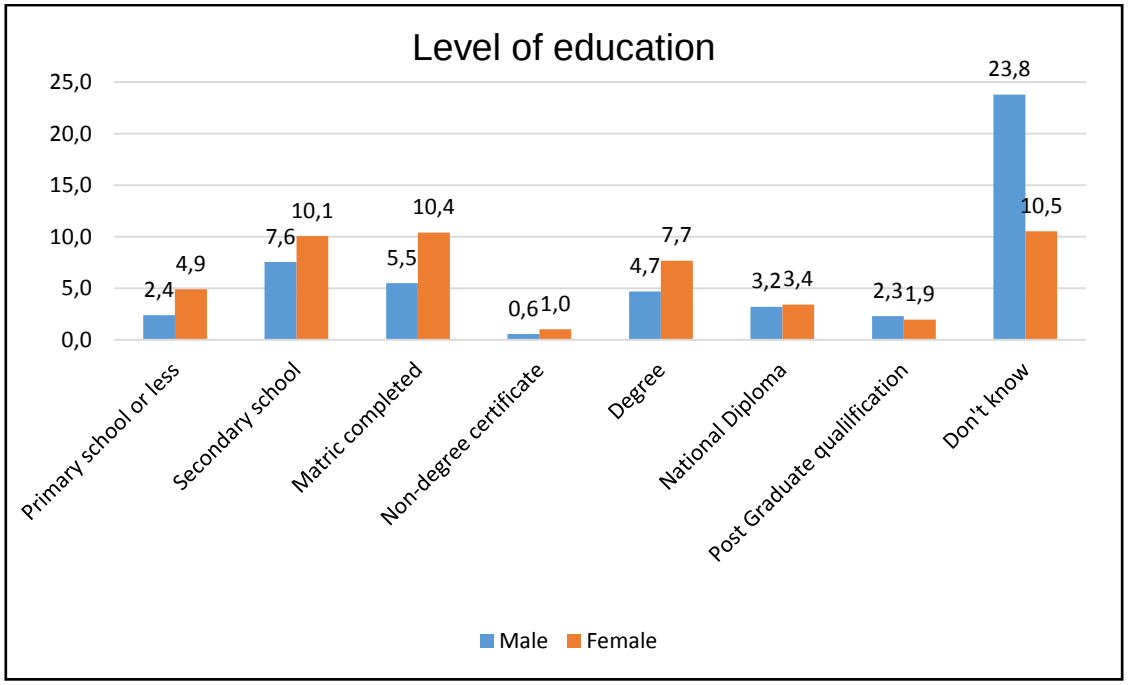

Figure 4.5: Level of education of male and female guardian

4.4.1.1.9 Household income

Cooter et al. (2004:252) found in their research that access to higher education across all income groups is recognised as a national priority. Their main concern, however, was about the continued provision of economic access to all levels of higher education (Cooter et al., 2004: 253(b)) and they indicate that the financial aid process is need based. They contradict

Aamodt's finding (section 2.7.5) that financial incentives have a limited influence on career choice by claiming that family income and education debt could interact in influencing career choice. The majority of TUTFEBE's learners are from lower-income families, less than R12 000 according to Figure 4.6, which emphasises the continued need for financial support in higher education.

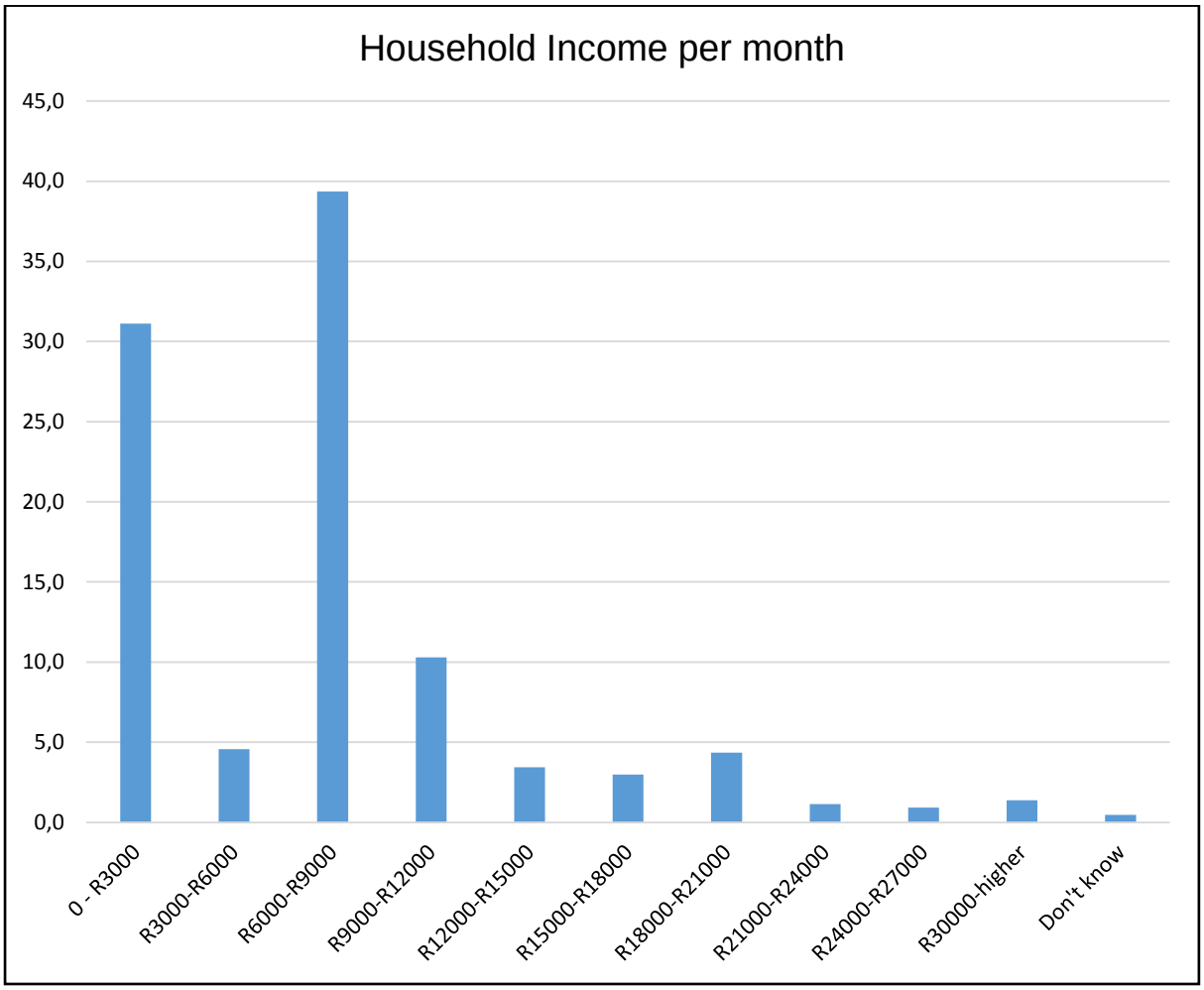

Figure 4.6: Household income per month

4.4.1.1.10 Employment status of father and mother

Indicated in literature (section 2.8.1 (a)) the influence of parents in career choices of learners were confirmed. Although full-time employment from both father and mother was revealed as 19% and 23% respectively, the unemployment, as shown in Figure 4.7, status was alarming with the fathers 12% and mothers 21% were unemployed. This might explain why parents were absent in their children's educational lives, due to the lack of finances and time.

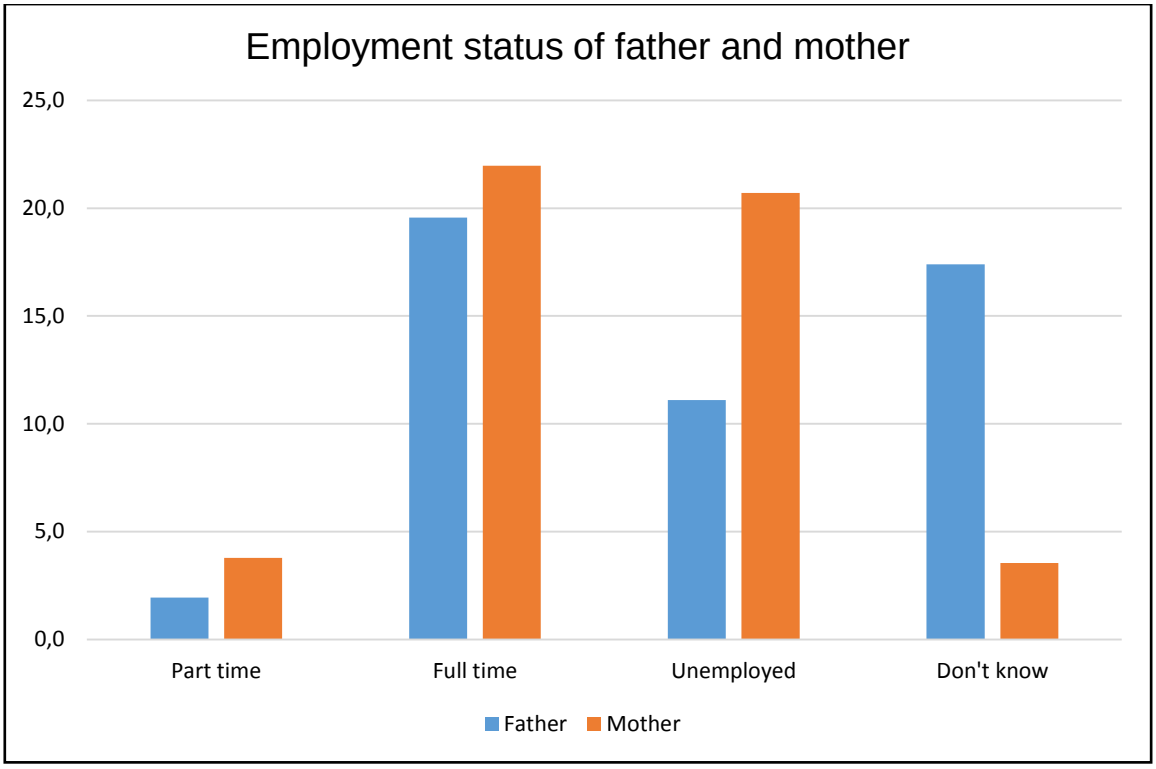

Figure 4.7: Employment status of father and mother

4.4.1.1.11 Method of payment

Chapter 1: Finances were not showed as a hindrance for learners when they considered tertiary education in spite of the recent Fees must Fall protests. It is assumed that learners are well aware of the availability of government bursaries, although there are not enough such bursaries. The National Student Financial Aid Scheme (NSFAS) was indicated as the means of payment of 54% of respondents, and guardians paid for the studies of 30% of the respondents as shown in Figure 4.8. Field (2.7.5) alleged with the learner's knowledge of available tuition subsidies created a more relaxed approach with learners, when applying for courses and concluded (2007:2) that subsidies certainly have an effect on career choices in comparison with qualifying for a loan.

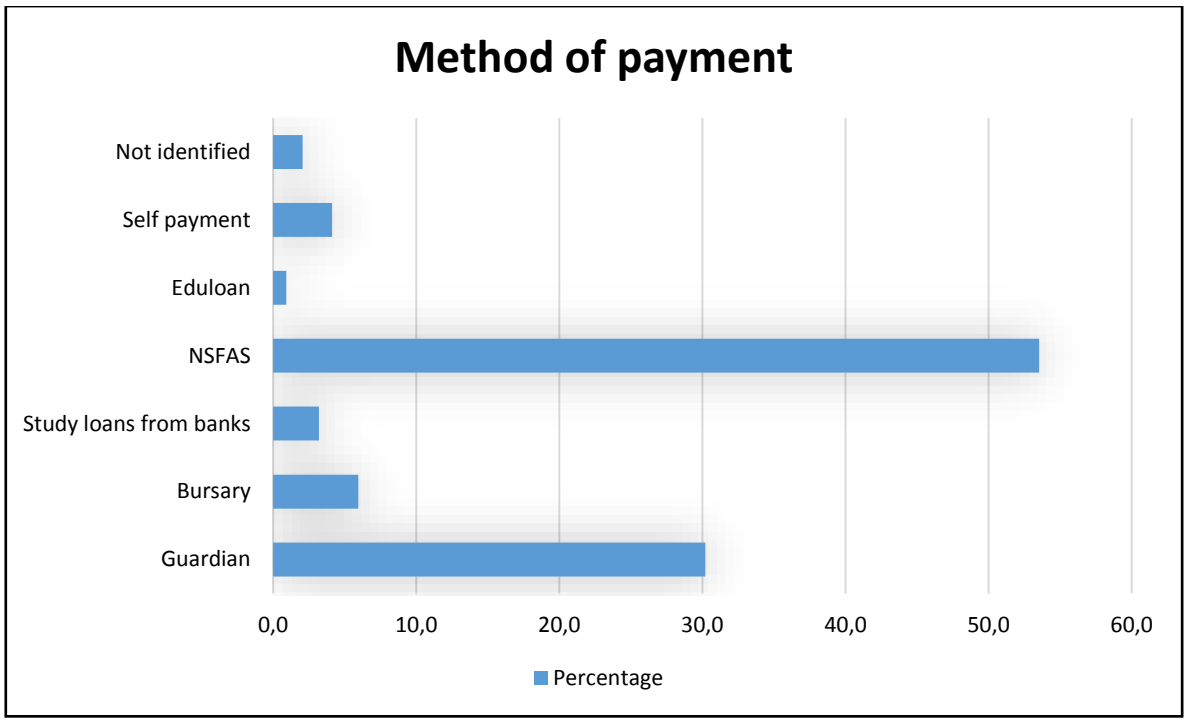

Figure 4.8: Method of payment

4.4.1.2 Questionnaire - Section Two

4.4.1.2.1 Background

The second section of the questionnaire, Study Decisions, addressed the main objective. By identifying the influencing factors, the marketing and recruitment actions to increase the number of prospective students for TUTFEBE were addressed. In this section the time frame when learners' decisions about their careers are taken was identified. The tools most used to assist in their decision-making were identified. The impact of different people on learners' career choice was determined. Finally, it was shown why TUTFEBE was the preferred institution. The section concluded with an open-ended question to allow the participants to express their views.

The tools used in deciding on a career were ranked as follows: Career guidance professionals, internet information, institutional marketing material, career shows and exhibitions and school science expos were the main means of gathering information, and the TUT website also played a role. Career guidance professionals were identified as one of the main target audiences in the marketing and recruitment model. In view of the new qualifications introduced at TUTFEBE, it is very important to educate the guidance professionals about the new qualification framework offered. The TUTFEBE web page is in place and the information obtained from the questionnaires confirmed the important role it played in career choice

decisions, although that was not the main means of information. The current marketing material is professional and the significance of these publications was revealed in the information obtained from the questionnaires. The importance of career exhibitions was identified and ways of addressing this challenge were captured in the marketing and recruitment model. This information had a direct impact on the methods utilised in the marketing and recruitment efforts of the marketing and recruitment model. Although career choice decisions' timeframe was identified as being after Grade 10, learners choose their subjects at the end of Grade 9. That is why marketing and recruitment actions should be presented at a younger age. Learners should be made aware earlier on of the career opportunities in engineering to understand why it is important to excel in the enabling subjects. A significant 80% of respondents confirmed that they were successful in being selected for the programme of their first choice. First-hand information from an acquaintance working in the engineering industry was identified as the most influential factor in the career choice of learners and stimulated the idea to use work shadowing as a means of career awareness creation in the marketing and recruitment model. Parents, professional guidance support and teachers were indicated as the main role players in learners' career choices.

