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The transition of engineers from technical positions to general management

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Abstract

In the South African business environment, there is a lack of both engineers and managers. This creates a compounded problem whereby many engineers find themselves transitioning from a technical position to general management. This transition has prompted the need to investigate the competencies required for engineers to effectively transition into general management and the methodologies used to acquire general management competencies.

The research was conducted in two phases. The first qualitative phase took the form of semi-structured, in-depth interviews. The results obtained from phase one was used together with the literature review to develop the constructs for phase two. Phase two consisted of two quantitative self-administered closed-ended questionnaires. A questionnaire was developed for engineering managers and a separate questionnaire was constructed for human resource managers. A total of 116 respondents from 31 different countries participated in the research.

The results in terms of the competencies required to transition into general management showed that interpersonal skills are the most important, followed by leadership skills. Highly focused business skills are the least important competencies. The methodologies used the most depict that the majority of people acquired their general management competencies through trial and error / learning on the job, networking and short business learning courses. The findings have been used to develop a model that will help organisations and human resource practitioners to assist engineers in the transition process.

Declaration

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

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Dedication

I would like to dedicate this research to my parents, Danavathie and Govindasamy Chetty.

You have provided me the opportunities to ensure that we received the best education. I am most grateful for your continuous words of encouragement, support and sacrifices that you have made for your beloved children.

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1.1 Introduction

Engineers have played a crucial role in the development of South Africa and are the backbone of a number of industries. Industries such as manufacturing, construction, food and beverage, automotive, and mining are all driven by engineers. Engineers possess a diverse set of skills which are rooted predominantly in mathematics and science-based subjects. A young graduate engineer can therefore be viewed as an individual who is interested in the application of scientific and mathematical principles to practical ends such as the design, manufacture and operation of economical structures, machines, processes and systems. It is also a common phenomenon that engineers are employed by project houses as project mangers. Based on the competitive business environment today and in the hope of achieving a competitive advantage, many historically non engineering organisations are also recruiting and employing engineers. These industries comprise of banking, consulting and even sales focused organisations. The belief is that engineers in general adapt better to highly pressurised and demanding environments, however it is astonishing that only half of those trained to be engineers end up doing engineering work (Toit & Roodt, 2008).

Based on the diverse skill set that an engineer is equipped with, the need for engineers is greater than ever before. However, for a variety of reasons such as attractive pay cheques and better socio-economic conditions, South Africa's best engineers are being lured abroad (Gauteng Business News, 2008). A report compiled by the South African Department of Labour indicates that the number of South African engineers considering leaving the country is increasing (Toit & Roodt, 2008). This inevitably gives rise to a huge shortage of engineers. This shortage of science and engineering skills in South Africa has not gone unnoticed. Science and Technology Minister Naledi Pandor has widely expressed that South Africa needs to urgently produce more engineers (Terblanche, 2011). Terblanche (2011) agreed with Toit and Roodt (2008) in

that only half of those engineers that graduate go on to practice engineering, while the remainder go on to work in banks and other financial institutions. The Engineering Council of South Africa (ECSA) has acknowledged the shortage and set out structured initiatives to tackle this problem and train 30,000 engineers by 2014. However on the path to 2014, it is inevitable that South Africa's lack of engineering capacity will hamper development and growth in the country (Terblanche, 2011).

In addition to the above-mentioned shortfall of engineers, South Africa is also facing a serious shortage of managers. While the public sector is affected the worst, both the private and public sectors continue to suffer from management shortages (Mail & Guardian, 2008). The shortage of management competencies not only affects large organisations, but the situation is even worse in small, medium and micro enterprises, which can be viewed as the workhorses of the country. The problem originates in the fact that many business owners lack a tertiary education, making it extremely difficult for them to manage the daily responsibilities of the business (Mail & Guardian, 2008). South Africa can be described as a double-edged sword; on one side there is a serious shortage of employment, whilst on the other there is a shortage of high-skilled workers (Sharp, 2011). Sharp (2011) reported that in April 2011, there were 829,800 unfilled positions for high-skilled workers in the areas of senior management and professional and technical occupations. Table one indicates estimates of the level of skill shortages or surpluses in various occupations in South Africa.

Table 1: Skills shortages or surpluses in various occupations in South Africa (Sharp, 2011)

Occupation	***Skills shortage (000s)****
Manager	216.2
Professional	178.4
Technician	432.1
Clerk	86.6
Sales and service worker	104.3
Skilled agriculture	3.1
Craft and related trade	65.5
Plant and machine operator	72.0
Elementary worker	-967.6
Domestic worker	-247.4
Total	***-56.8***

Transformation policies such as employment equity, affirmative action and broad based black economic empowerment (BBBEE) have also created a migration effect amongst white professionals. The impression is that these policies have been pursued too aggressively and appointments have been based on colour and not on competencies. Toit and Roodt (2008, p. 47) stated that “almost a fifth (one million) of the white population have left the country in the last 10 years, listing crime and affirmative action as the biggest reasons for the exodus.” Another effect of policies such as BBBEE is that token appointments have been made and a decrease in requirements in terms of average age and experience has created a recipe for failure. Many newly appointed young black manager’s lack the competencies and experience to cope with the pressures exerted on them. Without the necessary training, the result is that they are set up for failure.

Skill shortages directly affect the efficiency and productivity of any organisation. The above illustrates that a shortage of engineers and managers in the country creates a compounded problem, which in turn affects the growth and sustainability prospects of many South African enterprises. Sharp (2011, p. 22) stated that “most economists agree that South Africa’s skills shortage poses a significant limitation on the country’s long-term economic growth potential.” Due to the lack of managerial, professional and technical skills, economic opportunities have to be passed by.

In the South African context, where there is a serious shortage of individuals with management skills, it is common to find engineers becoming managers. Following their undergraduate qualification and initial training in their respective organisations, positions for management and leadership opportunities arise. Hence the transition of technical personnel such as engineers to general management is evident in many organisations today. As engineers develop their careers, they find themselves taking on more management responsibilities and their roles become less technically focused and more business management focused. As a result, engineers need to be equipped with the appropriate skills to successfully embark upon a management or leadership position. It is imperative that the development of leadership is the primary focus for senior management and board members. If this is not the case, organisations are more likely to make incorrect decisions. In extreme cases, organisations may be forced to promote inexperienced, untested and possibly unqualified junior managers. In other instances the organisation may have to look outside for executives, which then gives rise to the dilemma of whether the individual would adjust and fit the company’s culture and behaviour (Cohn, Khurana & Reeves, 2005).

If organisations which employ engineers are to reach their optimum potential, it is essential for them to focus on leadership skills and qualities, transitioning technically skilled staff to acquire management capabilities.

Furthermore, the escalation of globalisation has created a playing field for competitors from every sphere of the world, making the business environment tougher and more challenging than ever before. Organisations have no option, therefore, but to ensure that they are building a company that will be steadfast. The only way of ensuring sustainability is by investing in people, making sure that there are adequate leaders to take the company into the future. Dragoni, Oh, Vankatwyk and Tesluk (2011, p. 5) defined cultivating leaders for the future as “strategic thinking competency.” This means that the skills required from these future leaders would need to be robust enough to build resilient strategies.

1.2 Research Objectives

As described above, engineers play a pivotal role in many industry sectors. For the purpose of this research, the career transition of engineers in the manufacturing industry will be evaluated. The objectives of this research are therefore:

- To determine suitable general management competencies for engineers to make the transition.
- To identify the learning and methodology practices that engineers undertake to obtain the identified missing competencies.
- To determine the differences in perceptions of competencies and methodologies between engineers and human resource managers.

Chapter 2: Literature Review

2.1 Introduction

Following the description of the research objectives above, the literature review aims to get a deep understanding of career management and career transition - in particular the career management and career transitions of engineers. This is followed by an analysis of leadership and leadership skills amongst engineers. The literature review further highlights management competencies and the methods that can be used to achieve those competencies.

2.2 Career Management

The most recent literature on career management has outlined that careers have undergone critical changes since the 1990s (Thite, 2001). The traditional position of viewing career management has drastically changed. Based on the difference in expectations, career management needs to be analysed at the organisational and individual levels (Thite, 2001). Due to the ever changing competitive business environment, organisations have the privilege of changing the deliverables required from employees as the situation may deem necessary. This leaves employees in an unfortunate position in that employees have less bargaining power in terms of job security, promotions, incentives and remunerations (Thite, 2001). Brousseau, Driver, Eneroth and Larsson (1996) suggested that employees today need to be more flexible and must be willing to travel at any point of time. Employees must be equipped with a diverse set of skills and knowledge that can be used to achieve the company's goals and objectives (Brousseau *et al.*, 1996).

It is understood that career goal setting is a requirement, if not an imperative, for employees and their organisations (Greenhaus, Callanan & Kaplan, 1995). A career goal highlights to the employee a distinct picture of his or her future. Moreover, it can provide a clear target of what needs to be achieved by

guiding actions and behaviours in order to achieve those goals. Career management can serve as a basis for effective human resource planning and can in turn promote job performance (Greenhaus *et al.*, 1995). However, based on the turbulent business environment, Hall and Richter (1990) argued that to set a specific career path for an individual is too limiting and unrealistic. The individual becomes narrowly focused in achieving the goals set and does not venture outward, hence becoming tunnel vision (Hall & Richter, 1990). The usefulness of specific career management goals is therefore dependent on the situation. There are instances when career management goals are beneficial and there are instances when career management goals are useless or even harmful (Hall & Richter, 1990).

2.2.1 Career Management for Engineers

Ismail (2003, p. 2), defined engineers "as persons employed in technical work for which the normal qualification is a degree in science or engineering." An engineer's career can be understood as the variety of positions and jobs during the life of the engineer as a result of various factors such as personal, organisation and working conditions (Ismail, 2003). There are two types of career dichotomies for engineers: individual vs institutional and technical vs managerial careers (Ismail, 2003). Individual vs institutional careers can be viewed conceptually as internal vs external careers. They involve both the individual's subjective and objective needs. Technical vs managerial careers can also be referred to as preference (Ismail, 2003). Technical involves an employee moving through his career pathway while remaining involved in technical specialisation. The managerial career path involves slowly moving the individual away from their usual technical responsibilities and taking on more management responsibilities (Ismail, 2003). Petroni (2000a) suggested that this is the most attractive route for engineers as it carries the most reward and prestige. In addition to the above career routes, there are two other career paths for engineers: project to project and technical transfer (Petroni, 2000a).

Project to project refers to a situation whereby an engineer desires neither a promotion nor movement up a managerial or technical ladder. The engineer only seeks the opportunity for engaging in challenging engineering activities without any reward (Petroni, 2000a). Technical transfer refers to the engineer having the opportunity to transfer technical knowledge and skill out of the research and development department for the purpose of production and commercialisation (Petroni, 2000a).

2.3 Career Transition

A large amount of modern careers have become unpredictable and characterised by various occupational changes and transitions (Mayrhofer & Iellatchitch, 2005). Duberley, Mallon and Cohen (2006, p. 6), described career transitions as the “punctuation marks in a career story.” At the trivial level, career transitions that are related to work occur in numerous areas such as international careers, change within an organisation, development steps in an occupation or spouse-related employment changes (Mayrhofer & Iellatchitch, 2005). At a more analytical level, career transitions are those vital points in an individual’s career that will have both subjective and objective characteristics. These characteristics can take the form of values, cultures, family, career development and other personal factors that relate back to both the individual and organisation (Duberley *et al.*, 2006).

A component of career transition also refers to the gaining of a variety of competencies to develop a range of marketable skills to maintain employability and hence job security (Duberley *et al.*, 2006). Being employed no longer provides job security. Uncertainty and unpredictability is now a major characteristic, making any long-term commitments difficult and nothing one can take for granted. Hence employability in terms of tacit knowledge and skills, being valued on the labour market and not being exclusive to any one organisation, are the root causes for career transitions (Mayrhofer & Iellatchitch, 2005).

2.3.1 Career Transition for Engineers to Management

In order for engineers to make an effective transition into management it is necessary that they receive special attention, irrespective of the usual control and management practices (Petroni, 2000b). There are two central theories that describe the need for particular attention. The first is that it is extremely difficult to retain engineers in the organisation and secondly it is problematic for engineers to make the transition into management (Petroni, 2000b). The transition to management has been described by engineers as difficult for those who make it and for those who do not (Petroni, 2000b). Those engineers that make the transition discover that they have many competency gaps that need to be filled, and for those that do not make the transition, even though placed on the same band in terms of salary and job grade as the equivalent management position, the technical position inevitably lacks the element of power and authority (Petroni, 2000b).

A large number of engineers from all levels are naïve about the amount of technical and management competencies that are needed to be a successful leader (Farr & Brazil, 2009). Engineers who want to become indispensable to organisations or have reached a self-actualisation level (Beaumont, 2009) will consider undertaking the transition from an engineer to a management role. Self-actualisation is defined by Farr and Brazil (2009, p. 5) as, “the manifestation of our potential as human beings beyond basic survival needs and is a good way to describe lifelong learning.” Engineers recognised for possessing this ability therefore make the transition to management and continue to pursue more management and technical skills as the industry evolves. Senior engineers have achieved success because they have manifested technical excellence and management competencies (Farr & Brazil, 2009).

2.4 Management Skills

In recent years, the roles and functions of managers have changed drastically, largely because of the context in which these skills are being

applied (Worrall & Cooper, 2001). The organisational, economic and technological context has changed and in some cases does not resemble anything close to its original identity (Worrall & Cooper, 2001). The school of thinking with regards to management skills can be thought to be comprised of both hard and soft skills (Crosbie, 2005). Hard skills are made up of intelligence and the technical competencies an individual possesses, whereas soft skills can be referred to as intangible skills (Crosbie, 2005). Crosbie (2005) illustrated that technical skills and knowledge accounts for only 15% of the reason a person gets a job and subsequently progresses in that job. The remaining 85% of job success is based on the individual's ability to understand and converse with people (Crosbie, 2005).

Balaji and Somashekar (2009) agreed with Farr and Brazil (2009) that soft skills are made of the following core components:

- Leadership;
- Team Work;
- Interpersonal Skills;
- Continuous Learning Capacity;
- Futuristic Thinking;
- Decision Making Capacity;
- Self-Management Skills; and
- Listening Skills.

Crosbie (2005, p. 48) further argued that "for anyone who has wrestled with how to deliver bad news to an employee, handle an emotional conflict, motivate a team, calm their own anger, inspire others towards a vision or persuade an audience to a course of action," it is clearly apparent at the deepest level how difficult it is to become well trained in the soft interpersonal skills.

2.4.1 Management Skills for Engineers

Today's changing business environment demands that engineers possess soft skills in addition to technical hard skills. Building the capabilities of engineers to better suit leadership and management roles has become critical in organisations that employ engineers (Kumar & Hsiao, 2007). The general perception of an engineer is that he or she resembles something of a nerd who is generally more interested in gadgets and technology rather than other human beings (Molen, Schimdt & Kruisman, 2007). Engineering-related subjects are very goal-oriented and to a large extent can be completed in the personal capacity of the engineer. There usually is very little or no team work needed for completion of the subject. Consequently, engineers do not develop their social skills (Molen *et al.,* 2007). Emilsson and Lilje (2008) conducted a study pertaining to the extent to which social psychological theories assist with training communicative and management skills in engineering education. Emilsson and Lilje (2008) agreed with Molen *et al.* (2007) that undergraduate engineering studies do not include the necessary interpersonal skills required by organisations.

A further study conducted by Molen *et al.* (2007) based on the personality characteristics of a group of engineers with different levels of experience, noted that engineers should pay a lot more attention to interpersonal skills competency which is vital to master when in a management role. The more experienced the engineers were the more independent and meticulous they proved to be. Balaji and Somashekar (2009) contended that soft skills are critical for engineers, specifically in the global environment, and those engineers that possess the appropriate competencies will be able to withstand organisational retrenchments and downsizing. Therefore for engineers to remain productive and climb the corporate ranks they will need to gain the relevant soft skills. The consensus between Molen *et al.* (2007) and Balaji and Somashekar (2009) was that engineers, irrespective of their years of experience, should take into account the career advancing importance of soft skills. Research has been conducted by the Office of University Research and Education and the United States Department of Transportation, which found

that the performance of engineers improved after they were given soft skills training (Balaji & Somashekar, 2009).

In addition to the interpersonal skills that are needed for engineers to make the transition to a management level, Bowden (2010) identified one other very important skill that engineers in particular need to be equipped with, this being ethics. Bowden (2010) stated numerous discrepancies which have occurred due to the lack of ethics in this field, such as The Hyatt Kansas Walkway collapse, the West Gate Bridge and the Threadbo disaster. Bowden (2010) approached the issue of ethics from a personal skill perspective as being a lack of communication, and stated that although the causes for each of the above disasters were a disregard for ethics, they were aggravated by a failure to communicate between various responsible organisations.

2.5 Leadership

Whilst management can be considered as the tasks an individual carries out on a daily basis to ensure the effective operation of the business, leadership is a separate and distinct function that is essential for the successful performance of the business. Leadership involves developing the strategy and direction of the firm by influencing others to achieve their goals (Nienaber, 2010). There are many definitions of leadership, however most definitions seem to comprise of the following components (Farr, Walesh & Forsythe, 1997):

- Interpersonal influence;
- Goal orientation; and
- Purposive.

Farr *et al.* (1997, p. 39) described leadership as “the process of influencing an organised group toward accomplishing its goals.” An alternative way to discuss leadership is in terms of attributes of effective leaders. Figure 1 below is a depiction of nine leadership attributes (Farr *et al.*, 1997). A deep

understanding of these nine qualities will help to define what a good leader is and will also highlight areas that require development (Farr *et al.*, 1997).

Figure 1: Nine leadership attributes (Farr *et al.*, 1997)

According to Farr *et al.* (1997), an effective leader must be a big thinker in terms of quality and responsibility. The leader should be ethical in nature and possess the ability to master change. Mastering change is essential because people come from different social and cultural backgrounds. Risk taking and pursuing a mission for a purpose are also skills that a respectable leader should possess. A good leader, in addition, should have the ability to make a decision, be capable of inspiring their teams through team building and not abuse their power. Ultimately communication is essential for leaders to get their perspectives across; consequently good communication is essential for an effective leader (Farr *et al.*, 1997).

There are a number of authors that rally for the differentiation between management and leadership, however the general consensus is that both management and leadership are ultimately concerned with the success of the business and should be treated as an integrated whole (Nienaber, 2010). The findings of Nienaber (2010) suggested that both management and leadership are interwoven. The components of leadership listed by Farr *et al.* (1997) also fall within the management boundaries defined by Nienaber (2010). In modern

times, the terms “leadership” and “management” are often used interchangeably. Although the interchangability of words may cause some confusion, in contemporary times, the introduction and concept of leadership in any organisation is synonymous with management (Nienaber, 2010).

2.5.1 Leadership Skills for Engineers

In a period of intensified global competition, leadership is a key element in satisfying the needs of the engineering profession (Bowman & Farr, 2000). To develop a concise definition for leadership is difficult enough; to develop a definition for leadership for technical engineering management seems almost impossible (Farr *et al.*, 1997). As engineers rise to positions of increasing responsibility and move up the corporate ladder, leadership becomes an essential skill (Bowman & Farr, 2000). Farr *et al.* (1997) highlighted in figure 2 below that as an engineer progresses in seniority, leadership competencies are imperative for success.