The third category in the questionnaire focused on choice of institution. Once again, the period was identified when the choice of institution was made. The reasons how, when and why learners decided to study at TUTFEBE and which people played a significant role in their institution of choice were acknowledged. The most effective advertisement method was identified. The role that TUTFEBE's reputation played was clarified. The results discussed below were obtained.

4.4.1.2.2 Decision-making period

Even though the majority of learners (58%) as shown in Figure 4.9 only made their career choice after Grade 10, the literature revealed (section 2.2) that recruiters needed to capitalise on the early decision making stage, since that was when learners' attitudes and views were developed.

It is assumed that should awareness of engineering be created with learners at an earlier age, their awareness of the importance of being successful in the required subjects, which are Mathematics and Physical Science, would contribute to informed decisions when choosing a career.

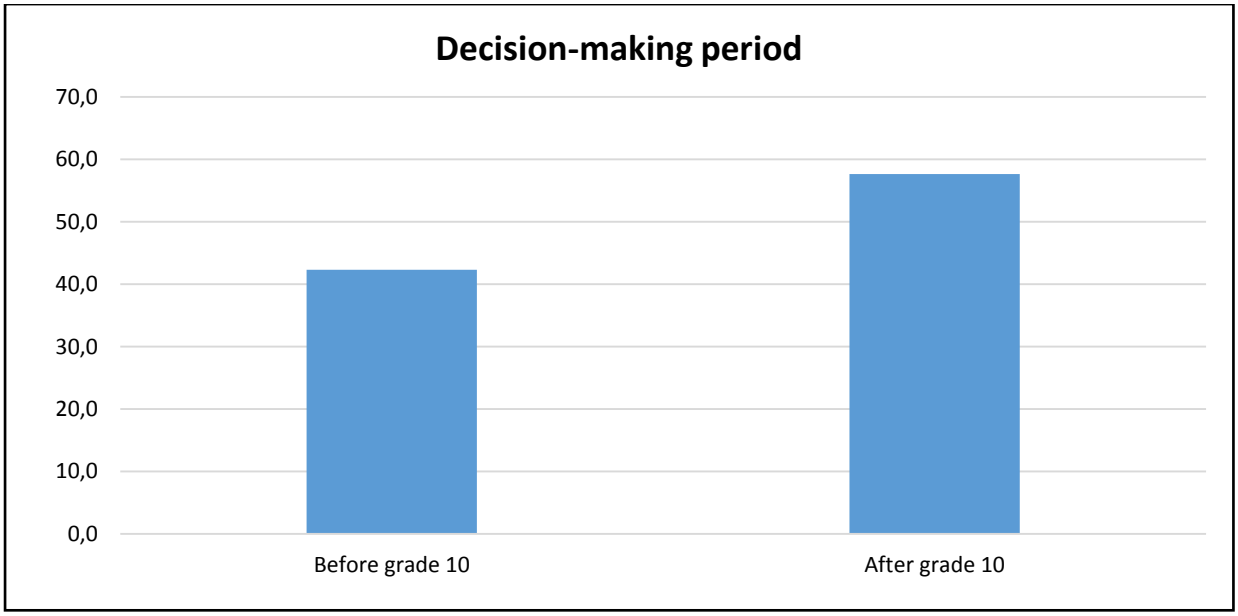

Figure 4.9: Decision-making period

4.4.1.2.3 Selected programme offered at another institution

It is encouraging to note that even though the students' programme of choice was also offered at another institution, 89% of learners opted for TUTFEBE, see Figure 4.10. Only 1% of students indicated that their programme was not presented at another institution. There might be a number of explanations for this, such as geographical location, accommodation possibilities and admission requirements. The specific programmes offered at TUTFEBE also played a role. For example, the students stated that they had heard by word of mouth that it was desirable to obtain a qualification from TUT's Department of Civil Engineering.

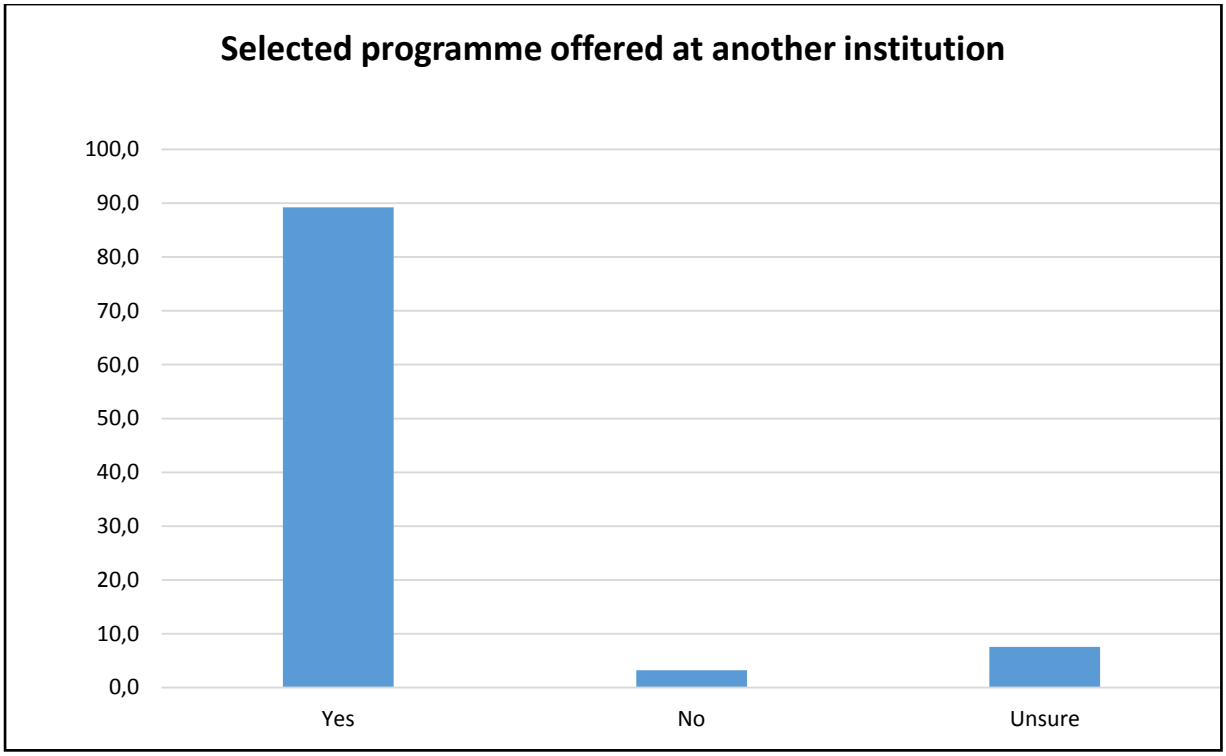

Figure 4.10: Selected programme offered at another institution

The main reason for students *not* being selected for their first choice was identified as not meeting the minimum requirements of their preferred institution. If one takes the competitors in consideration, two of which are academic universities, it can be deduced that this might be the reason why these students chose a UoT as their second choice. Due to the lower minimum admission point scores (APS), it would be an easier alternative for learners. It seemed that many learners and the public at large do not clearly understand the differences between the training and the qualifications conferred at an academic university and at a UoT. Most of the respondents' first choice was Electrical Engineering, followed by Mechanical Engineering, but due to limited space not all of them were selected for those particular courses.

When asked which tools were utilised in career choice decisions, the following data was retrieved:

4.4.1.2.4 Preferred tool used in career choice decision

Results captured in Table 4.2 shows career guides (13%) and the Internet (10%) were the main tools used to investigate career choices. The professional marketing material provided by the TUTFEBE was identified as the third highest tool (9%), which confirms the importance of the quality of marketing material offered at recruitment drives. Career exhibitions (8%) and science expos (7%) were also highly ranked. It was noteworthy that open days and Facebook were ranked quite high, which confirms the necessity of continuing with the presentation of an

open day and proceed with Facebook communication. Disappointingly, the assumed *flagship recruitment projects* like the robotics workshops and Lego League competitions were at the bottom of the priority list. This indicates that more efforts should go into introducing these projects to a larger audience.

Table 4.2: Preferred tool used in career choice decision

Possible tools	%
Career guides	13
Internet information	10
TUT pamphlets/brochures	9
Career shows/exhibitions	8
School science expos	7
TUT website	7
Television	5.2
TUT Open Day	5
Facebook	5
Career magazines	4
Library	4
Campus visits	4
Newspapers	3.8
Radio	3.1
Faculty Facebook page	2
YouTube	2
WhatsApp	1.4
Sasol Techno X Career Exhibition	1.1
Twitter	0.9
Advertisements on busses	0.6
Mobi sites	0.6
Faculty Competition Day	0.5
Mix-it	0.5
Sport events	0.4
Blogs	0.4
Robotics competitions	0.2
Faculty involvement in any form	0.2
Lego League competitions	0.1

4.4.1.2.5 Individuals or experiences that influenced career choice

Once again parents were identified as a major influence (62%) in the career choices of learners, career advisors and guidance with 60%, and, most of all, acquaintances who work

in the engineering environment (65%). The influence of TUT's recruiters and advisors received the lowest score of 23%, and this emphasised the need for an evidence-based targeted marketing and recruitment model for FEBE.

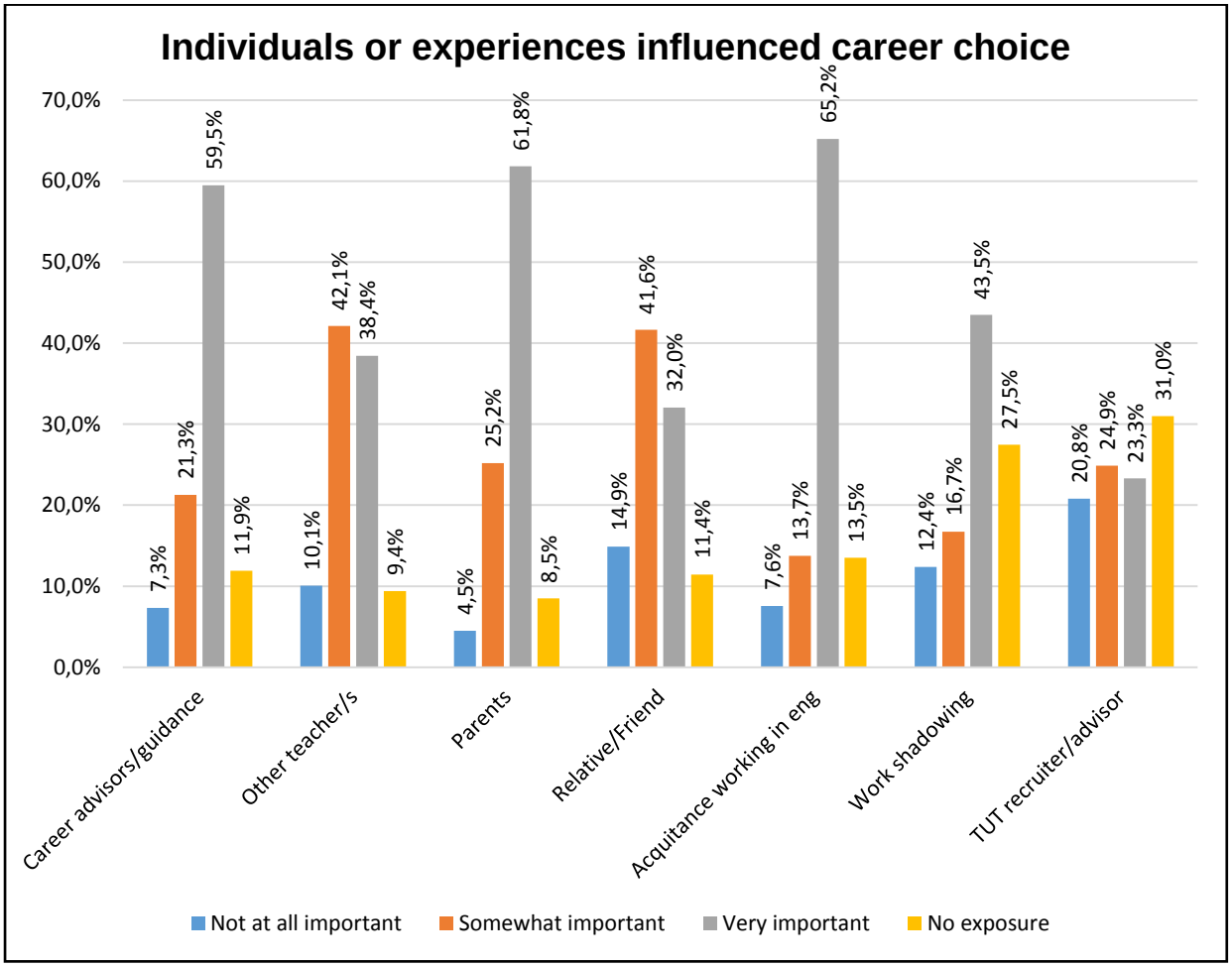

Figure 4.11: Individuals and experiences that influenced career choice

4.4.1.2.6 The influence of individuals and experiences on the decision to choose TUT as the preferred institution

Parents stood out as the primary influencing factor (66%) as shown in Figure 4.12 when learners chose their institution. Course graduates (46%), alumni (51%) and acquaintances (52%) working in the engineering field were highly influential. Unexpectedly, family members working at TUT were identified as the lowest influencing factor. This information revealed that much more can be done to inform staff, university-wide, of the programmes offered at the FEBE and to have a specific action in the marketing and recruitment model for internal marketing. Specific divisions that work with prospective students and enquiries should be kept informed on a continuous basis of the programmes offered at FEBE and of projects like the Solar Car and Baja races.