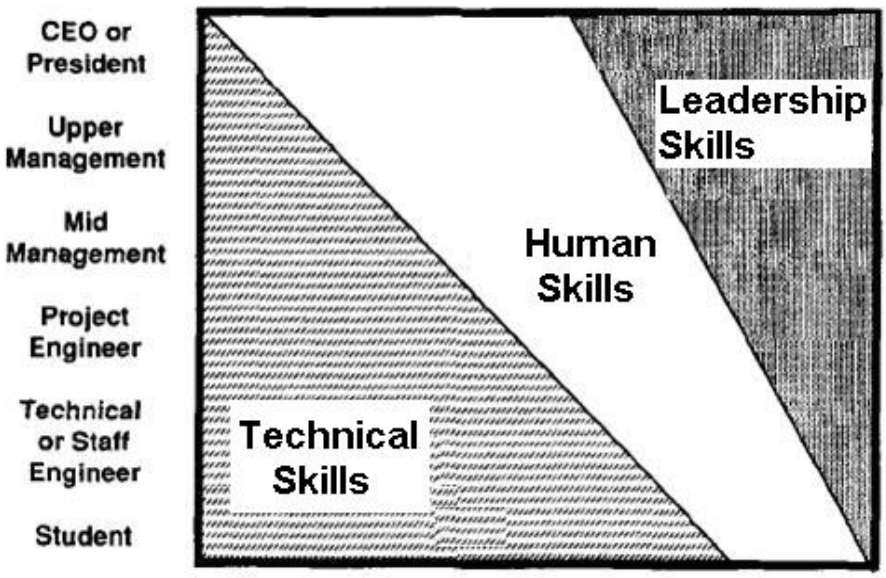


Figure 2: Evolution in skills for a successful engineer (Farr *et al.*, 1997)

From figure 2 above, it is important to note that leadership skills are not a priority skill needed for a young engineer, however, if the young engineer has

ambition to move up the corporate ladder, in order to prepare the individual for taking on roles with more responsibility and authority, it is essential that leadership skills be instilled early (Farr *et al.*, 1997). Bowman and Farr (2000) concur with Farr *et al.* (1997) that second to technical expertise for junior to middle engineers, leadership is the single most valuable competence required to survive in the competitive engineering profession.

2.6 Developing Management and Leadership Skills

Investments in management and leadership development are part of an on-going search in many industry sectors for the key to enable more effective organisational performance (McGurk, 2010). Management and leadership development can be viewed as the anchors of a triumphant career, yet of all the human resource management functions, these subject matters are the most misunderstood and poorly implemented (Wright & Belcourt, 1994). No matter the size of the organisation, the single most distinguishable factor of a successful company from others is the quality and competence of its management team (Wright & Belcourt, 1994).

Crosbie (2005) identified humanist psychologist Abraham Maslow's four stages of learning, as depicted in figure 3 below, as a learning process which organisations need to take cognisance of when trying to develop management skills, be they soft or hard skills. Maslow's argument is that learners begin as unconsciously incompetent, meaning that people do not know what they are not made aware of. As a result, learners believe that they are efficient and are not aware that they could develop skills to make them more efficient (Crosbie, 2005).

The second stage is when learners are presented with information which leads to the realisation that more skills are required in order to create better efficiencies. This stage is called the consciously incompetent. This is a very difficult stage to transcend as individuals will have to understand and accept

their lack of skills in order to move forward. Should individuals deny this stage it could detrimentally impact an organisation's growth (Crosbie, 2005).

The third stage is referred to as consciously competent. Learners have now accepted the change that has to occur and are beginning to utilise the new skills, however there is a measure of uncertainty at this stage, as with any new process or way of working (Crosbie, 2005).

Unconsciously competent is the fourth stage. At this stage the new skill has become a natural way of working and the learner has mastered the skill and become an efficient worker. Once all four stages have been successfully completed, a learner has gone through the difficult change process of acquiring and utilising new skills (Crosbie, 2005).

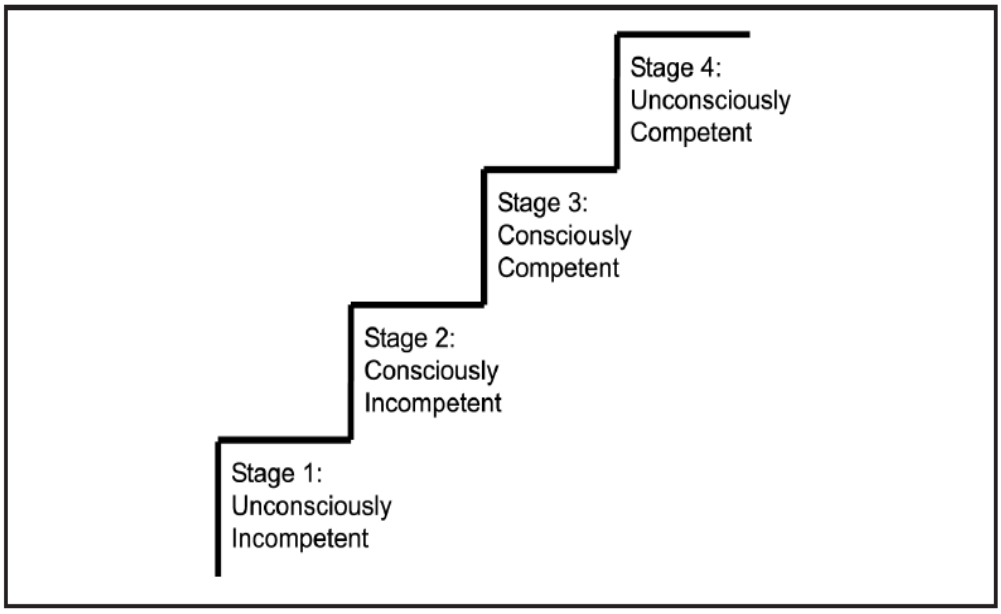


Figure 3: Abraham Maslow's stages of learning (Crosbie, 2005)

Homer (2001) stated that organisations are interested in finding ways in which they can relate skills development with strategic objectives and in doing so comply with industry regulations. Skills management, if done correctly, has the ability to save organisational costs by appropriating resources. Homer

(2001) encouraged skills management within organisations because it measures individual competencies, assesses skills gaps, and aids organisations to implement more cost effective and effective training and development practices.

Wright and Belcourt (1994) recognised 10 reasons why it is imperative for organisations to invest in the growth and development of managers:

1. The most obvious being to improve overall performance;
2. The organisation's internal consensus to organically nurture talent;
3. To build a common spirit and organisational culture;
4. To establish a cultural standard predetermined by management;
5. Encouragement to climb the corporate ranks;
6. The need to establish a set of skills for future organisational growth;
7. Emphasise political stability and portray an environment of equality for stakeholders;
8. As a form of payment or compensation;
9. Protection of manager from sub ordinates as a psychic defence; and
10. Legitimisation of the social order.

Homer (2001) emphasised the issue that organisations' biggest concern is the time that the work force is away on training, which results in non-productivity. In order to eradicate this perception, Homer (2001) emphasised that skills gaps should be identified and tailored for each individual, thus reducing the amount of time spent on training.

2.6.1 Development Programmes for Engineers

According to Homer (2001) and Wright and Belcourt (1994), in order to develop any management programme one needs to look at the link between organisational strategy and skills development. Individual careers are strategically focused as they are linked to long term business goals.

The initial step for engineers to attain success in a development programme towards a management role is to become self-aware. The engineer needs to go through a process of introspection and critically analyse one's own shortcomings in terms of competency gaps, only then can the engineer continue working with on-going impetus towards a well-defined development plan (Farr & Brazil, 2009), i.e. from unconscious incompetent towards conscious incompetent (Crosbie, 2005).

General Electrical, being one of the world's most prosperous companies, has attributed their success to the investment in people development and training (Waters, 2009). Notably, credibility has been given to the organisation's significant investment in engineering growth and development strategies. Leadership and management skills are further broadened to encompass engineering practices with management components. General Electric has developed a robust human resources system which takes into consideration recruiting, mentoring, training, deploying, evaluating and rewarding. The investment in human capital has cost the organisation a significant amount, however the competency development that has been leveraged from the system has been phenomenal (Waters, 2009).

It is evident that organisations are yearning for engineers - who have the aptitude to lead multidisciplinary teams, the ability to link business language and attributes to technical requirements, and are truly management material - to give organisations a steadfast competitive edge (Farr & Brazil, 2009). Engineering practitioners have long identified that the hiring criteria for engineers are their technical abilities and the firing criteria are their lack of soft skills. Engineers are also aware that their promotions are awarded for their competency in management skills (Farr & Brazil, 2009).

2.7 HR Perceptions of Competencies

As the competitive landscape evolves, the development of skills leading to increased job performance becomes more important for technical employees

(Clardy, 2008). Clardy (2008) was of the view that a resource based strategy emphasises the importance of core competencies as the tools for a sustainable competitive advantage. Wooten and James (2008) further highlighted that developing leadership capabilities are essential for leaders to steer the organisation out of a crisis. Communication, decision making and the preservation of organisational culture were noted by the human resources department as key elements for leaders to be successful when in crisis mode (Wooten & James, 2008).

Weber, Crawford and Dennison (2012, p. 228) were of the opinion that "in all of the competency research related to management, essential competencies include skills that can be classified as soft skills." Weber *et al.* (2012) conducted a study which involved human resource professionals rating the importance of the soft skills competencies found in literature. The results of the study suggested that of the 116 soft skill competencies that were assessed by the human resource professionals, the majority of them were deemed important (Weber *et al.*, 2012).

A significant amount of time and effort are invested so that technical managers can develop their soft skills. Consequently, organisations develop management development programmes commonly known as MDPs for their managers (Sahni, 2011). Management training inevitably increases the effectiveness of a manager and has an impact on the abilities, competencies and skills of a manager (Sahni, 2011). Simpson and Lyddon (1995) agreed with Weber *et al.* (2012) that management development programmes are essential for individuals to develop core competencies focusing on soft skills. Human resource departments must be cognisant of soft skills and ensure that they form a major part of management development programmes (Weber *et al.*, 2012). Sahni (2011) highlighted the importance of soft skills as follows:

- They enable the individual to deal with modern technology;
- They equip the individual to meet the challenges and demands of modern education and careers;

- They facilitate interpersonal relations;
- Appropriate decisions can be better made;
- Communication is much more effective;
- A more analytical approach to a situation is evident;
- The individual can face crises and pressure with ease;
- The individual's confidence is enhanced;
- Higher levels of empathy are developed.

Lengnick-Hall and Lengnick-Hall (2003) were also of the opinion that soft skills such as building network relationships are a crucial source of competitive advantage. Relationships are the foundation of an individual's capability and should be used strategically to provide an added advantage.

2.8 Conclusion

As a result of the competency gaps identified in the literature review above, organisations need to consider implementing sustainable management development programmes to organically facilitate the transition of engineers into management roles. Institutions of higher education and organisations should also focus on providing courses in leadership to engineering practitioners and students. Emilsson and Lilje (2008) suggested that engineers should be invited from workplaces to act as role models to engineering students as well as lecturers within the education programme, since lecturers did not have the necessary interpersonal skills required by organisations. The purpose of this research is to identify the key competencies that are required by engineers in the manufacturing industry and to gain an understanding of how these competencies are accumulated by these engineers.

Chapter 3: Research Questions

The research will aim to understand the career transition of engineers from technical positions to general management. Following the literature review above, the research will answer the research questions outlined below:

3.1 Research Question One

What general management competencies do engineers require to make the transition from a technical position to general management?

The research question seeks to determine and understand the competencies that engineers require to make the transition from a technical position to general management. The identification of these competencies will assist organisations and HR practitioners to develop individual development plans for engineers that provide these competencies.

3.2 Research Question Two

What learning and methodology practices do engineers undertake to acquire the identified general management competencies?

This research question seeks to explore and understand the process and methods of accruing the competencies that engineers require to transition from a technical position to general management.

3.3 Research Question Three

Research question three takes the form of hypothesis testing as follows:

Ho: The competencies that engineers require to make the transition from a technical position to general management are the same for middle, senior and executive engineers.

Ha: The competencies that engineers require to make the transition from a technical position to general management are different for middle, senior and executive engineers.

This research question seeks to determine the differences and/or similarities of competencies between middle, senior and executive engineers. This will assist organisations and HR practitioners to provide the necessary opportunities for different levels of management.

3.4 Research Question Four

Research question four takes the form of hypothesis testing as follows:

Ho: The perceptions of engineers and HR managers of the competencies that engineers require to make the transition from a technical position to general management are the same.

Ha: The perceptions of engineers and HR managers of the competencies that engineers require to make the transition from a technical position to general management are different.

This research question seeks to determine the differences and/or similarities of the perceptions between engineers and HR managers regarding the competencies that engineers require to make the transition from a technical position to general management.

3.5 Research Question Five

Research question five takes the form of hypothesis testing as follows:

Ho: The learning and methodology practices that engineers undertake to acquire general management competencies are the same for middle, senior and executive engineers.

Ha: The learning and methodology practices that engineers undertake to acquire general management competencies are different for middle, senior and executive engineers.

This research question seeks to determine the differences and/or similarities of the methodologies between middle, senior and executive engineers.

3.6 Research Question Six

Research question six takes the form of hypothesis testing as follows:

Ho: The perceptions of engineers and HR managers of the learning and methodology practices that engineers undertake to acquire general management competencies are the same.

Ha: The perceptions of engineers and HR managers of the learning and methodology practices that engineers undertake to acquire general management competencies are different.

This research question seeks to determine the differences and/or similarities of the perceptions between engineers and HR managers on the methodology practices that engineers undertake to acquire general management competencies.

Chapter 4: Research Methodology

4.1 Research Method and Design

Saunders and Lewis (2012) stated that establishing a concrete research design is essential for two main reasons, the first being deciphering the research philosophy which assists in analysing the critical ideas surrounding the research. The second is to confirm that the appropriate plan has been established so that the research results are credible.

The research was conducted in two phases. Phase one was qualitative, which was used to develop the constructs for the second phase which was quantitative. Hence the research included a hybrid approach. A hybrid approach suitably complements an empirical, exploratory research design by gaining insights from both qualitative and quantitative analysis of data (Sandelowski, Voils & Barroso, 2006). According to Sandelowski *et al.* (2006) the mixed research approach is targeted specifically at the amalgamation of qualitative and quantitative research within empirical based studies.

4.2 Phase One Research Method

A qualitative study was conducted to support the literature. Qualitative research, as described by Mouton (2008), focuses on words and observations to articulate reality and endeavours to describe people in natural circumstances. The key component is the involvement of people where their revelations are encouraged in a fostering environment (Mouton, 2008).

4.2.1 Population

The population of relevance was selected from a single large multi-national enterprise, SKF. In 1914 SKF started a sales outlet in South Africa and in 1915 started the later-to-be Volvo bearing. In 1916 SKF bought and started its first steel production plant, manufacturing quality steel for ball bearings. In

1926, AB Volvo, a subsidiary of SKF, started production of experimental cars and become independent in 1935. Over the next 60 years SKF were inventors of five new bearing families, with a total assortment today of over 225 000 different bearing products. On 16 February 2007 SKF celebrated its 100th birthday at 120 production sites in 24 different countries with 41 200 employees. Today, SKF consists of approximately 44 000 employees and has a global footprint in 110 countries. The population of relevance were individuals that met the following criteria:

- Middle, senior and executive managers with an engineering background;
- Human resource managers.

The reason SKF was chosen as the population of relevance was because of access to the organisation and the global reach of the organisation.

4.2.2 Sample

For the purpose of this research, a non-probability sampling technique was utilised. Sampling members were chosen on the basis of those who were best able to answer the research questions. In other words, a purposive sampling technique was employed (Marshall, 1996). The target sample was as follows:

- Two middle managers with an engineering background;
- Two senior managers with an engineering background;
- Two executive managers with an engineering background;
- One human resource manager.

Middle, senior and executive managers were defined as follows:

- Middle managers were defined as individuals that have people reporting to them;

- Senior managers were defined as individuals that had managers reporting to them;
- Executive managers were defined as individuals that were a director or managing director or enterprise / group manager.

4.2.3 Unit of Analysis

The unit of analysis were the perceptions of the middle, senior, executive and human resource managers, on the transition of engineers from technical positions to management.

4.2.4 Data Collection Tool

Semi-structured in-depth interviews were conducted focusing on the research questions above. Interviews were chosen because there are many advantages that a research project of this type can benefit from. The advantages inherent in interviews and hence the reason why they were chosen for this research are as follows (Britten, 1995):

- Interviews yield a higher response rate;
- The interviewer can probe deeper into a response given by the participant;
- The participant can get clarification on questions; and
- Interviews are useful for untangling complex topics.

Appendix A depicts the interview guidelines that were used during the in-depth interview process for phase one. For consistency, a basic introduction was drafted and each interview commenced with the interviewer explaining the introduction to each interviewee. Five to six open-ended questions were then presented to the target sample.

4.2.5 Data Collection Method

Face-to-face and telephonic interviews were conducted. All interviews were conducted in a private and confidential manner, in a closed office. Hand written notes were documented and all interviews were voice recorded. Each interviewee was asked beforehand if they agreed to the voice recording and none of them objected. Voice recording is a method that allows for effective analysis after the interview has taken place as the researcher can play the interviews back and pick up on information that may have been omitted.

The interviewer proceeded in a random order with the questions listed in the interview guidelines. The reason for the random as opposed to chronological order of questions arose out of the incidence when some responses overlapped into the subject matter addressed by other questions. Therefore, in order to maintain a logical but conversational progression of the answers, the interviewer followed through immediately with questions relevant to the original response. Each question from the interview guideline was discussed in-depth and the interviewer recorded notes before moving on to the next question.

4.2.6 Data Analysis

The data from the interviews was analysed with the main aim of reducing the information into interpretable sections of information and then using this information to develop the quantitative questionnaire for phase two of the research.

On the basis that phase one was conducted as a qualitative study, a content analysis technique was used to analyse the data. This is a common method used to analyse written, verbal or visual communications. This technique is also apposite to the research because it identifies common themes in the data in an effort to reduce the primary data and group them into constructs (Mouton, 2008).

4.3 Phase Two Research Method

Phase two consisted of a quantitative study that was conducted. Quantitative research is a systematic investigation of definite responses and can be used to make large decisions (Mouton, 2008). Quantitative data take the form of categorical data or numerical data. Categorical data are data that have been grouped in a descriptive set or ranked in a particular order. Numerical data involves the measuring of the data using numbers (Saunders & Lewis, 2012).

4.3.1 Population

As highlighted, the research was conducted in one large multi-national enterprise, SKF. Therefore the population of relevance was the same as highlighted for phase one.

4.3.2 Sample

As illustrated for phase one, a purposive sampling technique was also used for phase two (Marshall, 1996). Participants were identified using SKF's intranet system. Sampling was achieved by searching through the intranet and identifying managers with an engineering background. Once the participants were identified, an email was sent to them with a link to the questionnaire.

A total of 116 individuals from 31 different countries were used to collect the data. The sample comprised of the following:

- 38 middle managers with an engineering background;
- 29 senior managers with an engineering background;
- 22 executive managers with an engineering background;
- 27 human resource managers.

4.3.3 Unit of Analysis

The unit of analysis were the perceptions of the middle, senior, executive and human resource managers regarding the transition of engineers from technical positions to management.

4.3.4 Data Collection Tool

Two quantitative research questionnaires focusing on the research questions above were developed. A questionnaire was designed for middle, senior and executive managers with an engineering background, while a separate questionnaire was designed for human resource managers. Questionnaires were chosen because they can collect data from a large enough number of respondents and hence provide the researcher with sufficient valuable data and insights to answer the research questions (Mouton, 2008).

4.3.4.1 Questionnaire Design

Each questionnaire was made up of three sections. The first section was not part of the actual questionnaire but was an introductory section that formed part of the email that was sent to participants. The introductory section provided an introduction to the research study, and highlighted that participation was voluntary and that participants could withdraw at any time without penalty. In addition, the researcher and supervisor's details were provided.

The second section, which was the first part of the questionnaire, concentrated on determining the level of management and the demographics of the participants. Participants were required to provide information on their years of experience as a practising engineer or practising in the field of human resources, their age, the country that they currently work in and to state if they had any business qualifications.