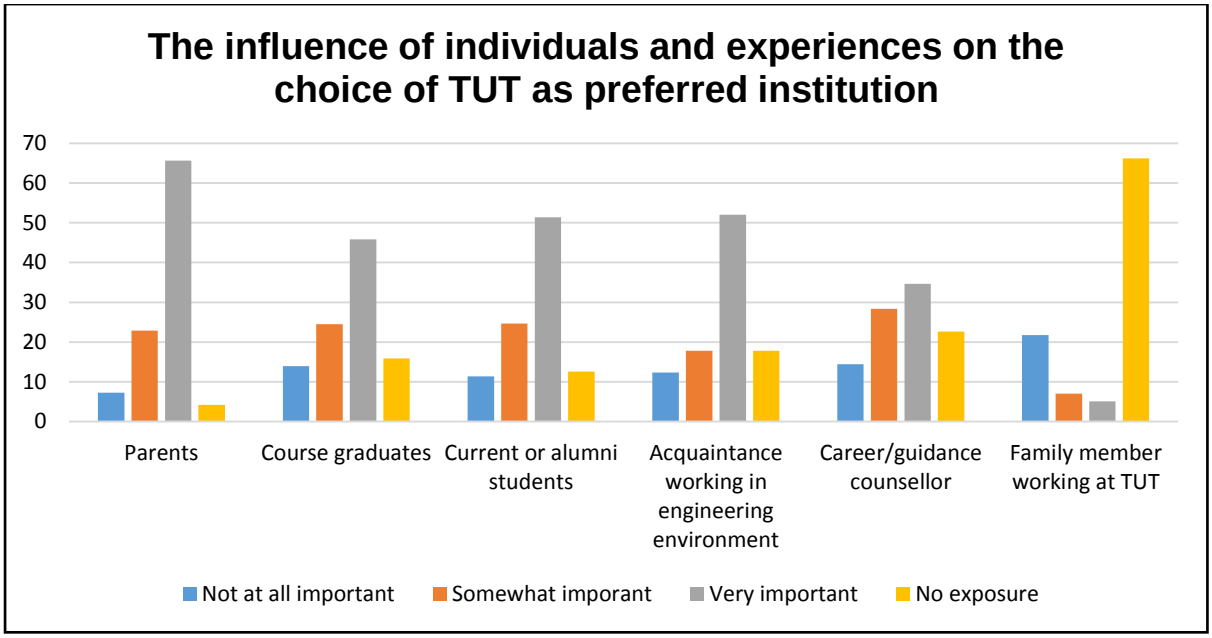

Figure 4.12: The influence of individuals and experiences on the choice of TUT as preferred institution

4.4.1.2.7 Recognition of the TUT logo prior to study at TUT

Pampaloni (2010:19) explains that the commitment to continue with tertiary education is often the first major life-changing decision in a person's life. External influences as well as the anticipated desired outcome play an important role and this is where the recognition of the TUT logo and the institution prior to learners' choice of institution plays a role. This recognition of the image of in institution is the result of effective branding. After the identification of the influences on learners' choice of institution, TUTFEBE's recruitment messages were changed to target those influences, with the expectation that they would encourage learners in their decision-making. Figure 4.13 revealed that Internet played the most important role (22%), followed by influences at school (21%), and then career guidance books (13%). The career guidance books and professional marketing material support the importance of career guides (section (iv)).

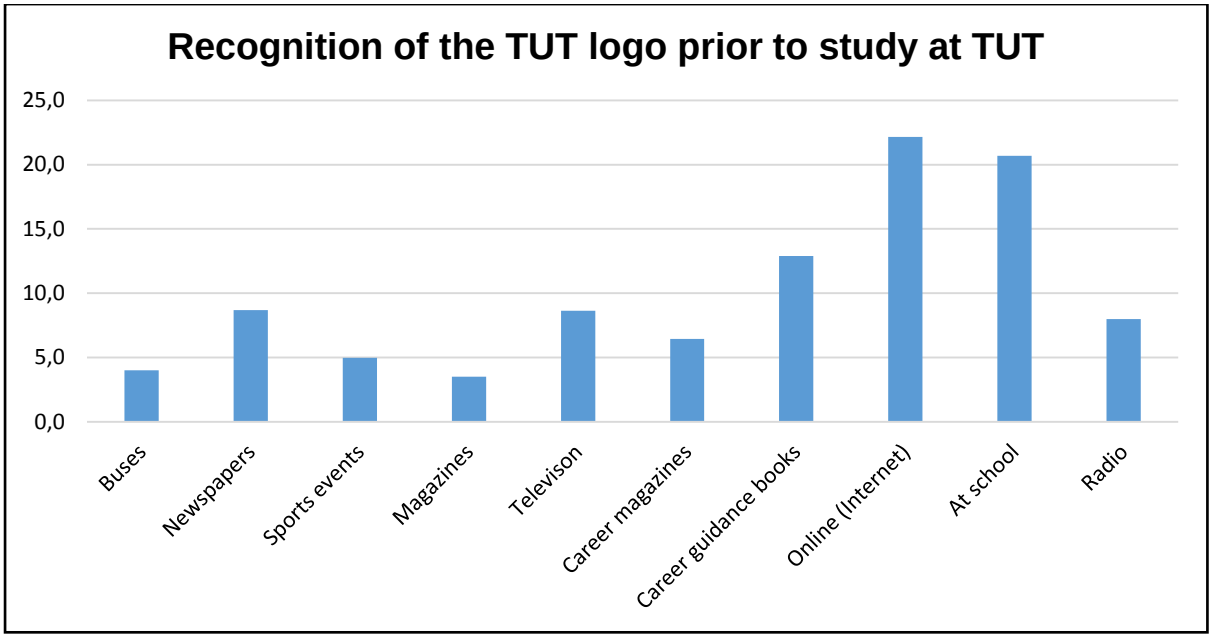

Figure 4.13: Recognition of the TUT logo prior to study at TUT

4.4.1.2.8 Preferred social media recruitment method

Facebook stood out as the most preferred method of social media interaction (13%), followed by WhatsApp (12%) and YouTube (9%) as shown in Figure 4.14. Although the youth experience social media as part of their world, it cannot be assumed that all students, regardless of status, will be able to use social media (section 2.6.2). A well-planned social media strategy in the marketing and recruitment model is a definite requirement.

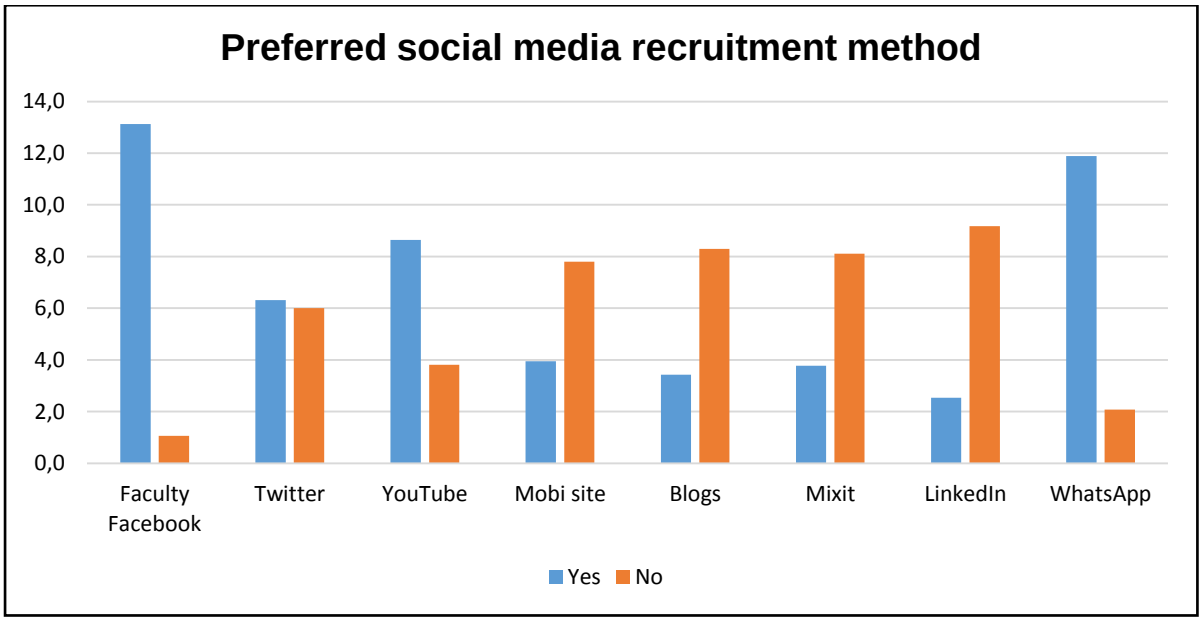

Figure 4.14: Preferred social media recruitment method

4.4.1.2.9 Factors influencing choice of TUT as institution

Parents' influence was identified as the most important factor in the career choices of learners. Word of mouth was another powerful influential factor which should not be left out. One of the movements implemented in the marketing and recruitment model was to empower current staff and students by means of regular internal marketing actions with knowledge on the programmes offered at the TUTFEBE. The word of mouth influence emphasised the importance of good service delivery to current students so that the message about the professionalism of the institution can be spread. Alumni came through as a valuable means of marketing the institution and the use of alumni to assist with the recruitment of learners became one of the additional methods in the marketing and recruitment model. The use of the Internet was identified as most important, as well as the presence of TUT at schools (career and science expos). Facebook was by far the preferred social media choice of communication. TUT (being a UoT), where applied theory is the method of teaching, was identified as most important. The learners also implied that UoTs are seen as institutions that ensure better employment possibilities.

The final section of the questionnaire, Guidance Experience, consisted mainly of open- ended questions aimed at determining the influence of Mathematics and Physical Science teachers on career choices. The respondents were asked to explain the reasons why a specific engineering field was chosen. They were also asked to state, where applicable, why they changed from Mathematics as a school subject to Mathematical Literacy, to determine if they understood the consequences of that decision, should they choose engineering as a career. Finally, the learners had the opportunity to share ideas on how to present Mathematics and Physical Science at schools to motivate an interest.

4.4.1.2.10 Factors influencing choice of TUT as an institution

In the identification of preferred institution of choice as displayed in Figure 4.15, *teaching method* took the lead with 49%. The *preferred method of teaching* (49%) confirmed that UoTs play a very important role in tertiary education (section 4.5.5). The *cost of attending* scored one percent less (48%). The importance of *tuition fees* were contradicted in the statistics, as it was found to be a very important factor, after it had been revealed as not playing an important part (section (xi)). It might be that students explored the total financial implication of studying, including accommodation and transport. The possibilities of being *employed* after graduation (section 4.4.2) was revealed as 44%, with *research reputation*, 43% and *geographic location* as 42%.

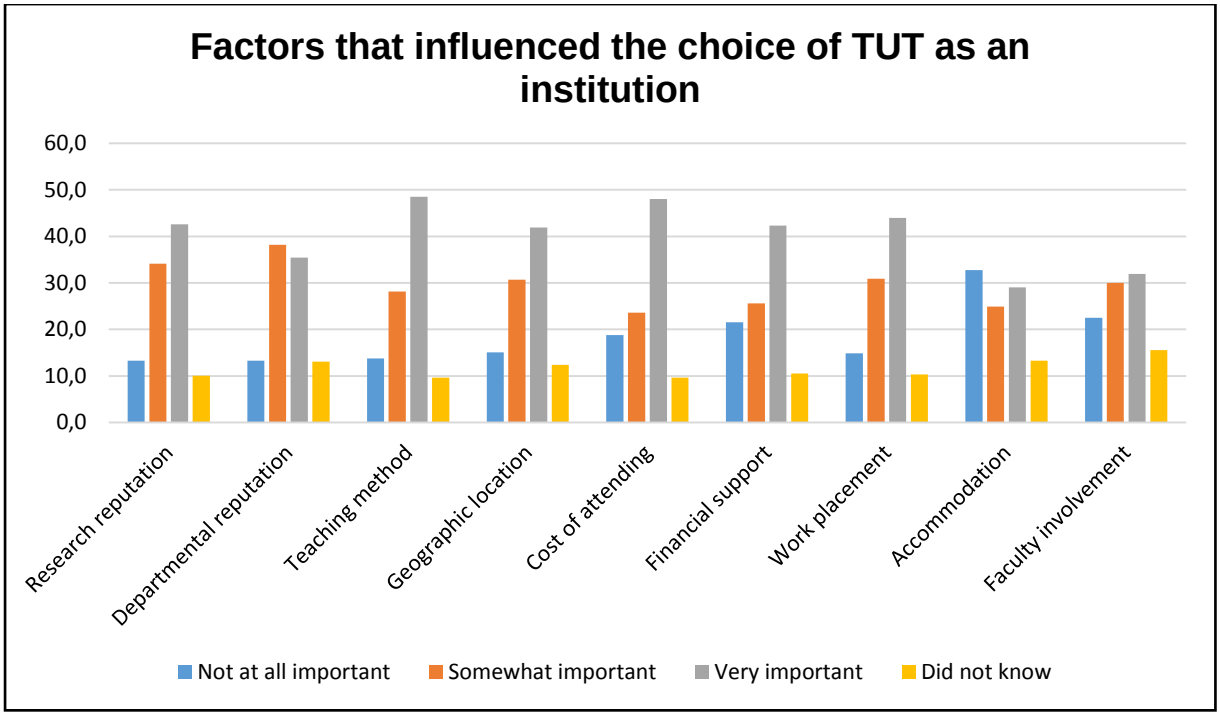

Figure 4.15: Factors that influenced the choice of TUT as an institution

4.4.1.2.11 Support received on TUT information

Professional and specific marketing material was identified as the most important means of information received (62%), although Pampaloni (2010:22) in reference to Hossler who said that brochures were not necessarily used to make a decision, but definitely a factor when confirming a choice. From Figure 4.16, the influence of family was identified as 60%. It is theorised that the encouragement, motivation, assistance with the preparation of applications and finally the financial assistance received (Pampaloni, 2010:22) constituted a major influencing factor. The role current students' influence had on prospective students was 53%. This led to the idea of using current students at career exhibitions to present their projects to the learners. By using this method learners should be able to associate with student better and have a better understanding of what that specific career entails. The least important influence was identified as parents working at TUT (5%), which supported the notion that stronger emphasis should be placed on the internal marketing of FEBE.