The third section focused on research questions one and two, that is, the competencies required for engineers to make the transition from a technical

position to general management and the methodologies used to attain the identified competencies. A 1 – 5 Likert scale was used to rate the two questions.

The questionnaire for middle, senior and executive managers had an additional question at the end. Participants were required to rate the percentage of their work that was currently technically related and rate the percentage of their work that was currently general management related.

4.3.4.2 Identification of the Questionnaire Constructs

Phase one of the research phase was used to develop some of the constructs of the questionnaires for research questions one and two. The questionnaires were finalised once the analysis of the face-to-face interviews was completed via a content analysis technique. For research question one, nine high level competencies were identified from research phase one. The nine high level competencies were then further broken down into detailed competencies. Together with the competencies identified in research phase one and the literature review, 28 competencies were listed on the questionnaire. Table two below highlights the 28 competencies and its origins.

Table 2: 28 Competencies listed on questionnaire

Competencies	From Research Phase One	From the Literature Review
Interpersonal skill – managing people	X	
Leadership – communicate direction including a shared understanding of the direction	X	
Interpersonal skill – empowering employees so that they can discharge their responsibilities effectively		X
Leadership – influential, how to have influence over others	X	
Leadership – to make decisions ethically and understanding ethical responsibility		X
Interpersonal skill – honing on employees' abilities so that they can achieve their full potential		X
Business – determine priorities		X
Business – set direction including establishing a strategy		X
Interpersonal skill – delegation	X	
Interpersonal skill – working across cultures	X	
Business – assume responsibility for the survival and growth of the business		X
Interpersonal skill – considering the emotions of staff which contributes to building trust		X
Interpersonal skill – being able to have tough conversations	X	
Business – determining what constitutes customer value		X
Leadership – how to manage the way people perceive you		X
Interpersonal skill – public speaking	X	
Business – determine what goods and services customers desire, including the price they are willing to pay		X
Project management skills		X
Leadership – how to manage your reputation		X
Business – anticipate the business operating environment in the next five years		X
Economics – being able to understand the functional drivers of the business	X	
Economics – being able to understand the economic operating environment	X	
Finance skills – budgets, quotes, forecasting, etc.	X	
Sales – how to sell engineering products, different sales techniques, buying behaviour, etc.	X	
Business – business processes adopted by SKF	X	
Understanding marketing concepts – product positioning, advertising, promotions, etc.	X	
Business – business writing skills		X
Business – a knowledge of contemporary issues		X

For research question two, five broad methodologies were identified from research phase two. These methodologies were then further broken down into

specific methodologies. Together with the methodologies identified in research phase one and the literature review, 14 methodologies were listed on the questionnaire. Table three below highlights the 14 methodologies and their origins. Refer to Appendices B and C for the questionnaire for managers with an engineering background and the questionnaire for HR managers respectively.

Table 3: 14 Methodologies listed on questionnaire

Methodologies	From Research Phase One	From the Literature Review
Trial and error / Learning on the job	X	
Networking		X
Short business learning courses – certification programmes, diplomas, etc.	X	
Mentorship/coaching programmes	X	
Academic courses – a degree qualification	X	
Business literature	X	
Communities of practice		X
SKF management development programmes such as IMP and GLP	X	
Disciplined research	X	
Special assignments		X
Going for executive coaching		X
e-learning courses		X
Departmental exchange programmes		X
Social media – forums, blogs, groups such as LinkedIn and Google Groups		X

4.3.4.3 Questionnaire Pre-testing

The questionnaires' design phase was followed by a pilot test phase that tested the ability of the questionnaires to extract the data of interest. The pilot test phase was achieved by carrying out testing of both the questionnaires and technology with a group of six typical respondents that were chosen on a convenience basis.

Pre-testing allows the researcher to identify problems with the questionnaires design and instructions (Saunders & Lewis, 2012). During the pre-testing phase, ambiguities of certain questions were identified and were rephrased so

that questions had the same interpretation by all respondents. Questions such as “are you a middle manager” or “are you a senior manager” had to be rewritten as “do you have people reporting to you” and “do you have managers reporting to you.” Since there was no clear grading level across the different countries that the questionnaire was administered in, this method of determining the level of management of each participant proved to be unequivocal. The technology that was used to execute the questionnaires was also modified so that respondents could choose more than one option for certain questions like engineering qualifications. To ensure that the questionnaires were completed and that questions were not skipped, the technology was also modified to make every question compulsory. The respondents were not allowed to proceed to the next page of the questionnaire without completing every question on the current page.

4.3.5 Data Collection Method

The online web based tool ‘Surveymonkey’ was used to construct the questionnaires. This method was chosen because it provided the respondents anonymity and confidentiality. In addition, it allowed the researcher to reach a broader sample, including those respondents that were not based in South Africa.

4.3.6 Data Analysis

The questionnaires were developed such that a large portion of the responses received were in the form of categorical, ordinal (ranked) data (Saunders & Lewis, 2012). To verify consistency and omissions of the questionnaires, the data collected in phase two was initially subjected to a cleaning and editing process. A content analysis technique was used to analyse the open-ended questions. The categorical data was then put through a coding phase. Coding involved the allocation of a numerical number to the data which then enabled the researcher to transfer the data from survey to computer for analysis (Mouton, 2008).

Kruskal-Wallis testing was used to determine the differences or similarities of competencies and methodologies between middle, senior and executive managers. Kruskal-Wallis was used as the method of analysis because the data was non-parametric and consisted of more than two samples (Albright, Winston & Zappe, 2009). The main purpose of Kruskal-Wallis is to check whether the means of three or more samples are significantly different in statistics (Albright *et al.*, 2009). An alpha level of 0.05 was used for the analyses. The p-value for each competency and methodology was calculated. A p-value greater than 0.05 indicated that there were similarities across the three levels of management, whilst a p-value of less than 0.05 indicated that there were significant differences in the perceptions of the competency and methodology between the three levels of management. The Kruskal-Wallis testing method was therefore applicable to answer research questions three and five.

Mann-Whitney U testing was used to determine the differences or similarities of competencies and methodologies between engineering and HR managers. Mann-Whitney U testing was used as the method of analysis because the data was non-parametric and consisted of only two samples (Albright *et al.*, 2009). The main purpose of Mann-Whitney U is to check whether the means of two samples are significantly different in statistics (Albright *et al.*, 2009). An alpha level of 0.05 was used for the analyses. The p-value for each competency and methodology was calculated. A p-value greater than 0.05 indicated that there were similarities between the engineers' and HR managers' perceptions, whilst a p-value of less than 0.05 indicated that there were significant differences in the perceptions of the competency or methodology between engineers and HR managers. The Mann-Whitney U testing method was therefore applicable to answer research questions four and six.

4.4 Research Limitations

A major research limitation was that the research was conducted in one organisation, SKF, therefore the research cannot be necessarily generalised. Furthermore, the research was conducted based on engineers that had graduated with qualifications that had no management subjects as part of the curriculum for the qualification. The engineering curriculum was a limitation to the study, if the curriculum changes substantially to include general management courses, this will in turn have an impact on the validity of the study.

Chapter 5: Results

This chapter presents the results of the research study. The results of research phase one are presented, which are followed by the results of research phase two. Research phase one was used to develop the constructs for research phase two, whilst research phase two focused on answering the research questions.

5.1 Results for research phase one

Research phase one was a qualitative study that investigated the competencies required for engineers to transition from a technical position to general management and the methods that engineers used to develop these competencies. In addition, managers were asked to quote their percentage of work related to technical responsibilities and their percentage of work related to management, as well as the role of the employer in developing these competencies.

Phase one took the form of semi-structured in-depth interviews. The data obtained from phase one was used to develop the quantitative questionnaire for phase two of the research. A total of seven semi-structured in-depth interviews were conducted. Six of the interviews were done face-to-face whilst one of the interviews was done telephonically with an executive manager based in Brussels, Belgium. To allow for effective analysis, all of the interviews were voice recorded.

5.1.1 Competencies required for engineers to make the transition from a technical position to general management

The competencies can be defined into two broad groups, namely hard skills and soft skills. Hard skills can be viewed as those competencies that can be gained through the class room, i.e. formal education. These skills include

competencies such as finance and marketing skills. Soft skills can be viewed as those skills that cannot be taught to someone and include competencies such as interpersonal skills and people management.

From the interviews it was evident that a large portion of the sample, with the exception of the two middle managers that were interviewed, was in agreement that in order to make the transition a combination of certain hard skills and soft skills were necessary.

> *"Firstly you need basic understanding of business processes and business principals. Handling people is a continuous process and handling difficult people is one of the first things that a manger should learn how to do." – Executive Manager*

All seven individuals that were interviewed mentioned that interpersonal skills are competencies that engineers require. Interpersonal skills can be viewed as a broad topic that consists of a number of soft skills such as learning to manage different people, working across cultures and building trust amongst your employees.

> *"People skills is one of the most important skills that should be developed. It includes recruiting, dismissing and developing your people." – HR Manager*

> *"People can not be managed by using your engineering expertise and technical know how. People are complex and for me this was the hardest thing to understand." – Middle Manager*

Leadership was highlighted by one of the interviewees as the single most important competency that needed to be developed as an engineer. Leadership, as explained in the literature of chapter two, is imperative for a team of individuals to achieve their targets and goals. Leadership is focused on the well being of the team and hence overall business.

> *"The moment you move in to a management position, what's very important and stood out for me was leadership. How to lead people to achieve a common objective and making sure that your team is motivated." – Senior Manger*

Although SKF is a company that develops engineering products, the engineered product still needs to reach the market. The individuals interviewed were responsible for the proper functioning of the technical department as well as obtaining their sales target for the financial year. Hence engineers that make the transition to a management role of a technical department, especially at SKF, have to be able to sell the engineered product. Sales techniques were therefore a competency that many interviewees highlighted also needed to be developed.

> *"What is very important to SKF, is the sales skills. We are an engineering company but we are a sales company of engineering products. You need to get exposure to sales and sales management." – HR Manager*

> *"At SKF we have adopted the Miller Heiman sales philosophy. This sales process allows us to channel our opportunities constructively and hence get exposure to sales techniques." – Senior Manager*

In total, nine broad competency topics were identified during the in-depth interviews. Table four below lists these topics and the perceptions of middle, senior, executive and HR managers of the competencies required to make the transition from a technical position to a general management position.