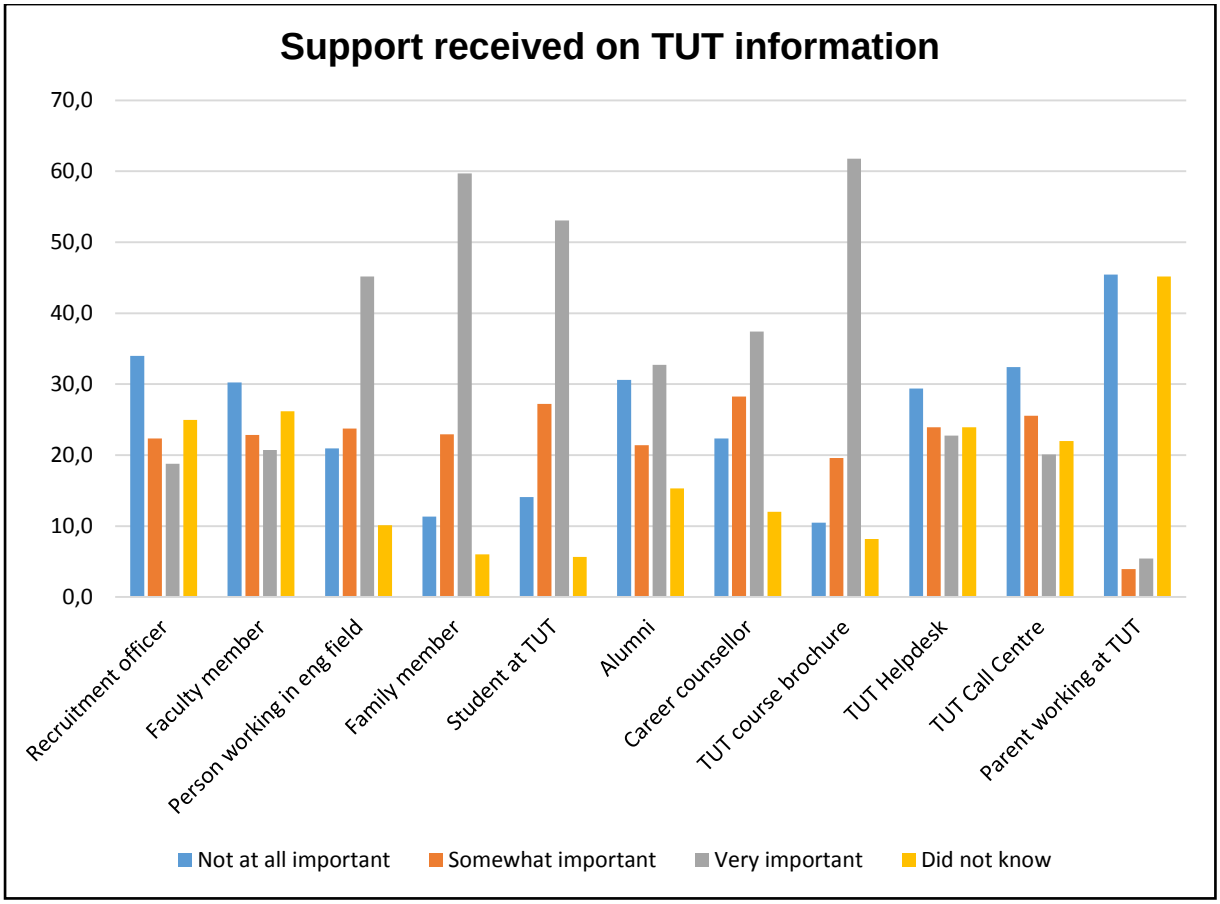

Figure 4.16: Support received on TUT information

4.4.2 Qualitative approach

The statistics obtained from the questionnaire show that Mathematics and Physical Science teachers have a major impact on learner's career choice. The majority of learners were adamant that their teachers were competent in teaching these subjects. Contrary to popular belief, the learners who switched to Mathematical Literacy did so because they wanted to; they made the decision. These statements were contradicted in the interviews. An interviewee explained that the school's management decided to transfer learners to Mathematical Literacy, should they perform poorly in Mathematics in Grade 10. Another respondent explained that his Mathematics teacher was continuously drunk and added no value to the Mathematics classes. He was offended that nothing has been done about the situation, although management knew about the situation.

Where Mathematics and Physical Science teachers created stimulating environments for learners when presenting these subjects, their expectations of pursuing a career in engineering became prominent. They became goal-orientated to achieve the compulsory

marks (admission requirements) to allow them access to tertiary education. Although learners saw it as a challenge to perform well in the enabling subjects, they took note of the possible opportunities and believed that they would create the better life they strived for. The following outcomes were anticipated: (a) bursaries would be available, and (b) the demand for engineering professionals would ensure employability and good salaries. Some of the respondents liked the idea of being able to solve real-life problems, and identified a career in engineering as the means of being an asset to their social environment, their country and their families.

Many respondents were discouraged and reported that their teachers did not understand the content. Some teachers read the content from the handbook and became impatient when learners asked questions. Nonetheless, these negative experiences motivated them to work harder. Extra classes, attending study groups, holiday schools using mentors, and watching the Discovery channel on TV were some of the strategies they used to make it into the engineering environment. The positive influence of friends was rated highly.

Technical awareness was mainly created in learners who took technical subjects at technical schools. One student said: *I considered my families background and saw that engineering would help me change the situation at home*. Another student stated that he had almost been electrocuted, and that stimulated his interest in electrical engineering. It was also revealed that the need for engineers in South Africa created expectations of good salaries and employment, and therefore learners who studied in the engineering field had an advantage. Not only were they interested in the intrinsic value, but a few also shared that they would like to be a contributor to their country's wellbeing by, for instance, assisting in making electrical power available to all in the country. A few of the respondents were mature enough to have done research on the various fields in engineering and to compare them with their interests, predisposition and abilities to determine their career choices. The open day was mentioned as one of the marketing events that assisted with their career choice.

In their response on how to create an interest and motivate learners to pursue Mathematics and Physical Science, similar themes to the ones already identified were mentioned. Once again, the competency of the teachers and their role were frequently addressed. The respondents suggested that these subjects should be presented in a practical manner, preferably with examples that they could associate with real-world experiences. Competitions were suggested to keep it fun. The need to be exposed to the engineering profession at an earlier age (primary school) was mentioned.

4.4.3 Overview of guidance experiences

Interest came up as the highest individual factor in career choice, although it was inspired by different influences. In cases where learners were confronted with incompetent Mathematics and Physical Science teachers their self-efficacy or belief in themselves became dominant. The socio-economic status and environment (contextual factors) where they grew up played an important role; whether it inspired them to provide a better quality of life for their families or exposed them to fixing things in and around home. In the subjects' explanations of how they decided on the career they chose, the individual factors intertwined with contextual factors were clearly visible. The influences of teachers and role models in their lives was once again emphasised.

4.4.4 Triangulation of data

The explanatory mixed-method design was used. This design method established a better understanding by using the qualitative data to clarify and enrich the quantitative findings (Maree, 2007:279) and to comprehend the lives lived by the learners (Curtis & Curtis, 2011:70). To interpret the data, thematic clusters were formed (Creswell, 2013:187).

4.5 THEMATIC CLUSTERS

4.5.1 Interest

The main theme stood out as an interest in subjects like Mathematics, Physical Science, Technical Drawing, Mechanical Engineering, Civil Engineering, Computer Engineering and Life Science, to name the recurrently mentioned subjects. It became clear that most of the respondents were from technical schools and that they were fortunate to be more informed of the importance of the enabling subjects than the rest of the learners. Therefore, although TUT is capable of attracting learners from technical schools, more interactions with academic schools should be implemented.

4.5.2 People's influence

The qualitative data supported the quantitative data when it was determined that teachers, family, community members and acquaintances were the individuals who had the most influence on learners' career choices. Advice from someone working in the engineering environment and with first-hand experience was regarded as most significant. Their parents were their main advisors when it came to institution of choice, followed by current students and alumni. Interestingly, staff members at TUT had no impact, and this was one of the factors addressed in the marketing and recruitment model.

4.5.3 Exposure to engineering

Career exhibitions and science shows were identified as the second major influence on career decisions. The respondents explained that the visibility of projects gave them a better understanding of careers, which assisted with their career choices. The TUT open day was mentioned as one such an event that made a difference. Work shadowing should also be mentioned in this category, as it has been seen that awareness creation through experiences at a younger age is very effective. Work shadowing was added to the marketing and recruitment model. Exposure in various forms was very influential, be it at an exhibition or at home where they fixed things or helped their fathers to repair cars. School and campus visits were popular, and Internet use was identified as being at the top of the priority list.

4.5.4 Teachers

One of the main influences on career choice was identified as the teachers. Most of the learners stated that they were in the engineering field because of their teachers. This statement confirmed the results of the quantitative data. Even when learners were confronted with negative circumstances in Mathematics and Physical Science classes, they enabled themselves by pursuing various additional ways to master those subjects. The important influence of teachers was again specified in their suggestions on how to improve the interest in Mathematics and Physical Science. The literature revealed that targeting Mathematics and Physical Science teachers and enabling them with the skills required to present these subjects in a practical manner was the most cost-effective method of preparing learners for engineering studies.

4.5.5 Teaching method

Although the differences between the qualifications conferred by an academic university and a university of technology were still not clearly understood, the teaching method (applied technology) was identified as an influence in their choice. Those who chose TUT as their second or third choice (with UP and UJ being their first choices), were quite satisfied with being at a university of technology now and preferred the practical aspect of the teaching method. One student indicated in the interview that he was adamant to pursue the route to qualify as a professional engineer.

4.5.6 Employability

Most of the learners had been advised by their peers that their employability would be much higher if they graduated at a UoT. This fact is supported by the Department of Higher Education and Training (2014:124), where the members of a project team are displayed in Figure 4.17.

Engineering team

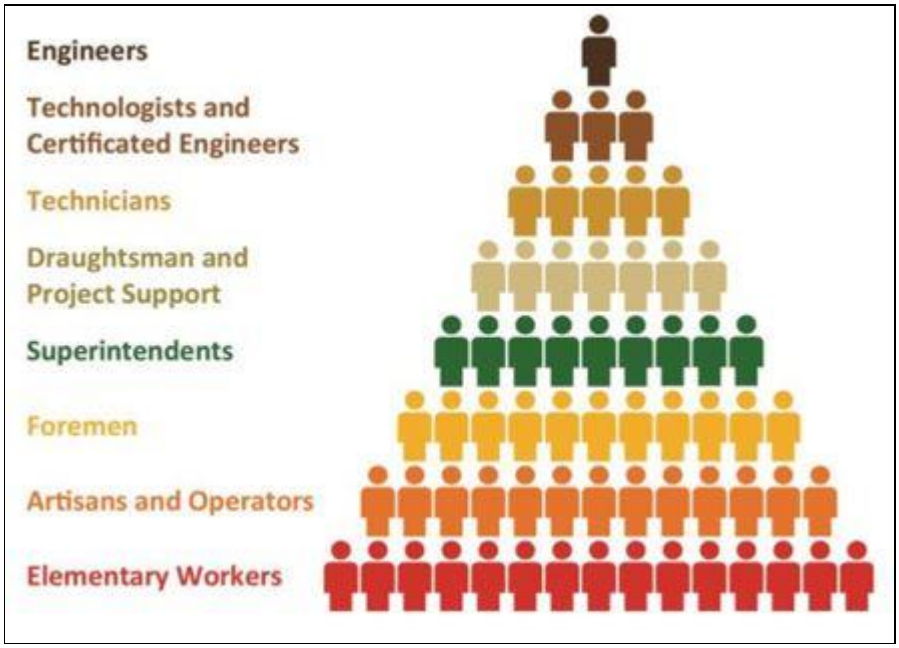

Figure 4.17: Engineering team (Source: Department of Higher Education and Training, 2014:124)

It was also suggested that TUT should be more involved with industry to enhance the awareness of TUT. This is currently addressed in the newly established IndustryGrid division in FEBE. It is believed that the successes of this division will be visible in the learners that are recruited.

4.5.7 Image and reputation

Image was mentioned at the interviews as an important factor when choosing an institution and the respondents explained that image is highly rated at their age. The reputation of the Faculty and of specific departments was referred to. Civil Engineering was identified as, *if you want to study Civil Engineering, you do it at TUT*. The lack of security on the campus was raised, although they were very proud to be associated with TUT's "main campus". The term "main campus" suggests that not all the campuses were on par regarding image and reputation. Most of the respondents confirmed that the marketing material provided by TUTFEBE formed part of their information on possible careers.

The influences that played a role in the career choices of learners were identified. Thematic clusters emerged as stimulation or creation of an awareness or *interest* in engineering, the influences of different people on learners' career choices, relevant exposure to careers in

engineering, the huge impact of Mathematics and Physical Science teachers on learners' career decision making, method of teaching, employability and the image and reputation of an institution.

These themes identified were addressed in the marketing and recruitment model for the TUTFEBE. A plan of action to address each theme was designed and implemented in the model.

CHAPTER 5: FINDINGS AND DISCUSSION

5.1 INTRODUCTION

Chapter 4 addressed the analyses of the data captured and the interpretation and triangulation thereof. The results obtained from data were discussed. With the clarification of the data, themes were clustered. The ethical considerations applied were explained. The marketing and recruitment actions currently being executed at TUTFEBE were considered. The necessary attributes to develop effective technicians and technologists were acknowledged.

In this chapter, the summaries of the findings of the literature review are discussed. The limitations are identified and the conclusions are made. The identified themes are addressed and rated according to highest impact. The attributes required to develop suitable technicians and technologists are acknowledged and integrated into the marketing and recruitment actions identified for the model. The actions that are already being implemented in the current marketing and recruitment model for the TUTFEBE are explored and additional efforts to strengthen them are addressed. Recommendations are made about additional actions that should be integrated to ensure a steady pipeline of learners to become prospective students with the required attributes to be recruited for the TUTFEBE.

The study intended to identify and prioritise the career influences on learners regarding career decisions, create applicable actions and prioritise them in accordance with the available allocated financial and human resources.

5.1.1 Background information: reference to literature

It is evident that engineering faculties need to assume responsibility for the recruitment of their students. The *one size fits all* approach was identified as being the route not to follow. Copying seems to be the main strategy in most institutions regarding marketing and recruitment engagements. At present, learners are consumers and are interested in their return on investment (Maringe, 2006:466) when identifying a career and institution. The fact that marketing is everybody's job (*referring to universities' internal stakeholders*) has been exposed. The literature revealed that the marketing and recruitment actions should focus on the *uniqueness* of a faculty to attract the appropriate learners for that specific faculty. TUTFEBE's healthy engagement and cooperation with industry were seen as its most valuable asset. It is hoped that the recently established IndustryGrid at TUTFEBE, where relationships between the industry and TUT are encouraged, will lead to the creation of a pipe-line of students for TUTFEBE. This is complemented by the *relevant content* presented in syllabi as well as the hands-on experience component of the programmes that give TUTFEBE's

graduates a competitive advantage in industry. Specific programmes were recognised as being the most preferred in the country. Civil Engineering was clearly identified as such a programme in the respondents' replies.

The intention with this study was to identify targeted actions for attracting learners with the required attributes to form a continuous pipeline of prospective students for the TUTFEBE. Therefore, the critical factors or sub-strategies that promoted career choices in engineering were identified. An assessment of what was already been done to motivate learners to excel in Mathematics and Physical Science was done to determine which methods can be implemented in this model. The influences that played a role in the career choices of learners were clustered according to theme. Finally, the relevant social media platforms influencing career decisions were identified and used in the targeted marketing and recruitment model.

5.1.2 Results

Prior studies noted the importance of a university's involvement with and presence at schools to create an awareness of the institution and the courses offered at that particular institution. Career guidance professionals, open days and career exhibitions were identified as very important, especially in circumstances where learners' parents are uninvolved in their academic lives. The provision of opportunities like the current hands-on experiences created outside the traditional engineering courses with the Competition Day, Robotics workshops, and Lego League competitions created an awareness of engineering. These opportunities were acknowledged as being indispensable.

Professional institutional marketing material that complements the marketing and recruitment actions was indicated as having a high priority. Students specified the important role image plays in their world and identified the professional marketing material as one of the components that define the image of an institution and faculty. This marketing material enables learners to share the information with their peers and fellow learners, and this results in the information on the institution and careers reaching a broader audience.

Word of mouth plays an important part in marketing, and therefore the internal stakeholders were informed of the significant role they play to support the marketing and recruitment actions in an institution. Faculty and service departments' staff in the institution was made aware of the influence their professional service delivery had on building and maintaining a positive reputation of the institution.

The content of the syllabi was acknowledged. The content should be relevant to real-world situations to assist learners in realising what engineering entails. The advisory committees in each department consist of a panel of industry partners and academics and advised the

academics on a continuous basis of what should be included in syllabi to keep the content relevant to the real world of work.

Another factor identified to make engineering more attractive as a career choice was the availability of multiple access routes across the sub-frameworks of the Higher Education Qualification Sub Framework (HEQSF). Multiple access routes would, for example, enable learners to access engineering programmes via the recognition of prior learning (RPL), via the Technical Vocational Education and Training (TVET) colleges, and via the schooling system (South Africa, 2013:7).

NATIONAL QUALIFICATIONS FRAMEWORK (NQF)

	Level	Qualification Type		
Higher Education Qualifications Sub-framework (HEQSF)	10	Doctoral degree Doctoral degree (professional)	*	
	9	Master's degree Master's degree (professional)	*	
	8	Bachelor's Honours Degree, Postgraduate Diploma, Bachelor's Degree	Occupational Certificate (Level 8)	Occupational Qualifications Sub-framework (OQSF)
	7	Bachelor's Degree, Advanced Diploma	Occupational Certificate (Level 7)	
	6	Diploma, Advanced Certificate	Occupational Certificate (Level 6)	
	5	Higher Certificate	Occupational Certificate (Level 5)	
General and Further Education and Training Qualifications Sub-framework (GFETQSF)	4	National Certificate	Occupational Certificate (Level 4)	
	3	Intermediate Certificate	Occupational Certificate (Level 3)	
	2	Elementary Certificate	Occupational Certificate (Level 2)	
	1	General Certificate	Occupational Certificate (Level 1)	

Figure 5.1: (National Qualifications Framework (adapted from Government Gazette, Republic of South Africa, 2013)

The community where the learners grew up and specifically the parents of learners were identified as forming part of the broader audience. School principals were recognised as playing an important role because they defined the excellence at their schools. Schools where principals applied the *no tolerance approach* stood out as worthy schools and their learners and staff were disciplined and well informed. Mathematics and Physical Science teachers were identified as the shortest, most influential and cost-effective route to access learners and create the necessary awareness that is lacking.

Access to the Internet was identified as "nice to have", and will undoubtedly become an absolute necessity in future, but at present it cannot be assumed that all learners have access to these tools. Although social media and the Internet cannot be used as the main route of communication, it still needs to remain an integral part of the marketing and recruitment model.

The coordinated actions by government leaders, industry partners and universities to supply the industry with well-equipped graduates to promote national competitiveness were discussed. The IndustryGrid addresses this need and Boys2Men is one example of such a project. Work shadowing has a vital influence on career choice and this was one of the means not exploited to its fullest in the current model, and incorporated in the marketing and recruitment model.

The importance of awareness creation of courses in engineering to reach a larger audience was noted. To reach the majority of learners (TUTFEBE's prospective students), recruitment actions were identified to keep the larger audience informed of the institution and particularly of TUTFEBE's admissions requirements and courses offered.

The results of this study assisted the researcher in designing a high-impact marketing and recruitment model for the TUTFEBE.

5.1.3 Unexpected outcome

A surprising observation was that finances were not indicated as an obstacle for learners when they considered tertiary education in spite of the recent Fees must Fall protests. It seems that learners are well aware of the availability of government bursaries, regardless of the fact that there are insufficient such bursaries. Fifty percent of the respondents indicated the National Student Financial Aid Scheme (NSFAS) as their means of payment for their studies. As suggested by Field (2007:7), the available tuition subsidies contribute to prospective students being more relaxed when they apply for admission to study courses.

The time frame in which learners needed to be made aware of engineering was observed. It was theorised that, should awareness of engineering be created at primary school level, the importance of being successful in the required subjects, Mathematics and Physical Science, would contribute to informed decisions when choosing a career. Learners' perception is currently that *Mathematics is difficult*. This perception should be transformed so that they rather perceive *Mathematics as being different*. It is assumed that by presenting practical activities like competitions, the perception of Mathematics and Physical Science as being difficult might be changed.

The fact that the majority of courses the learners opted for were also presented at other institutions, and learners still preferred TUTFEBE, was unexpected. This suggested that the reputation of the Faculty of Engineering and the Built Environment and specifically certain departments dominated their career choice.

One unanticipated finding was that advertising in newspapers and on radio was not experienced as a valuable source of marketing. Television, the Internet, faculty brochures and career magazines were identified as supportive in gaining career information.

Contrary to expectations it was found that the public at large, including educators and learners, were not clear on the differences of the qualifications conferred by the different tertiary institutions, namely technical vocational education and training (TVET) colleges, universities and UoTs. The lack of understanding about which qualifications give access to which careers, and the various careers available in engineering for *artisans, technicians, technologists and engineers* was emphasised.

5.1.4 Supporting results of previous research

It was observed by Koedinger, (2012:790) that simple ideas and complex thoughtful processes lead to sense making. This includes explanation-based learning and scientific discovery. By participating in technological projects sense-making links the non-verbal with the verbal forms of Mathematical and Scientific concepts. The fact that applied technology makes more sense to learners can be used to the advantage of UoTs, as they are institutions where applied technology is the mode of teaching. This is evident, as 58% of learners preferred UoTs as their tertiary institution of choice.The international phenomenon, a lack of information on what engineering entails, was listed as the main reason for not opting for a career in engineering.
The finding of this study suggests that engineering is still perceived as predominantly male-orientated, seems to be consistent with previous research see Table 4.1. This underlines the importance of the FEMENG chapter established at TUTFEBE and its endeavours to promote engineering among females.

The shortages and quality of Mathematics and Physical Science teachers should be addressed and more should be done to equip learners with the required competencies. In most of the international strategies discussed in Chapter 2, the role of teachers was addressed as one of the main components in higher education institutions' marketing and recruitment actions.

The holistic approach of vocational schools was introduced in the marketing and recruitment model, following the example of the Malaysian model. The first phase focuses on developing learning awareness of learners by addressing the following: the development of self-esteem (to promote self-efficacy), respecting and being grateful to their peers, spiritual learning (which addresses cultural differences like attitudes, and religious and work values), and ultimately developing a clear ambition for the future, to assist them in achieving their expectations, which should ultimately determine their goals. The programme proceeds to introduce learners to

Mathematics and Physical Science, concluding with interesting learning activities to familiarise learners with applied technology.

Successful partnerships were indicated as a large component in an operational marketing and recruitment model. Partnerships with industry, the education sector and teachers were the most important ones. Various partnership programmes are identified in the marketing and recruitment model for TUTFEBE.

5.1.5 Internet-related results of previous research

Although the Internet was identified as one of the most important methods for gaining information, the literature makes it clear that one cannot assume that all learners have access to the necessary resources. In this technological era, social media cannot be ruled out as a means of communication, but it should not be identified as the major communication channel. It does however continue to form an integral part of the marketing and recruitment model.

5.1.6 Explanation of results

Many of the identified actions were already present in the current marketing and recruitment model. Hands-on experience is included in all the programmes, as laboratory work forms an integral part of the syllabus and work-integrated learning (WIL) is the final component of the qualification. The study revealed that some of the current actions should be supported more, for instance, the FEMENG and Robotic clubs, as well as Lego League workshops at schools.

The influence of TUT's internal stakeholders was revealed as being an underutilised marketing tool. To address this challenge various workshops were designed, to be executed by the Staff Development Division.

5.1.7 General suggestions

5.1.7.1 Interest

Krapp and Prenzel (2011:31) describe their theory on interest related to motivations and learning as "interest evolving out of manifold relationships between persons and objects in social and institutional settings". These relationships and persons were explored to develop suitable actions to promote and stimulate an interest in engineering as a career. Singh et al. (2002:324a) explain that learners' aspirations will increase in Mathematics and Physical Science with an earlier awareness creation and interaction with those subjects. Although learners' cognitive abilities, and their social environment - home and matters of family relations - were important predictors of success, attitude (self-concept and self-efficacy), perseverance and academic engagement were identified as salient positive influencing factors.

It is believed that a broader interest in engineering can be created by exploring partnerships in depth. With the recently established IndustryGrid, these partnerships can be expanded and utilised to encourage learners to make TUTFEBE their institution and faculty of choice. At present, this division manages multiple programmes, which should have a positive impact on the suitability of the students it attracts. One of the IndustryGrid's main goals is to create personal relationships with the different industry partners. These relationships will ultimately be advantageous to our current students only, but could be exploited to arrange for possible work shadowing, identified as a powerful tool for career choice, which would create opportunities for learners.

5.1.7.1.1 Identified actions

A cohort of primary schools with whom to form partnerships was selected to start with. The actions in the partnerships were identified as:

- support and cooperation during the science expos at schools;
- mini competition days hosted at these schools; and
- presentation of career days.

5.1.7.2 Influence

Attitudes are formed by social authorities like parents and teachers (Singh et al., 2002:324b). It is theorised if high school learners perform well in Mathematics and Physical Science, their career aspirations towards mathematics, science and engineering disciplines improve. They become outcome-orientated, which determines their goals and motivates them to work harder in these subjects to achieve the desired results. It is expected that, if Mathematics and Physical Science teachers are empowered, their positive influence will strengthen and motivate learners to pursue these subjects.

Singh et al. (2002:330) acknowledge the importance of information about the possible career opportunities in engineering at an opportune time in a learner's academic cycle as a contributing factor for learners to choose engineering as their career.

5.1.7.2.1 Identified actions

- Selected schools were targeted, where teachers were empowered with knowledge and skills in the enabling subjects. They were also trained to optimally utilise their well-equipped laboratories successfully to benefit learners' academic advancement. During these workshops information on the courses and the careers in engineering available to learners was disseminated.

- Principals and relevant teachers at schools were invited to attend presentations at TUTFEBE to introduce them to TUT, FEBE and the programmes offered. The applications of the qualifications conferred were clearly communicated.

5.1.7.3 Exposure

Co-curricular activities enhance the relevance and understanding of engineering in everyday life (Singh et al., 2002:330). Vogelsang and Astin (2000:25) confirmed the benefits of service experience to the academic content when they researched the influences of course-based service learning, experiential learning, work-integrated learning, generic community service and voluntary service. They determined that course-based service was more fruitful than generic community service. Such activities were integrated into the marketing and recruitment model by presenting competitions in the different engineering programmes, and engaging in community projects with the Robotics courses and Lego League competitions. Additional opportunities were created to enhance the exposure of engineering in communities.

5.1.7.3.3 Identified actions

- Information about the engineering profession was disseminated by empowering current students with a professional presentation and marketing material to do presentations and prepare them to present at their schools and religious societies in their communities. The students were perceived as role models, they practised their softs skills, and awareness was created of the TUTFEBE and its programmes. Students were also encouraged to act as tutors at their schools wherever possible.
- Thanks to these interactions, parents became aware of what engineering is all about and of the importance of their support to motivate children to determine a specific outcome for their careers and identify the goals to achieve this.
- First Lego League, Cyber JunkYard and PheuDrive challenges have already been presented in the Faculty, which gave students the hands-on experience referred to.

5.1.7.4 Employability

The method of teaching was identified as another influential factor by the respondents when they chose their institution. In the qualitative study the interviewees revealed that they understood that studying at UoTs gave them a better employability status. In research done at the University of Luton, Fallows and Steven (2000:75) confirmed that to have knowledge of an academic subject only is no longer sufficient in today's challenging economic situation. The skills needed to increase employability prospects are information retrieval and handling, communication and presentation skills, planning and problem-solving skills and social development and interaction (Fallows & Steven, 2000:75). Finch et al. (2013:684) agree that

these are the skills that strengthen students' employability. Undergraduates who experience real- world challenges and applications enhance their employability opportunities (Finch et al., 2013:685).

5.1.7.4.4 Identified actions

- At the TUTFEBE, students participate in hands-on projects, for example, building a solar car or a Baja car. The experience they gain by participating in the races is real- world experience. They have to manage the challenges that arise while they participate, and apply problem-solving skills on the spot. It is believed that this experience and newly acquired skills prepare them for the real world of work. At present an in-service training module forms part of the syllabus. It is also referred to as work-integrated learning (WIL) or experiential learning.
- Vocational schools for learners were integrated into the marketing and recruitment model. Soft skills were incorporated into these programmes, which ensured a holistic preparation and assisted learners to make informed decisions. The abilities learners need to increase their employability are captured in modules offered at these vocational schools. It is theorised that learners will experience Mathematics as different; challenging but not difficult, once they participate in hands-on experiments.

5.1.7.5 Image and reputation

Reputation is a social construct that is defined as the generalised level of esteem for an organisation held by a stakeholder (Finch, et al., (2013:685). One of the categories identified in this research is programme-level reputation. Civil Engineering was indicated as such a factor when respondents identified that they were influenced to study at TUTFEBE by word of mouth when civil engineering was their identified career choice. Despite the student unrest experienced at TUT and the public perception that TUT is a hostile environment, learners still chose TUTFEBE as their preferred institution and faculty.

5.1.7.5.1 Identified actions

- The following stakeholders were informed of their important role in marketing TUTFEBE: Current staff and students at the FEBE, as well as staff of the Call Centre, Student Development and Support, Recruitment, Student and Information Services, all of whom work with the prospective and current students. This was done by presenting custom-made workshops to the different target groups.
- The physical appearance of the environment where students study was carefully inspected. Where possible, affordable adjustments were made to improve the appearance of the students' learning environments. Administrators in the different

departments were identified and requested to take responsibility for the appearance of administrative departments and manage their display boards in a professional manner.

5.1.7.6 Additional actions – social media technology

- A study done by Davis et al. (2012:11) on the influence of social media in higher education clearly revealed the importance of social media technology interventions to promote marketing. The FEBE website is currently administered by a dedicated administrator. Facebook, Twitter and You Tube are the active channels utilised at present. It is suggested that the status quo be maintained. A database of learners who participated in career exhibitions and in various events on campus and showed an interest in engineering is regularly updated. These prospective students are invited to *like* our Facebook page, to form relationships and encourage them to study at TUTFEBE.