Table 4: Perceptions of middle, senior, executive and HR managers of the competencies required to make the transition from a technical position to general management

Competency	EM1	EM2	SM1	SM2	MM1	MM2	HR1	Total
Finance (Budgets, quotes, forecasting etc.)	X	X	X	X			X	5
Marketing (Principals of marketing, positioning etc)	X	X	X					3
Sales (How to sell engineering items, different sales techniques)	X		X	X		X	X	6
Interpersonal Skills (Working and managing different people etc.)	X	X	X	X	X	X	X	7
Public Speaking			X					1
Business Processes adopted by SKF	X	X	X		X			4
Economics (Global trends, macro and micro principals etc.)	X			X				2
Leadership (Motivate people, getting a group of people to achieve their goals etc.)				X				1
Coordinate activities of different people.						X		1

Key:

EM1	Executive Manager 1
EM2	Executive Manager 2
SM1	Senior Manager 1
SM2	Senior Manager 2
MM1	Middle Manager 1
MM2	Middle Manager 2
HR1	HR Manager 1

One of the questions in the interview was what percentage of their work relates to management and what percentage relates to technical responsibilities. With the exception of one middle manager, all other managers responded that a greater or equal percentage of their work is dedicated to management responsibilities. Table five below illustrates the division of work for each manager.

Table 5: Percentage of work related to management and percentage of work related to technical responsibilities

	Percentage of work related to management	Percentage of work related technical responsibilities
EM1	95%	5%
EM2	70%	30%
SM1	60%	40%
SM2	90%	10%
MM1	10%	90%
MM2	50%	50%

From table five above, it is evident that as the manager moves from middle management up to senior and then executive management, their corresponding percentage of work related to management increases.

5.1.2 Learning and methodology practices that engineers undertake to acquire the general management competencies

Learning and methodology practices are the methods that are used by engineers to develop the competencies required to make the transition from a technical to a general management position. These methods consist of, amongst others, learning on the job and academic courses. From the interviews it was evident that a large portion of the sample, with the exception of one executive manager, was in agreement that short academic courses as well as formal academic courses was the method of developing general management competencies.

> *"Those engineers that have made the transition successfully have always acquired the skills through some academic business course." – HR Manager*

> *"I personally attended a management course that was tailored for technical people that have now become managers." – Middle Manager*

Whilst attending academic courses seemed to be the best way to develop general management competencies, the interviewees were in agreement that

if these competencies are not practised soon after being acquired, the skills and techniques will be lost. Hence the manager must make a conscious effort to implement the learnings from the academic courses once they return to the workplace. The individual must also be in a leadership position that will afford him or her an opportunity for implementation.

> *"It is all well to go and study an academic course, but if you fail to implement the learnings then most of the course becomes futile." – Middle Manager*

> *"A person that registers to do an MBA should be in a management or leadership position that allows the individual the opportunity to implement the learnings." – Senior Manager*

Learning on the job was the second most chosen methodology by the participants that were interviewed. Learning on the job illustrates that the participant did not attend any formal academic course or did not attend a formal academic course when they were given the positional responsibility. Their individual learnings and acquiring general management competencies came through trial and error, reflecting on their experiences and then generating and sharing new insights whilst simultaneously performing their job duties.

> *"I was given the position and was expected to run with it. There was no evaluation to determine if I had the competencies or not. I was expected to learn on the job." – Executive Manager*

In total, five methodologies were identified during the in-depth interviews. Table six below lists these methods that engineers undertake to develop general management competencies.

Table 6: Methodologies that engineers use to develop general management competencies

Methodology	EM1	EM2	SM1	SM2	MM1	MM2	HR1	Total
Disciplined research	X							1
Learning on the job / informal training				X	X			2
Conscious decision to change	X							1
Short academic course e.g. certification, diploma		X	X		X	X	X	5
Formal academic course e.g. MBA, Bachelors degree				X			X	2

All of the above information gathered from the interview phase was then combined with the literature to develop the quantitative questionnaire that was used for phase two of the research.

5.2 Results for research phase two

Research phase two was a quantitative study that investigated the following:

- What are the competencies required by engineers to make the transition from a technical position to general management?
- What learning and methodology practices do engineers undertake to acquire the competencies?
- Are there differences or not between middle, senior and executive managers on the competencies and methodologies they require to make the transition from a technical position to general management?
- Are there differences or not between engineers and HR practitioners on the competencies and methodologies that engineers require to make the transition from a technical position to general management?

This research phase was accomplished by collecting primary data through questionnaires. As described in chapter four, two questionnaires, one for HR managers and one for engineers, was administered. The data obtained from this research phase focused on gathering data to answer the research questions.

5.2.1 Sample description

With regards to the questionnaire for the engineers, 109 responses were received. The responses were reviewed and cleaned, and for reasons such as incomplete questionnaires and not meeting the research requirements, 20 responses were excluded from the study. Therefore the sample size for managers with an engineering background was 89. The 89 respondents comprised of middle, senior and executive managers and were received from six of the seven continents. In total, participants were from 31 different countries.

With regards to the HR manager's questionnaire, 30 responses were received. The responses were reviewed and cleaned, and for reasons such as incomplete questionnaires and change of job responsibilities, three responses were excluded from the study. Therefore the sample size for HR managers was 27 from 12 different countries. Table seven below depicts the composition of the sample and table eight depicts the continents and countries that the participants resided in.

Table 7: Composition of sample

Level of Management	Frequency	Percent
Middle Manager	38	42.7
Senior Manager	29	32.6
Executive Manager	22	24.7
Total	**89**	**100.0**
HR	**27**	**100.0**

Table 8: Continents and countries that participants resided in

Continents	Countries	Countries
Asia	China	Taiwan
	Philippines	Kazakhstan
	India	Vietnam
	Korea	Singapore
Africa	South Africa	
North America	Canada	United States of America
Europe	Sweden	Belgium
	Netherlands	Finland
	Czech Republic	Poland
	Croatia	United Kingdom
	Germany	Austria
	France	Russia
	Spain	Switzerland

	Italy	
Australia	Australia	
South America	Chile	Argentina
	Brazil	Venezuela

All levels of management had some sort of technical qualification, with the most common being a Bachelor in Engineering (BEng) or Bachelor of Science in Engineering (BScEng). Table nine below depicts the level of technical qualification that the managers had achieved. The mode for each level of management was highlighted to show the most popular response for the sample. The total for each technical qualification was calculated by assigning numerical values of the technical qualification categories to the Likert scale (McCall, 2001). The numerical values on the Likert scale were then summed to arrive at an overall score that represented the total number of managers that selected a particular category. The percentage total value was then calculated by dividing the overall score for each category by the sample size.

The survey also comprised of an open-ended question that was constructed with the aim of determining if managers with an engineering background had any business qualifications. The responses were analysed using a content analysis technique (Mouton, 2008) and recorded into eight categories listed in table ten below. Four of the respondents answered the question in an illogical way. In addition, 44 respondents did not answer the question and were therefore excluded from the analysis of the question.

Table 9: Technical qualification achieved by managers

Level of Managers	**Technical Qualification**						
	0	**1**	**2**	**3**	**4**	**5**	
	Other	Technical Qualification Diploma	BTech Eng	BEng / BScEng	MSc / MEng	PhD	Mode
Middle Manager	5.3%	7.9%	5.3%	39.5%	34.2%	7.9%	3
Senior Manager	3.4%	31.0%		31.0%	27.6%	6.9%	1 and 3
Executive Manager	4.5%	27.3%	4.5%	31.8%	22.7%	9.1%	3
Total	**4.5%**	**20.2%**	**3.4%**	**34.8%**	**29.2%**	**7.9%**	**3**

Table 10: Content analysis of business qualifications

Qualification	Frequency
MBA and other business management qualifications	19
None	6
Marketing	4
Sales training and experience	4
Operations / Production Management	4
Financial studies	2
Entrepreneur / Business owner	1
Environmental studies	1
Total	41

In order to determine the maturity of the sample, respondents were questioned on the number of years of experience they recorded practising engineering and HR. Table eleven below indicates years of experience practising engineering and HR. The mode for each level of management was highlighted to show the most popular response for the sample.

Table 11: Years of experience as a practising engineer and HR

Management	Years of experience as a practising engineer / HR				
	<= 1 year	>1 and <=5 years	>5 and <= 10 years	> 10 years	Mode
Middle Manager	0.0%	13.2%	36.8%	50.0%	> 10 years
Senior Manager	6.9%	17.2%	17.2%	58.6%	> 10 years
Executive Manager	4.5%	13.6%	13.6%	68.2%	> 10 years
Total Engineers	**3**	**13**	**22**	**51**	
HR	3.7%	0.0%	14.8%	81.5%	> 10 years
Total HR	**1**	**0**	**4**	**22**	

5.2.2 Percentage of work related to general management

Table 12 describes the percentage of work related to general management. As illustrated, the range of the percentage of work related to general management increases to 100% as an individual moves from a middle management position to an executive management position. On average, just above 70% of an executive manager's work is related to general management rather than technical engineering, therefore validating that the research is important.

Table 12: Percentage of work currently related to general management

Level of Management	General Management Related		
	Min-Max	Range	Mean
Middle Manager	15-85	70	49.47
Senior Manager	30-95	65	63.28
Executive Manager	30-100	70	70.45

5.2.3 Research question one: What general management competencies do engineers require to make the transition from a technical position to general management?

A total of 28 competencies were used in a structured survey questionnaire to gather data for research phase two from the three levels of engineering management. Table 13 below is a rank ordered table according to means of the competencies that engineers required to make the transition from a technical position to general management. Respondents were asked to rate the perceived importance of each competency that helped to make the transition from a technical position to general management using a five point Likert scale. The definitions of the five points on the Likert scale were as follows:

- 1 = Not important at all
- 2 = Some-what important
- 3 = Important
- 4 = Very important
- 5 = critically important.