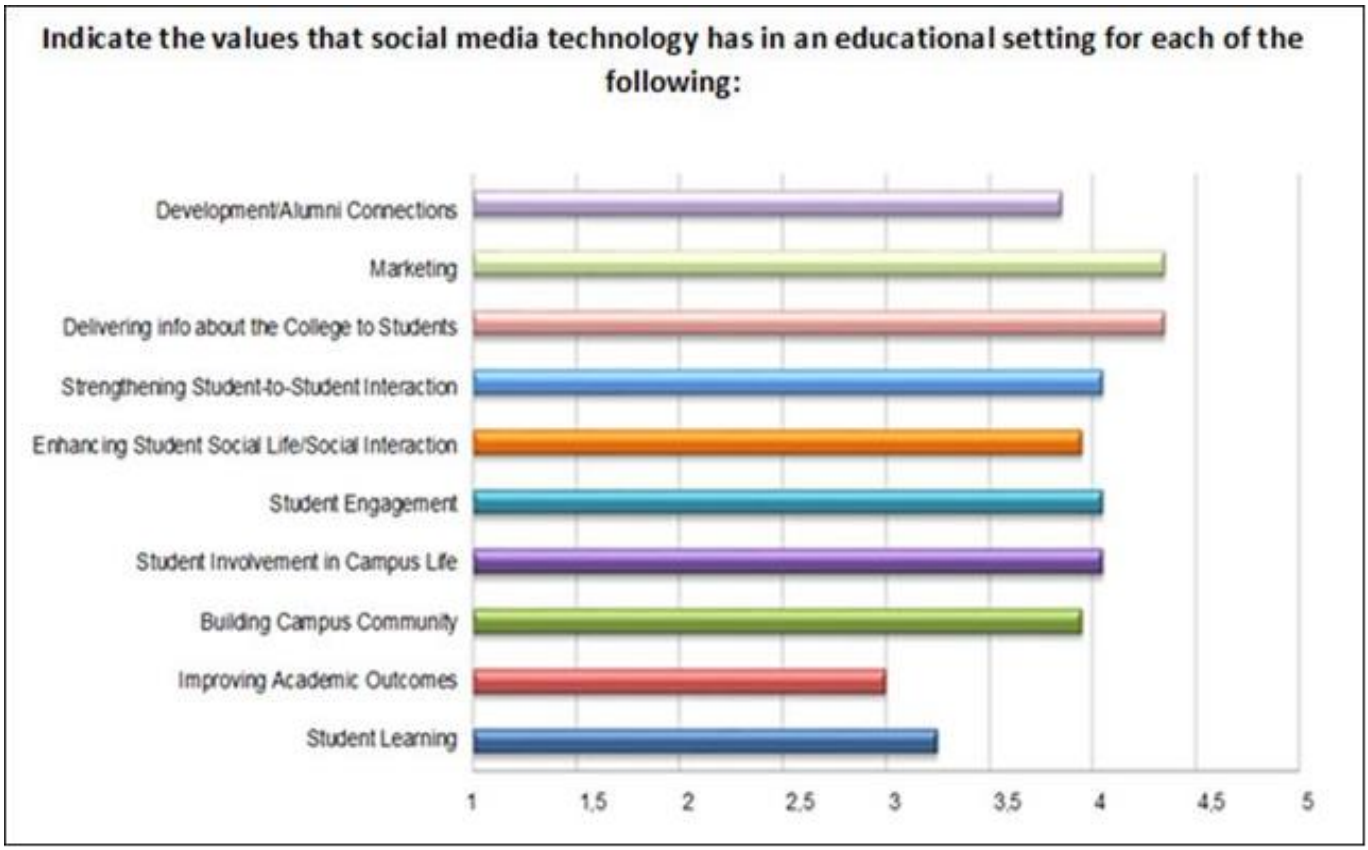

Figure 5.2: Community college leaders' perception of the value of social media to the college and its mission (adopted from Davis et. el 2012:11)

5.2 SUMMARY

It was found that the “one size fits all” approach was not the route to follow. It became clear that the TUTFEBE needs to take responsibility for promoting its own programmes and creating a pipeline of prospective students. The fact that marketing is the responsibility of all internal stakeholders of TUT was brought to light by the statistics obtained in this research, as was the fact that much more can be done with internal marketing to familiarise the internal stakeholders with FEBE. FEBE’s unique aspects were identified and marketing and recruitment actions that would promote those aspects optimally were implemented in the marketing and recruitment model for the FEBE. Unexpected outcomes and contradicting and supporting results were identified. Specific actions were proposed according to the themes identified in the findings.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The previous chapter summarised the findings of the literature review. The primary factors influencing the career choices of current students were clustered according to themes. These themes assisted in the identification of marketing and recruitment actions for the TUTFEBE. The themes also assisted in creating actions for motivating learners to perform well in the enabling subjects they need, namely Mathematics and Physical Science, should they decide to follow a career in engineering. The statistics revealed the impact of social media on career choices, and identified the preferred social media platforms. The attributes required to develop suitable technicians and technologists were recognised and directed the actions to incorporate in the marketing and recruitment model. The current successful marketing and recruitment activities for the TUTFEBE were mentioned and additional efforts to strengthen these were identified.

Recommendations were made on how to ensure a steady pipeline of learners to become prospective students with the required attributes for the TUTFEBE to recruit from.

6.2 OVERVIEW OF THE RESEARCH

6.2.1 Overview of introductory chapter

Learner recruitment was identified as a critical component of a university's business. In South Africa, the government embarked on a drive to educate the youth in Mathematics and Physical Science to increase the number of learners that can pursue engineering as a career to support the country's infrastructure development and economic growth. Universities were cautioned that, should they not meet their enrolment and throughput targets, it might impede on their funding formula (section (1.1). With national and international institutions competing for an applicant pool that was declining due to the current problems experienced in the education system, learner recruitment became a critical discipline.

As such, an effective and targeted approach was essential in order to ensure that enrolment targets were met and that TUT continues to address national skills, competency and capacity needs.

This study produced a marketing and recruitment model for the TUTFEBE that focused on evidence-based actions to stimulate greater numbers of learners to study Mathematics and

Physical Science at school level, and to encourage them to become engineering graduates hopefully at TUTFEBE.

6.2.2 Overview of literature review

This chapter determined what had already been done in the area of recruiting learners with the required aptitude to follow careers in engineering by investigating engineering education, factors influencing learners' decisions, and worldwide strategies on how to recruit learners for engineering. The researcher determined how learners made their career choices, as well as the influences that played a role in those choices. Influences such as technology awareness, language proficiency, and teachers' role, the impact of the learning environment, the learner's self-efficacy, and finances were discussed. The similarities and differences experienced worldwide in the challenge of the declining numbers in engineering were deliberated.

It was determined that the multifaceted approach was the most appropriate route to follow. The influence of social media marketing was unpacked. The inter-relatedness of partnerships to support the success of recruiting learners with the necessary aptitude for engineering was acknowledged.

The theoretical framework that supported this study was reviewed and used to conceptualise the problem of how to recruit suitable learners for engineering at TUTFEBE as a social phenomenon .Interventions on how to develop an interest in engineering were recognised. The importance of exposure to career information and the tools learners accessed and used were addressed.

6.2.3 Overview of the research approach

The research objective was to determine which marketing and recruitment actions could be executed in an evidence-based marketing and recruitment model for the TUTFEBE, and thereby stimulate an increase in the number of pipeline learners to become prospective engineering students for TUTFEBE.

The case study design was applied to this study. The multi-method approach was followed. Two sets of data, quantitative and qualitative, were captured and triangulated to investigate the research questions. The research questions were: Which strategies were most effective in motivating learners and prospective students to excel in Mathematics and Physical Science; which primary factors influenced the career choices of current students in engineering; and which social marketing platforms had the most influence on the career choices of prospective engineering students at TUTFEBE. By answering these questions, recommendations for a

general framework to guide the marketing and recruitment actions for learners to study engineering were identified.

6.2.4 Overview of the data analysis and interpretations

The analyses of the data captured and the interpretation and triangulation thereof were debated. The ethical considerations, informed consent, anonymity and confidentiality were considered. The results of the investigation to determine which influencing factors played a role in learners' career decisions led to clustered themes. These identified themes were unpacked. The themes identified were the stimulation or creation of an awareness or interest in engineering, the influences of different people on learners' career choices, relevant exposure to careers in engineering, the important impact of Mathematics and Physical Science teachers on learners' career decision making, the method of teaching, employability, and the image and reputation of an institution.

6.2.5 Overview of the findings and discussions

The study intended to identify and prioritise the influences on learners regarding career decisions, to create applicable actions, and to prioritise those actions according to the available allocated financial and human resources.

A graph portraying the recently approved National Qualifications Framework (Figure 5.1) to which tertiary institutions need to adapt was shown. Unexpected outcomes were addressed. Both contradicting and supporting facts in previous research were clarified. The explanations of results, followed by proposed actions for addressing them, were summarised. It was determined which actions were already active in the current marketing and recruitment model for the TUTFEBE. Those actions were explored, and additional efforts to strengthen them were addressed.

6.3 RESEARCH QUESTIONS REVISITED

6.3.1 Research question 1

What are the critical components or sub-strategies of an ideal marketing and recruitment model for the FEBE in promoting choices for engineering as an educational and career field?

6.3.1.1 Identified unique aspects

To break away from copying seems to be the main strategy. The unique aspects of the FEBE were identified as the hands-on projects, the Solar Car Challenge, the Baja Bug races and the Robotics and Lego competitions. Unique programmes in the Faculty were identified as Architecture, Mechatronics and 3D Design (Industrial Design), and Polymer Technology. Civil

Engineering stood out in the statistics as the preferred department to qualify for a career in engineering.

6.3.1.2 Decision-making period

To create an awareness of careers in engineering, the identified marketing and recruitment actions should be implemented at an early stage in the learner's academic life. The earlier learners are exposed to engineering in a playful, hands-on manner, the better the chances are that an interest in engineering might be created. An added advantage of those projects would be that they relate to real-world problems. Should the learner decide on a career in the engineering field, outcomes should be identified that would determine their goals, namely to perform well in the enabling subjects, Mathematics and Physical Science, to give them access to academic programmes in engineering.

6.3.1.3 Different messages for different audiences

The targeted audiences were identified as:

- **Career guidance councillors**: Specific actions were implemented to inform councillors of the TUTFEBE programmes and of the admission requirements. The careers available to students who qualify at a UoT were explained.
- **Industry**: The recently established IndustryGrid has started collaborating with the industry by presenting regular workshops for current students. This division creates interaction with local industry and international partners, also introducing these two audiences to one another. To add to this, more targeted messages were created to interact with Advisory Committee members. One such action is to ensure that each member receives updated information on the TUTFEBE. *The Faculty in Perspective*, an annual publication, is another method. This publication summarises Faculty events and contains detailed information on research done by Faculty members.
- **Internal stakeholders**: This audience was identified in statistics as an underutilised area in terms of its influence on career choices of learners. The TUT divisions that interact directly with prospective learners were identified as the Call Centre, Recruitment and Information. Regular presentations to these staff members were scheduled in the marketing and recruitment model. Faculty staff was identified as another internal stakeholder, and an annual workshop to keep them on par with what is happening in the Faculty was scheduled in the model.
- **Mathematics and Physical Science teachers**: To start with, the footprint schools were identified and various interactions were scheduled to empower their staff with information on the programmes offered at FEBE. This included inviting the relevant teachers (Mathematics, Physical Science and Life Orientation) as well as the principals to campus

and introducing them to the Faculty. Depending on financial resources, workshops for Mathematics and Physical Science teachers was another interaction that could be implemented in the model. Additional interactions at schools were implemented, like offering career days at these schools, presenting mini competition days, and acting as adjudicators at their science expos.

- **Parents**: To gain access to parents, their communities have to be targeted.
- **Prospective students**: Open Days, Competition Days, Robotics workshops, and Lego League workshops were some of the actions identified for execution. Campus visits were advised for targeted students who performed well in Mathematics and Physical Science.

6.3.2 Research question 2

What actions were/are the most effective in motivating learners to excel in Mathematics and Physical Science?

- Support and cooperation during the science expos at schools. Faculty staff can assist at schools' science expos on multiple levels. Staff can assess the projects. With these interactions, links may be formed with the staff at the Faculty and the learners, their parents and teachers.
- Presentation of mini competition days at schools. By presenting competition days at schools and relating the competitions to relevant syllabi information, learners will take note of the relevance of information in the syllabi.
- Open days at the University are one of the main attractions for informing learners on possible careers in engineering. Current students interact with prospective students by exhibiting their projects.
- Campus visits for schools were identified as a valuable action. Learners experience the campus and visit the laboratories where practical experiments and exhibitions are shared.
- Career shadowing is an additional action identified to complement the marketing and recruitment model. With the industry links developed at IndustryGrid, arrangements to host learners in workplaces can be arranged.
- Formal presentations on the different careers offered at the Faculty can be held at parents' evenings and career evenings.
- Vocational schools will be targeted. This action will be executed with identified learners.

6.3.3 Research question 3

What were some of the primary influencing factors on the career choices of current students in engineering?

- The primary factor that influenced learners' career choices was determined as being an interest in the field of engineering. Knight and Cunningham, (2004) support this argument

when they claimed that many students do not consider engineering as a career because they do not have a clear understanding of this field. Therefore it is theorised that more should be done to create an awareness of engineering and motivate interest in the engineering fields.

- The impact of the influences of different people on learners' career choices was another primary factor. The influences of the different people were unpacked.
- The influence of exposure to possible careers in engineering was determined. When learners understand the implications and applications of a specific engineering field it is easier for them to make choices.
- The quality of the teaching methods of Mathematics and Physical Science teachers played a major role in career choices. This study revealed the positive outcome of learners' perceptions of careers in engineering if they were tutored by positive competent teachers.
- The practical, focused, hands-on method of teaching at a UoT was acknowledged as an influence on learners' career choices.
- Employment was considered as being more readily available when students qualified at a UoT.
- Last but not least, the image and reputation of an institution played an important role in students' career choices.

6.3.4 Research question 4

Are social marketing platforms appropriate resources to utilise?

The implementation of a social media strategy in the marketing and recruitment plan was identified as a definite, but not as an exclusive recruitment tool.

6.4 RESEARCH CONTRIBUTION

6.4.1 Theoretical contribution

The SCCT framework adapted from Brown and Lent was adopted as a suitable theoretical framework for conducting this study. The SCCT framework assisted in the explanation of the factors that influenced career choice behaviour and how relevant the subjects' environments were in their career choices.

Self-efficacy and outcome expectations that lead to the identification of goals to achieve the desired outcome were the theoretical elements revealed. The interactions between the individual factors such as gender and race with the contextual factors like social-economic status and educational system were clear.

6.4.2 Methodological contribution

This multilevel design explained the benefits of the use of both qualitative and quantitative methods. By cross referencing this data the results were verified.

The qualitative approach was used as the first source of evidence for assessing students. The collection of the data was done in a structured quantifiable manner by using a designed questionnaire which the students completed using SurveyMonkey.

This was followed by focus group interviews conducted as the second source of data collection, to complement the quantitative findings.

During the interviews, the smaller sample of focus group students shared their views on their experiences of influences on their career decision-making in preparation of their engineering studies. The intimacy between the role players (interviewer and interviewee) assisted with the interpretations. In the integration of quantitative and qualitative data thematic clusters were identified. The interaction with subjects assisted positively with understanding human behaviour and the interpretation of their opinions (Savenye & Robinson, 2004:1047).

6.4.3 Practical contribution

This study's practical contribution was mainly that it determined which marketing and recruitment actions for the recruitment of engineering students for the Faculty were currently on target. The statistics revealed which current actions were underutilised and could be applied more to target a wider audience. The additional actions identified by the factors influencing learners' career choices were implemented.

6.4.4 Assessing the contribution

6.4.4.1 Noting implications

An underutilised niche area was identified in the statistics when the underutilisation of the internal stakeholders at TUT was revealed. TUT staff in general, FEBE members and parents at TUT were insignificant in influencing learners' choice of career and institution. There might be various reasons why internal stakeholders did not assist in spreading a positive word and creating a significant influence in learners' career choices. The academic and administrative staff members of FEBE should be empowered with knowledge about the Faculty and the institution at large. Specific efforts to engage faculty members in marketing and recruitment efforts were identified. Due to their heavy workloads, most of the faculty members focused on their academic or administrative responsibilities only. Actions were designed to promote FEBE to the internal stakeholders and to make them proud of their workplace and the institution they represent.

6.4.4.2 Implementation of additional actions

Specific actions were created to promote TUTFEBE as learners' preferred engineering faculty, by encouraging internal stakeholders to be proud of their work environment. Meet and greet events were initiated for staff to engage with one another.

An additional important action was to assist the FEMENG chapter at TUT with the promotion of females in engineering (section 2.8.1). The presence of females in engineering was evident in the Sasol Solar Car Challenge when four of the team members were female engineering students.

6.4.4.3 Methods of implementation

An event was hosted at each department and the staff at the support divisions were invited to attend these events. This updated the support staff on what the departments offered. The departments used this opportunity to introduce visiting members (faculty members as well as support staff members) to their laboratories, to tell their success stories, and to inform the attendees of the courses they presented.

6.4.4.4 Advantages of these additional actions

Through these regular events, staff members were able to reconnect and engage with one another. Faculty staff members took note of what was happening in other departments and support divisions' staff members were kept informed of what the different programmes at the various departments offered. This created a broader awareness and supported relationship building between departments and divisions. Good relationships are imperative for the provision of quality service, which assists in the creation of a positive image of the institution. If staff members have confidence in their faculty and institution it leads to positive word-of-mouth marketing for the faculty and ultimately for the university.

6.4.4.5 Who, where and when

The departments were scheduled to host a visit each semester to introduce their environments. The arrangements of these events were managed by the faculty marketer in consultation with the relevant head of department and the administrator of that specific department, to ensure that the departmental administrators' workloads did not become too heavy.

6.5 LIMITATIONS AND FURTHER RESEARCH

This study focused on a specific faculty at a specific university of technology and the results can therefore not be generalised. This research might however be used as a pilot study related to methods of recruiting engineering students for universities of technology. More research on the variables that play a role in motivating and creating interest in engineering could assist in recruitment and marketing efforts. Research on the type of physical activities that could be exploited to create a stronger awareness of engineering could be beneficial. Research on how to motivate current staff and students to take responsibility for and be proud of their institution, department and programme to assist in promoting a professional image of engineering in the public could also benefit marketing interactions.

6.6 SUMMARY

Although many of the current marketing and recruitment actions were on par with the rest of the world, it became clear in this study that some of the actions could be enhanced. The limited influence of projects referred to as TUTFEBE's unique projects (Robotics, Lego leagues, Solar and Baja Bug races) on learner's career choices showed that more should be done to introduce those activities to a wider audience. When the influences that played a role in learners' career choices were identified, alternative activities were included in the marketing and recruitment model for the TUTFEBE. The influences were clustered and ranked according to importance. The results of this study were scrutinised in a workshop attended by all the role-players in the recruitment and marketing of the FEBE. The activities were ranked according to priority, and linked to the available human and financial resources. It was accepted that marketing is the job of everybody in the faculty, and the different support divisions were educated on their valuable contributions and encouraged to participate in TUT's marketing and recruitment actions.

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APPENDICES

APPENDIX A: QUESTIONNAIRE

Factors influencing career choice of learners in engineering: A case of a selected University of Technology in South Africa.

The Faculty of Engineering and the Built Environment would like to conduct a study in how first-year students make study choices. Your individual responses to the questionnaire will remain confidential, and reports derived from questionnaires will not identify you personally. Please complete the shaded areas by making an X or fill in your answer.

BIOGRAPHICAL INFORMATION

1. *Programme/course enrolled for:* _____

2. *Age:*

17-20	1
21-23	2
24 & older	3

3. *Gender:*

Male	1
Female	2

4. *Year Matriculated:*

2009	1
2010	2
2011	3
2012	4
Prior 2009	5

5. *Home Town/City:* _____

Urban Township	1
Urban Suburb	2
Rural	3

6. *Province:*

Gauteng	1
North West	2
Mpumalanga	3
Northern Cape	4
Western Cape	5
Eastern Cape	6
Free State	7
KwaZulu Natal	8
Limpopo	9
International	10
If International please specify	

7. *School matriculated:* _____

8. *What is your mother tongue?*

Afrikaans	1
English	2
IsiNdebele	3
IsiXhosa	4
IsiZulu	5
Northern Sotho	6
Sesotho	7
Setswana	8
SiSwati	9
Tshivenda	10
Xitsonga	11
If other please specify	

9. *Identify who your guardian/s are.*

Mother	1
Father	2
Both	3
Sibling (brother or sister)	4
If other please specify	

10. What is the total monthly income of your guardian/s that supports you? Indicate by selecting the appropriate block.

Income bracket	
0 – R3 000	1
R3 000 – R6 000	2
R6 000 – R9 000	3
R9 000 – R12 000	4
R12 000 – R15 000	5
R15 000 – R18 000	6
R18 000 – R21 000	7
R21 000 – R24 000	8
R24 000 – R27 000	9
R30 000 and higher	10
Do not know	11

11. What is the highest qualification of your male guardian?

Education of male guardian	
Primary school or less	1
Secondary school	2
Matric completed	3
Non-degree certificate	4
National Diploma	5
Degree	6
Post graduate qualification	7
I don't know	8

12. What is the highest qualification of your female guardian?

Education of female guardian	
Primary school or less	1
Secondary school	2
Matric completed	3
Non-degree certificate	4
National Diploma	5
Degree	6
Post graduate qualification	7
I don't know	8

13. What is your male guardian's employment status?

Employment status of your male guardian	
Part-time employed	1
Full-time employed	2
Unemployed	3
I don't know	5

14. What is your female guardian employment status?

Employment status of your female guardian	
Part-time employed	1
Full-time employed	2
Unemployed	3
I don't know	5

STUDY DECISIONS

15. Which method of payment are you using for paying your studies?

Method of Payment	
Guardian is paying for my studies	1
Bursary	2
Study loans with banks	3
Study loan/bursary from NSFAS	4
Study loan from Eduloan	5
Pay my own studies	6
If other please specify	

16. When did you definitely decide that you wanted to study engineering?

Before Grade 10	1
After Grade 10	2

17. Is this engineering course you selected also presented at another university or college?

Yes	1
No	2
Unsure	3

18. Which other institutions did you consider for your engineering studies?

19. *Was the engineering course you selected, your first choice course?*

Yes	1
No	2

20. *If your answer is <u>no</u> why were you <u>not</u> accepted for your first choice of study?*

21. *If your answer in Question 20 was <u>no</u>, what was your 1st choice course?*

22. *If your answer in Question 20 was <u>yes</u>, what was your 2nd choice course?*

23. *In exploring your engineering course, which of the following tools did you use? You should mark everyone that you used.*

Possible Tools	Yes
1. Career guides	
2. Career magazines	
3. Library	
4. School science expo's	
5. Career shows/exhibitions	
6. TUT Website	
7. TUT pamphlets/brochures	
8. TUT Open Day	
9. Faculty Competition Day	
10. Robotics competitions	
11. Sasol Techno X career exhibition	
12. Lego League competitions	
13. Facebook	

Possible Tools	Yes
14. Twitter	
15. Advertisements on busses	
16. Newspapers	
17. Sport events	
18. Television	
19. Internet information	
20. Campus visits	
21. Radio	
22. Faculty Facebook page	
23. YouTube	
24. Mobi Sites	
25. Blogs	
26. Mix-it	
27. What'sApp	
28. Faculty involvement in any form	
29. If 28 is yes, please explain	

24. *Indicate how important the following individuals and experiences were in <u>your decision to study</u> your chosen engineering course by selecting one option for every one of the following people. Select one of the four options (1-4).*

People	Not at all important	Somewhat important	Very important	No exposure
1. Professional career advisor or guidance teacher	1	2	3	4
2. Other teacher(s)	1	2	3	4
3. Parent(s)	1	2	3	4
4. Another relative or friend	1	2	3	4
5. Someone working in the engineering profession	1	2	3	4
6. Work experience with someone in your chosen course	1	2	3	4
7. TUT recruitment advisor	1	2	3	4
8. Other specify	1	2	3	4
9. If other specify the person				

INSTITUTION CHOICE

25. When did you definitely decide that you wanted to study engineering at TUT?

Before grade 10	*1*
After grade 10	*2*

26. How important were the following people's advice in choosing TUT as the particular university? Select one of the four options for all the people.

People	Not at all important	Somewhat important	Very Important	No exposure
1. Parents	1	2	3	4
2. Course graduates	1	2	3	4
3. Current or old TUT student	1	2	3	4
4. Somebody already working in your engineering choice	1	2	3	4
5. Career or guidance counsellor	1	2	3	4
6. Parent working at TUT	1	2	3	4
7. Family member working at TUT	1	2	3	4

27. Prior to studying at TUT did you ever see or hear the TUT name or logo in/on:

Factor	Yes	No
1. Buses	1	2
2. Newspapers	1	2
3. At sport events	1	2
4. Magazines	1	2
5. Television	1	2
6. Career magazines	1	2
7. Career guidance books	1	2
8. Online (internet)	1	2

9. At school	1	2
10. Radio	1	2

28. *On which social media platforms do you spend the most time? Indicate the three platforms and rank it, with 1 being the most important, 2 second most important and 3 least important.*

	1
	2
	3

29. *Which social media recruitment effort would you have preferred if it had been available?*

Factor	Yes	No
1. Faculty Facebook page	1	2
2. Twitter	1	2
3. You Tube	1	2
4. Mobi-Site	1	2
5. Blogs	1	2
6. Mix-It	1	2
7. LinkedIn	1	2
8. What'sApp	1	2

30. *How important were the following factors in your <u>choice of TUT as university</u> and the department? Select one of the four options at every factor.*

Factor	Not at all important	Somewhat Important	Very Important	Did not know about it
1. Research reputation of university or department	1	2	3	4
2. General reputation of department	1	2	3	4
3. Teaching methods of department	1	2	3	4
4. Geographic location of campus	1	2	3	4
5. Financial considerations/cost of attending	1	2	3	4
6. Amount of financial support offerred	1	2	3	4
7. Ability of department to place students in particular courses	1	2	3	4
8. Sports facilities	1	2	3	4
9. Residences & accommodation	1	2	3	4
10. Faculty involvement	1	2	3	4
If yes, please explain				
11. Other please specify				

31. *For each of the following persons, please rate the helpfulness of the advice and support given regarding the TUT application. Select one of the four options at every person.*

People	Received *no* help	Received *limited* help	Received a *lot* of help	Did not know about it
1. Recruitment officer	1	2	3	4
2. Faculty member (Marketer or Public Relations Officer)	1	2	3	4
3. Person working in the engineering field	1	2	3	4
4. Family member	1	2	3	4
5. Another student at TUT	1	2	3	4
6. Alumni (old student)	1	2	3	4
7. Career/guidance counsellor	1	2	3	4
8. TUT course brochure	1	2	3	4
9. TUT Helpdesk	1	2	3	4
10. TUT Call Centre	1	2	3	4
11. Parent working at TUT	1	2	3	4

GUIDANCE EXPERIENCE

32. *Did your mathematics teacher inspire you to pursue a course in engineering?*

Yes	1
No	2

33. *If yes, please explain how your mathematics teacher inspired you.*

_____

34. If no please explain what alternative support in mathematics you used to pursue this career field.

_____

35. Was your mathematics teacher, according to your opinion, qualified to teach mathematics?

Yes	1
No	2

36. If no, explain how it influenced your choice in engineering?

_____

37. Did your physical science teacher inspire you to pursue a course in engineering?

Yes	1
No	2

38. If yes please explain how your physical science teacher inspired you.

_____

39. If no, explain what alternative support in physical science you used to pursue this career field?

_____

40. *Was your physical science teacher, according to your opinion, qualified to teach physical science?*

Yes	1
No	2

41. *If no, explain how it influenced your choice in engineering?*

_____

42. Were you advised by your school/teacher to change from mathematics to mathematics literacy?

Yes	1
No	2

43. If yes, how did you managed to do Mathematics?

_____

_____

_____

44. In one to two sentences, how did you decide on the particular engineering course you have enrolled for?

_____

_____

_____

45. What do you suggest should be done to create an interest/love for mathematics and physical sciences at school level?

_____

_____

_____

This questionnaire will be followed up with a random sample of focus group interviews (still to be identified) of the respondents in the following semester.

Thank you for completing the Questionnaire and helping us make better decisions on how to recruit engineering students and build an awareness of engineering. If you have any questions regarding this questionnaire or the use of the results, please contact:

Zelda Janse van Rensburg
Faculty Marketer
Faculty of Engineering and the Built Environment
Tel: (012) 382 5250
JanseVanRensburgZ@tut.ac.za

APPENDIX B: INFORMED CONSENT FORM FOR QUESTIONNAIRES

PROJECT OF THE FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

Primary investigator: Ms Z Janse van Rensburg (Faculty of Engineering and the Built Environment)

Dear Research participant,

You are invited to complete a survey questionnaire which forms part of a project in the Faculty of Engineering and the Built Environment.

Research is being conducted to determine how your choice of study was done. With this knowledge we will be able to design a recruitment model for the Faculty, targeting the right students using the correct methods. I am going to investigate the influence of social media marketing to the conventional ways of recruitment, like career exhibitions, competition days, open days etc.

If you decide to take part in the project, you will be required to complete the paper-based questionnaire once off. You will be asked to respond to questions regarding how your decision to study engineering, was made. It should not take more than 30 minutes to complete.

You should be a registered student in the Faculty to be eligible to complete this questionnaire.

Completion of the questionnaire involve no foreseeable emotional discomfort or inconvenience to you or your family.

The results of the questionnaire will have no direct personal benefit to you, but you will make a contribution towards a better understanding of how prospective students make career choices and how they can be informed through our recruitment efforts.

Your participation in this study is entirely voluntary and anonymous.

All the data that you provide in the questionnaire will be handled confidentially. This means that access to your data will be strictly limited to the researcher and research team. Also, your questionnaire responses and personal information will be kept and stored in a confidential format that will only be accessible to the researcher. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. The results of this study might be published in a scientific journal and/or presented at scientific meetings, but again without

revealing the identity of any research participant. The original questionnaires will be stored in a safe place for three years, after which they will be destroyed.

The Faculty Research and Innovation Committee and the HEDS-Research Ethics Committee of the Tshwane University of Technology have approved the project plan and verified the ethical considerations for this project. The ethics clearance number is Ref: 2012_3JvRensburg.

The primary investigator, Zelda Janse van Rensburg, can be contacted during office hours at Tel (012) 382-5250. Should you have any questions regarding the ethical aspects of the project, you can contact the Chairperson of the HEDS-Research Ethics Committee (Dr E van Heerden @ 012-382-5073) or the Executive Dean of the Faculty (Prof B van Wyk @ 012-383-5328).

Your participation in the project will be greatly appreciated.

I hereby agree to participate in this research project.