The mean of each competency was calculated to show the most important competency perceived by engineers. In order to determine the mean of each competency, a weighted sum was calculated. If the items on the Likert scale are assigned numerical values, the numerical values of the items on the Likert scale can be summed to arrive at an overall score (McCall, 2001). Each mean was then calculated by multiplying the integer value allocated to the scale response by the percentage responses for that scale value and then summing the totals (McCall, 2001).

From the 28 competencies the most important competency, according to means, as chosen by middle, senior and executive managers with an engineering background is “Interpersonal skill – managing people,” and the least important competency is “Business – a knowledge of contemporary issues.” The above results will be further discussed in Chapter 6.

Table 13: Rank ordered competencies that engineers require to make the transition from a technical position to general management

Competencies	1 Not important at all	2 Some-what important	3 Important	4 Very important	5 Critically important	Mean
Interpersonal skill – managing people	0.0%	1.1%	4.5%	48.3%	46.1%	4.39
Leadership – communicate direction including a shared understanding of the direction	0.0%	0.0%	20.7%	48.3%	31.0%	4.10
Interpersonal skill – empowering employees so that they can discharge their responsibilities effectively	1.1%	2.2%	12.4%	58.4%	25.8%	4.06
Leadership – influential, how to have influence over others	0.0%	3.4%	12.4%	59.6%	24.7%	4.06
Leadership – to make decisions ethically and understanding ethical responsibility	2.3%	1.1%	23.9%	36.4%	36.4%	4.03
Interpersonal skill – honing on employees abilities so that they can achieve their full potential	0.0%	3.4%	14.6%	57.3%	24.7%	4.03
Business – determine priorities	0.0%	2.3%	21.6%	48.9%	27.3%	4.01
Business – set direction including establishing a strategy	1.1%	6.7%	12.4%	49.4%	30.3%	4.01
Interpersonal skill – delegation	0.0%	4.5%	16.9%	59.6%	19.1%	3.93
Interpersonal skill – working across cultures	2.2%	3.4%	19.1%	52.8%	22.5%	3.90
Business – assume responsibility for the survival and growth	1.1%	5.6%	21.3%	47.2%	24.7%	3.89

of the business						
Interpersonal skill – considering the emotions of staff which contributes to building trust	1.1%	5.7%	19.3%	52.3%	21.6%	3.88
Interpersonal skill – being able to have tough conversations	0.0%	4.5%	25.0%	52.3%	18.2%	3.84
Business – determining what constitutes customer value	2.3%	2.3%	30.7%	51.1%	13.6%	3.72
Leadership – how to manage the way people perceive you	2.2%	3.4%	31.5%	50.6%	12.4%	3.67
Interpersonal skill – public speaking	1.1%	5.7%	33.0%	52.3%	8.0%	3.60
Business – determine what goods and services customers desire, including the price they are willing to pay	3.4%	6.7%	33.7%	46.1%	10.1%	3.53
Project management skills	4.6%	10.3%	29.9%	40.2%	14.9%	3.51
Leadership – how to manage your reputation	5.7%	6.8%	37.5%	35.2%	14.8%	3.47
Business – anticipate the business operating environment in the next 5 years	2.2%	14.6%	29.2%	42.7%	11.2%	3.46
Economics – being able to understand the functional drivers of the business	1.1%	13.6%	38.6%	36.4%	10.2%	3.41
Economics – being able to understand the economic operating environment	2.3%	14.8%	40.9%	31.8%	10.2%	3.33
Finance skills – budgets, quotes, forecasting, etc.	4.5%	19.1%	29.2%	36.0%	11.2%	3.30
Sales – how to sell engineering products, different sales techniques, buying behaviour, etc.	5.6%	14.6%	37.1%	30.3%	12.4%	3.29
Business – business processes adopted by SKF	4.5%	8.0%	50.0%	34.1%	3.4%	3.24
Understanding marketing concepts – product positioning,	1.1%	20.2%	41.6%	29.2%	7.9%	3.22

advertising, promotions, etc.						
Business – business writing skills	2.2%	18.0%	43.8%	29.2%	6.7%	3.20
Business – a knowledge of contemporary issues	5.8%	15.1%	41.9%	32.6%	4.7%	3.15

5.2.4 Research question two: What learning and methodology practices do engineers undertake to acquire the identified general management competencies?

A total of 14 methodologies were used in a structured survey questionnaire to gather data for research phase two from the three levels of engineering management. Table 14 below is a rank ordered table according to means of the methodologies that engineers undertook to acquire general management competencies. Respondents were asked to rate the perceived importance of each methodology that helped to acquire general management competencies using a five point Likert scale. The definitions of the five points on the Likert scale were as follows:

- 1 = not used at all
- 2 = some-what used
- 3 = used
- 4 = used a great deal
- 5 = extensively used.

From the 14 methodologies, the most important methodology according to means as chosen by middle, senior and executive managers with an engineering background is “Trial and error / Learning on the job,” and the least important methodology is “Social media – forums, blogs, groups such as LinkedIn and Google Groups.”

Table 14: Rank ordered methodologies that engineers used to acquire general management competencies

Methodologies	1	2	3	4	5	
	Not used at all	Some-what used	Used	Used a great deal	Extensively used	Mean
Trial and error / Learning on the job	2.2%	9.0%	19.1%	46.1%	23.6%	3.80
Networking	1.1%	12.4%	32.6%	36.0%	18.0%	3.57
Short business learning courses – certification programmes, diplomas, etc.	8.0%	18.2%	37.5%	26.1%	10.2%	3.13
Mentorship/ coaching programmes	6.9%	23.0%	34.5%	24.1%	11.5%	3.10
Academic courses – a degree qualification	16.1%	20.7%	25.3%	28.7%	9.2%	2.94
Business literature	9.1%	29.5%	39.8%	17.0%	4.5%	2.78
Communities of practice	14.8%	27.3%	28.4%	25.0%	4.5%	2.77
SKF management development programmes such as IMP and GLP	24.7%	18.0%	29.2%	22.5%	5.6%	2.66
Disciplined research	15.9%	30.7%	31.8%	15.9%	5.7%	2.65
Special assignments	22.7%	30.7%	19.3%	21.6%	5.7%	2.57
Going for executive coaching	30.7%	20.5%	26.1%	20.5%	2.3%	2.43
e-learning courses	38.6%	31.8%	20.5%	8.0%	1.1%	2.01
Departmental exchange programmes	53.9%	25.8%	14.6%	4.5%	1.1%	1.73
Social media – forums, blogs, groups such as LinkedIn and Google Groups	59.6%	24.7%	12.4%	3.4%	0.0%	1.60

The survey also comprised of an open-ended question that was constructed with the aim of determining the techniques that assisted the most in

transitioning from an engineer to general management. The responses were analysed using a content analysis technique (Mouton, 2008) and recorded into 12 categories listed in table 15 below. All 88 respondents were allocated to one of the 12 categories. One respondent answered that it was “hard to say in a short survey” and was therefore excluded from the analysis. Academic studies was the technique that assisted the most and recorded the highest frequency. Benchmarking was a technique that was listed by one participant. The above results will be further discussed in Chapter 6.

Table 15: Content analysis of techniques that assisted the most

Categories	Frequency
Academic studies	17
Trial and error / Learning on the job	13
Leadership / Interpersonal skills	9
Coaching / Mentoring	8
Networking	8
Exposure to different departments and assignments	6
Analytical thinking	6
Having an overview of the situation / Being able to implement strategy	6
Effective communication	5
Desire and ambition	5
Being transparent and asking for help	4
Benchmarking	1
Total	**88**

5.2.5 Results for research question three:

Ho: The competencies that engineers require to make the transition from a technical position to general management are the same for middle, senior and executive engineers.

Ha: The competencies that engineers require to make the transition from a technical position to general management are different for middle, senior and executive engineers.

The results for this hypothesis were obtained by performing Kruskal-Wallis on 28 competencies between middle, senior and executive managers. Kruskal-Wallis was used as the method of analysis because the data was non-parametric and consisted of more than two samples (Albright *et al.*, 2009). An

alpha level of 0.05 was used for the analyses. The p-value for each competency was calculated. A p-value greater than 0.05 indicated that there were similarities across the three levels of management, whilst a p-value of less than 0.05 indicated that there were significant differences in the perception of the competency between the three levels of management. The table below indicates the p-values obtained from performing the Kruskal-Wallis testing method for non-parametric data.

Table 16: Testing for differences between the three levels of management on competencies

Competencies / Skills	Kruskal-Wallis Test (p-value)	Outcome
Interpersonal skill – managing people	0.110	Not
Leadership – communicate direction including a shared understanding of the direction	0.344	Not
Interpersonal skill – empowering employees so that they can discharge their responsibilities effectively	0.517	Not
Leadership – influential, how to have influence over others	0.059	Not
Leadership – to make decisions ethically and understanding ethical responsibility	0.202	Not
Interpersonal skill – honing on employees abilities so that they can achieve their full potential	0.374	Not
Business – determine priorities	0.359	Not
Business – set direction including establishing a strategy	0.554	Not
Interpersonal skill – delegation	0.698	Not
Interpersonal skill – working across cultures	0.046	Significant
Business – assume responsibility for the survival and growth of the business	0.241	Not
Interpersonal skill – considering the emotions of staff which contributes to building trust	0.440	Not
Interpersonal skill – being able to have tough conversations	0.369	Not
Business – determining what constitutes customer value	0.571	Not
Leadership – how to manage the way people perceive you	0.078	Not
Interpersonal skill – public speaking	0.696	Not
Business – determine what goods and services customers desire, including the price they are willing to pay	0.069	Not
Project management skills	0.811	Not
Leadership – how to manage your reputation	0.427	Not
Business – anticipate the business operating environment in the next five years	0.491	Not
Economics – being able to understand the functional drivers of the business	0.011	Significant
Economics – being able to understand the economic operating environment	0.597	Not
Finance skills – budgets, quotes, forecasting, etc.	0.006	Significant
Sales – how to sell engineering products, different sales	0.302	Not

techniques, buying behaviour, etc.		
Business – business processes adopted by SKF	0.147	Not
Understanding marketing concepts – product positioning, advertising, promotions, etc.	0.013	Significant
Business – business writing skills	0.353	Not
Business – a knowledge of contemporary issues	0.808	Not

From table 16 above, the major finding is that there are mostly consistencies between the three levels of management. From the 28 competencies, 24 of them, with p-values greater than 0.05, were perceived the same by all three levels of management. The two highest of the competencies that were perceived the same were “Project management skills” and “Business – a knowledge of contemporary issues,” with p-values of 0.811 and 0.808 respectively.