…… …… ……

Name in printed letters Signature Date

APPENDIX C: INTERVIEW SCHEDULE

Introduction to explain the proceedings of the interviews

This is a follow-up on the questionnaires you completed, to understand which recruitment efforts worked best in attracting you, our current students, and which influences played a role in your career choices.

Kindly sign the consent form. Should you not want to participate or at all feel uneasy, you are most welcome to withdraw.

The interview session is being taped to ensure a fuller record of the interviews.

You are kindly requested to respect your fellow student's viewpoints and the confidentiality of this session.

There are no right or wrong answers. I would like to hear your stories. Sewell, 2001:1 defines qualitative interviews as "attempts to understand the world from the participant's point of view, to unfold the meaning of people's experiences (and) to uncover their lived world prior to scientific explanations" (De Vos et al., 2010:287).

Please speak up when you talk, to ensure a clear recording on the tape recorder. If you have any additional questions and comments, go right ahead at any time.

Furthermore, a post-interview worksheet will be furnished to you to make final comments and to mention aspects you might not have wanted to mention in front of other participants. This worksheet may serve as a way to verify the data as it was intended by the participants (Seymour, 2004).

To ensure confidentiality and anonymity, your identities are protected by taking the following measures:

- the data will be kept safe and
- field notes and transcripts will not contain any names.

Your names will not be revealed and this recording stays confidential.

A. Bibliographical questions

Purpose: To put participants at ease and it is non-threatening questions. These questions should identify the social status and the environment the respondents are from which will play a vital role in the design of the recruitment model.

Question 1
Which province are you from?

Question 2
Which home town are you from?

Question 3
At which school did you matriculate?

B. Study Decisions

Purpose: To determine which factors influenced our current students, in their study choices.

Question 4
Some people say scientist get all the credit for scientific advances, architects get all the credit for buildings and projects, but engineers get the blame when disaster happens. Do you agree that this is the case? Why, why not? (The purpose of this question is to start the conversation).

Question 5
At what stage in your life did you decide to study engineering?

Question 6
Why did you choose to study engineering?

Question 7
What influence did a teacher of perhaps a project have in your career choice?

Question 8

Who of the following people had an influence in your decision and describe in which way: a teacher, parent, guidance counsellor, recruitment officer, family or friend?

Question 9

Why did you choose this specific person?

Question 10

In your opinion, explain the traits and characteristics of an engineer?

Question 11

Why did you choose your specific course?

Question 12

What is a good example of engineering work today, in your opinion?

Question13

What are the success stories that engineers should be telling?

Question 14

What was your favourite subject in school and why?

Question 15

What was your least favourite subject in school and why?

C. Institution Choice

Purpose: These questions address what role the reputation of the university and in particular that of the faculty play in career choice.

Question 16

What made you aware of studying engineering at TUT?

Question 17

Is the course you chose presented at any other university?

Question 18

If yes, why did you prefer TUTFEBE?

D. Guidance Experiences

Purpose: To gather additional information and perspectives on the topic.

Question 19

What do you think should be done to promote a more positive image of engineering and make it more appealing to study?

Question 20

What kind of information do you think should be communicated to prospective students?

Question 21

In your opinion, at what stage of a learner's school career should we start communicating with them?

Question 22

Which avenues of communication, do you suggest, do we need to communicate with prospective students?

E. General Perspectives

Purpose: To determine the views on household problems experienced in this study field.

Question 23

What do you think contributes to the high failure rate in South Africa in mathematics and physical science?

Question 24

Who is responsible for the poor performance in these subjects in South Africa?

Question 25

Which personal factors attributed to your poor performance or success?

Question 26

Is there anything further you feel is important and like to share?

Note that focus group participants should be verbally encouraged to protect the identities of fellow focus group members and to respect the confidentiality of each other's viewpoints and/or perceptions at the onset of the focus group session.

APPENDIX D: INTERVIEW QUESTIONS

Factors influencing career choice of learners in engineering: A case of a selected University of Technology in South Africa.

Questions for Interviews

A. Introduction to explain the study

This is being taped so that I don't have to take notes while you are giving your opinions.
We just want to hear your opinions.
There are no right or wrong answers.
We are just looking for perspectives.
Please speak up when you talk.
If you have any additional questions and comments, please go right ahead at any time.
This is confidential, your names will not be revealed.

B. Explore the participant's school culture, experience and environment.

What was your favourite subject in school and why?
Was it because of a certain teacher or project perhaps?
What was your least favourite subject in school and why?

C. Focus on the role of the family members and friends in the career choice

Have you ever spoken to an adult about what you want to become?
If so who did you talk to? A teacher or a guidance counsellor, recruitment officer? A family friend? What was the conversation like and why did you choose this specific person?
Do you know anyone who is an engineer?

D. Exploring the actual considerations taken to choose engineering

What made you aware of the studying engineering at TUT?
Career exhibitions? Visit by a recruiter? Participating in the Competition Day? Lego Competitions? Robotic Competitions? Sasol TechnoX? Science Exhibitions?
Which study field did you choose and why this specific study field?
Satisfaction? Celebrity? Recognition (like receiving awards), Interesting work? Good money? Good lifestyle? Challenging? Opportunities? Create things? Competitive?
What is a good example of engineering work today? What are the success stories that engineering should be telling?

Some people say scientist get all the credit for scientific advances, architects get all the credit for buildings and projects, but engineers get the blame when disaster happens. Do you agree that this is the case? Why, why not?

What came to mind when you heard the word engineering the first time?

What kind of person is an engineer? What traits and characteristics, do you think an engineer has?

E. Exploring possible reasons for the problems experienced and solutions thereof.

What do you think contributes to the high failure rate in South Africa in mathematics and physical science?

Who is responsible for the poor performance in these subjects in South Africa?

Which sources of your own, attributed to your poor performance or success?

What do you think should be done to promote a more positive image of engineering and make it more appealing to study?

Do you think social marketing will have an influence in your choice of engineering as a career? What kind of information do you think should be communicated to prospective students?

APPENDIX E: INFORMED CONSENT FORM FOR INTERVIEWS

Dear research participant,

You are invited to participate in an interview session which forms part of a research project in the Faculty of Engineering and the Built Environment. This is a follow-up on the questionnaires you completed.

Your participation in this study is entirely voluntary and anonymous. **You are kindly requested to respect your fellow student's viewpoints and the confidentiality of this session.**

Research is being conducted to determine how your choice of study, was done. With this knowledge we will be able to design a recruitment model for the Faculty, targeting the right students using the correct methods. I am going to investigate the influence of social media marketing in comparison to conventional ways of recruitment, like career exhibitions,

competition days, open days etc.

All information obtained during the course of this study is strictly confidential. The study data will be coded so that it will not be linked to your name. Your identity will not be revealed while the study is being conducted or when the study is reported in scientific journals. All the data sheets that have been collected will be stored in a secure place. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. The information received during the project will only be used for research purposes and will not be released for any employment-related performance evaluation, promotion and/or disciplinary purposes.

There are no right or wrong answers. I would like to hear your stories and your voice. Sewell, 2001:1 defines qualitative interviews as "attempts to understand the world from the participant's point of view, to unfold the meaning of people's experiences (and) to uncover their lived world prior to scientific explanations" (De Vos et al., 2010:287).

If you decide to take part in the study, you will be required to do the following:

1. You will also be required to participate in a focus group interview.
2. The interview sessions will be conducted at a venue that the researcher will disclose to you.
3. The interview sessions will take place between 08:00 – 17:00 during the week and will not clash with your class attendance.
4. The interview session will take approximately one (1) hour.
5. You are requested to grant permission for the interview to be audio-recorded.
6. An optional post interview worksheet will be provided to you. This worksheet will enable you to share any information that you didn't feel comfortable sharing during the focus group interviews. The researcher will provide an easily accessible "sealed post box" in which you could post your worksheet. A sealed post box is available at Pretoria Campus in the entrance of Building 3 Ground Floor in the Foyer. If you decide to take part in the study, you will be required to sign the attached informed consent form.

WHAT ARE YOUR RIGHTS AS A PARTICIPANT IN THIS STUDY?

You have the right to withdraw at any stage without any penalty or future disadvantage whatsoever. You don't even have to provide the reason/s for your decision. Your withdrawal will in no way influence your continued relationship with the researcher and/or your academic progress in the University.

The Director of the Recruitment Department at TUT, Melien Rossouw, approved the research project in 2012.

The Department Research and Innovation Committee (DRIC) for the Faculty of Humanties and the Central Research and Innovation Committee (CRIC) of the Tshwane University of Technology have approved the project plan and verified the ethical considerations for this project. The formal ethics clearance number allocated to this project is REC Ref: 2013/10/012 FREC Ref: FREC/EDU/STF/2013/02.

The primary investigator, Zelda Janse van Rensburg, can be contacted during office hours at Tel (012) 382-5250. Should you have any questions regarding the ethical aspects of the study, you can contact the chairperson of the TUT Research Ethics Committee, Dr WA Hoffmann, during office hours at Tel (012) 382-6265/46, E-mail hoffmannwa@tut.ac.za. Alternatively, you can report any serious unethical behaviour at the University's Toll Free Hotline 0800 21 23 41.

A FINAL WORD

Your co-operation and participation in the study will be greatly appreciated. Please sign the informed consent below if you agree to participate in the study. In such a case, you will keep this copy of the signed informed consent from the researcher.

CONSENT

I hereby confirm that I have been adequately informed by the researcher about the nature, conduct, benefits and risks of the study. I have also received, read and understood the above written information. I am aware that the results of the study will be anonymously processed into a research report. I understand that my participation is voluntary and that I may, at any stage, without prejudice, withdraw my consent and participation in the study. I had sufficient opportunity to ask questions and of my own free will declare myself prepared to participate in the study.

Research participant's name: _____ (Please print)

Research participant's signature: _____

Date: _____

Researcher's name: **Zelda Janse van Rensburg** (Please print)

Researcher's signature: _____

APPENDIX F: FIELD NOTES OF INTERVIEWS

Interview Transcriptions

9 students participated – Electrical Extended

12 student participated – Industrial Engineering

Mathematics

Solve difficult problems

Found Mathematics a challenge. The level at high school and the level at tertiary level are too wide apart which … challenge.

I had a teacher who loved maths and I started liking the maths and was motivated to do well.

Presentation skills of the teacher were very uninteresting and therefore the maths was boring.

Physical Science

Challenging, problem solving.

Experience the fixing of everyday real practical problems.

Would like to be part of coming up with new ideas.

Teacher has an influence but did not like the teacher and I therefore performed not well.

Chemistry

I like it because I was good at it – one excel if it is something you like doing.

Industrial is second choice.

Electrical Technology/Design

Critical thinking – think more.

Want to re-invent and understand how it works. Applied maths and science.

Life Orientation

Express myself and my creativity. Share my own ideas.

Teachers Influence

Inspiring

Electrical Design teacher was the best in the country and therefore I was inspired to be like him and become the best in electrical engineering.

Least Favourite

Agriculture

Languages – the languages spoken at home and the languages used in the school was different.

Philosophy – Caboen – lot of memorization.

Life Sciences

Lot of theory – boring – obvious – lot of detail.

Geography

Memorize a lot of facts.

Drawings & Design

Not enough time – teacher gave the wrong information.

Biology

Information is irrelevant in the career I thought I wanted to follow.

Influence of peers

Most of the students who selected engineering as a career have family members who are engineers. Growing up with the idea that engineering will be my career as a result of the family.

I had my own ambition to become an engineer from Grade 10 without any influences.

DRC – 80% to proceed in electronics – if you do not succeed in mathematics you need to redo the whole year with all the subjects.

Did Mathematics Literacy and returned to do proper Mathematics.

Would like to make a difference in the community – got inspired with electricity not working. Many of the student do not finish, when they return they say it is too difficult.

Without any influences of other people

I like design – structures fascinates me, which is why I chose engineering.

Why TUT

Social network spread negative stories on TUT – went to UCT but failed – then came back to TUT.

UP because my brother was on UP – matric results were too low to be accepted at UP and then I had to go to TUT. But now I realize that the workload is hard but able to keep up.

DRC – 1st year study English – headmaster referred him to study engineering at TUT.

TUT alternative – applied and admitted at Wits (influence from friends) but was too late to qualify for financial aid. Thought TUT is an inferior university. Image changed while I am here.

Advised to attend TUT by teacher – employability is better with a qualification from university of technology.

Chose TUT because of a relative (mechanical) being here already. International student from DRC – infrastructure impressed him in South Africa. TUT needs to be marketed in DRC. Chose the practical option.

Applied at TUT and UP and accepted in both but enrolled at TUT.

Student visited industry and saw what the differences were between the engineers and technicians working.

From Germiston and TUT was my first choice.

Witbank - by word of mouth and students working in companies – the ones from TUT perform the best.

TUT is a softer choice – my friends who started at Wits deserted.

Eastern Cape, Umtata – talked to a mechanical engineer who told him that TUT is the best place to study engineering.

Student would like us TUT to be more actively marketed in the Eastern Cape – this is not our region.

My farther studied at the Technikon Pretoria and he advised me to come to TUT.

TUT students visited us at school and keep us informed about TUT.

Chose UoT because the practical make the theories easier to understand.

Talk more about the technology used in the classrooms so that the public can take note of our technology advancement.

The extended lecturers are passionate and makes a difference.

Talk about the success alumni.

Characteristics

Mathematic and Physical Science problems

No good foundation in primary school.

Government is responsible for the poor performance of these subjects.

Teachers are also responsible – not skilled enough, methods and language barriers.

Parents also need to take responsibility to support their children to motivate them to excel.

Pass rate is too late – 30% at school and then struggle to then achieve 50% pass rate in university.

DRC – Grade 8 – if you do not pass Mathematics you need to repeat all the subjects. By repeating all the subject the knowledge level excels.

Teachers and students need to take responsibility for this subjects – students need to practise a lot. Teachers do not push student towards their full potential – give them basic education.

Wrong message from a young age that maths is difficult.

Parents and peers discourage you.

You have to practise to become good at maths.

Good professionalism from teachers.

Positive image on engineering

Career exhibitions are the only means they experienced to make them aware of career choices.

Messages should be different.

Far off schools should be visited and expose to projects and competitions.

Competitions, bursaries.

Social marketing

Most students do not have internet and limited time on the cell phones.

Students feel that social marketing will not have an influence.

Bad publicity – corrupt, strikes – creates bad negative image.

Transnet schools should be investigated.

Most have access to cell phones.

Industrial

Industrial is the second choice of the majority of students in Industrial engineering.

Employability was promoted by teachers when studying Industrial – one of the students.

Civil was the first choice, but now I like this course.

Industrial is evident in all businesses but am still not sure if this is the course I would like to do.

Metallurgy was my first choice – second choice.

Like working in a team and this will be possible in Industrial.

Teachers promoted Industrial.

Started with Civil engineering, but realized that Civil is not for me. Tried for Mechanical and got space in Industrial.

Biomedical science was my first choice – still my interest and will see if I can change in future.

Even though it is not their first choice it may become a passion once they experience the course.

Industrial has a broad spectrum – you can work in any industry worldwide.

What came to mind when you heard the word engineering

Money, challenge, machines, development.