However, there were four significant differences with p-values of less than 0.05. The most significantly different competency perceived by the three levels of management was “Finance skills – budgets, quotes, forecasting, etc,” with a p-value of 0.006. Table 17 below indicates that there were significant differences between the mean values across the three levels of management for this particular competency. The second most significantly different perceived competency was “Economics – being able to understand the functional drivers of the business” with a p-value of 0.011. The above results will be further discussed in Chapter 6.

Table 17: p-values and mean scores of significantly different outcomes

Competencies / Skills	p-value	Level of Management (Mean)		
		Middle	Senior	Executive
Interpersonal skill – working across cultures	0.046	3.920	3.690	4.140
Economics – being able to understand the functional drivers of the business	0.011	3.110	3.660	3.590
Finance skills – budgets, quotes, forecasting, etc.	0.006	2.950	3.380	3.820
Understanding marketing concepts – product positioning, advertising, promotions, etc.	0.013	2.970	3.620	3.140

5.2.6 Results for research question four:

Ho: The perceptions of engineers and HR managers of the competencies that engineers require to make the transition from a technical position to general management are the same.

Ha: The perceptions of engineers and HR managers of the competencies that engineers require to make the transition from a technical position to general management are different.

The results for this hypothesis were obtained by performing Mann-Whitney U tests on 28 competencies between engineers, who were combined into one sample, and HR managers. Mann-Whitney U testing was used because the data was non-parametric and consisted of only two samples (Albright *et al.*, 2009). Engineers were combined to form one sample because there were only four significant differences between the three levels of management. (Refer to table 17 above to review the significant differences and their corresponding p-values.)

An alpha level of 0.05 was used for the analyses. The p-value for each competency was calculated. A p-value greater than 0.05 indicated that there were similarities between engineers and HR managers' perceptions, whilst a p-value of less than 0.05 indicated that there were significant differences between the perceptions of engineers and HR managers of the competency required to make the transition from a technical position to general management. The table below indicates the p-values obtained from performing the Mann-Whitney U testing method for non-parametric data.

Table 18: Testing for differences between perceptions of engineers and HR managers on competencies

Competencies / Skills	Mann-Whitney U (p-value)	Outcome
Interpersonal skill – managing people	0.003	Significant
Leadership – communicate direction including a shared understanding of the direction	0.087	Not
Interpersonal skill – empowering employees so that they can discharge their responsibilities effectively	0.027	Significant
Leadership – influential, how to have influence over others	0.072	Not
Leadership – to make decisions ethically and understanding ethical responsibility	0.002	Significant
Interpersonal skill – honing on employees abilities so that they can achieve their full potential	0.115	Not
Business – determine priorities	0.141	Not
Business – set direction including establishing a strategy	0.983	Not
Interpersonal skill – delegation	0.451	Not
Interpersonal skill – working across cultures	0.095	Not
Business – assume responsibility for the survival and growth of the business	0.011	Significant
Interpersonal skill – considering the emotions of staff which contributes to building trust	0.907	Not
Interpersonal skill – being able to have tough conversations	0.272	Not
Business – determining what constitutes customer value	0.033	Significant
Leadership – how to manage the way people perceive you	0.642	Not
Interpersonal skill – public speaking	0.482	Not
Business – determine what goods and services customers desire, including the price they are willing to pay	0.355	Not
Project management skills	0.877	Not
Leadership – how to manage your reputation	0.656	Not
Business – anticipate the business operating environment in the next five years	0.067	Not
Economics – being able to understand the functional drivers of the business	0.006	Significant
Economics – being able to understand the economic operating environment	0.122	Not
Finance skills – budgets, quotes, forecasting, etc.	0.811	Not
Sales – how to sell engineering products, different sales techniques, buying behaviour, etc.	0.494	Not
Business – business processes adopted by SKF	0.008	Significant
Understanding marketing concepts – product positioning, advertising, promotions, etc.	0.780	Not
Business – business writing skills	0.279	Not
Business – a knowledge of contemporary issues	0.854	Not

Out of the 28 variables analysed across the two samples, only seven of the competencies indicated a significant difference with p-values less than 0.05. This indicates that there is a great deal of consistency between the perceptions of engineers and HR managers on the competencies required for engineers to make the transition to general management. The two highest of

the competencies that were perceived the same were “Business – set direction including establishing a strategy” and “Interpersonal skill – considering the emotions of staff which contributes to building trust,” with p-values of 0.983 and 0.907 respectively. It is also important to note that the third and fourth highest competencies, which were perceived the same, were “Project management skills” and “Business – a knowledge of contemporary issues,” with p-values of 0.877 and 0.854 respectively. These competencies were ranked as the first and second highest perceived competencies between the three levels of management as described in table 16.

There were seven significant differences with p-values of less than 0.05. The most significantly different perceived competency being “Leadership – to make decisions ethically and understanding ethical responsibility,” with a p-value of 0.002. Table 19 below indicates that there were significant differences between the mean values of engineers and HR managers. The second most significantly different perceived competency was “Interpersonal skill – managing people” with a p-value of 0.003. The above results will be further discussed in Chapter 6.

Table 19: p-values and mean scores of significantly different outcomes

Competencies / Skills	p-value	Mean	
		Engineering	HR
Interpersonal skill – managing people	0.003	4.39	4.78
Leadership – to make decisions ethically and understanding ethical responsibility	0.002	4.03	4.63
Interpersonal skill – empowering employees so that they can discharge their responsibilities effectively	0.027	4.06	4.41
Business – assume responsibility for the survival and growth of the business	0.011	3.89	4.37
Business – determining what constitutes customer value	0.033	3.72	4.11
Economics – being able to understand the functional drivers of the business	0.006	3.41	3.93
Business – business processes adopted by SKF	0.008	3.24	3.74

5.2.7 Results for research question five:

Ho: The learning and methodology practices that engineers undertake to acquire general management competencies are the same for middle, senior and executive engineers.

Ha: The learning and methodology practices that engineers undertake to acquire general management competencies are different for middle, senior and executive engineers.

The results for this hypothesis were obtained by performing Kruskal-Wallis on 14 methodologies between middle, senior and executive managers. Kruskal-Wallis was used as the method of analysis because the data was non-parametric and consisted of more than two samples (Albright, Winston & Zappe, 2009). An alpha level of 0.05 was used for the analyses. The p-value for each methodology was calculated. A p-value greater than 0.05 indicated that there were similarities across the three levels of management, whilst a p-value of less than 0.05 indicated that there were significant differences in the perception of the methodology between the three levels of management. The table below indicates the p-values obtained from performing the Kruskal-Wallis testing method for non-parametric data.

Table 20: Testing for differences between the three levels of management on learning methodologies

Methodologies	Kruskal Wallis Test (p-value)	Outcome
Trial and error / Learning on the job	0.139	Not
Networking	0.487	Not
Short business learning courses – certification programmes, diplomas, etc.	0.350	Not
Mentorship/coaching programmes	0.538	Not
Academic courses – a degree qualification	0.044	Significant
Business literature	0.223	Not
Communities of practice	0.405	Not
SKF management development programmes such as IMP and GLP	0.002	Significant
Disciplined research	0.117	Not
Special assignments	0.560	Not
Going for executive coaching	0.887	Not
e-learning courses	0.249	Not
Departmental exchange programmes	0.442	Not
Social media – forums, blogs, groups such as LinkedIn	0.111	Not

and Google Groups		

From table 20 above, the major finding is that there are mostly consistencies between the three levels of management. From the 14 methodologies, 12 of the methodologies, with p-values greater than 0.05, were perceived the same by all three levels of management. The highest of the methodologies that were perceived the same was “Going for executive coaching” with a p-value of 0.887.

However, there were two significant differences with p-values of less than 0.05. The most significantly different competency perceived by the three levels of management was “SKF management development programmes such as IMP and GLP,” with a p-value of 0.002. Table 21 below indicates that there were significant differences between the mean values across the three levels of management for this particular methodology. The above results will be further discussed in Chapter 6.

Table 21: p-values and mean scores of significantly different outcomes

Methodologies	p-value	Level of Management (Mean)		
		Middle	Senior	Executive
Academic courses – a degree qualification	0.044	2.570	3.280	3.140
SKF management development programmes such as IMP and GLP	0.002	2.130	3.140	2.950

5.2.8 Results for research question six:

Ho: The perceptions of engineers and HR managers of the learning and methodology practices that engineers undertake to acquire general management competencies are the same.

Ha: The perceptions of engineers and HR managers of the learning and methodology practices that engineers undertake to acquire general management competencies are different.

The results for this hypothesis were obtained by performing Mann-Whitney U tests on 14 methodologies between engineers, who were combined into one

sample, and HR managers. Mann-Whitney U testing was used because the data was non-parametric and consisted of only two samples (Albright *et al.*, 2009). Engineers were combined to form one sample because there were only two significant differences between the three levels of management. (Refer to table 21 above to review the significant differences and their corresponding p-values.)

An alpha level of 0.05 was used for the analyses. The p-value for each methodology was calculated. A p-value greater than 0.05 indicated that there were similarities between engineers and HR managers perceptions whilst, a p-value of less than 0.05 indicated that there were significant differences between the perceptions of engineers and HR managers of the methodology that engineers undertake to acquire general management competencies. The table below indicates the p-values obtained from performing the Mann-Whitney U testing method for non-parametric data.

Table 22: Testing for differences between perceptions of engineers and HR managers on learning methodologies

Methodologies	Mann-Whitney U (p-value)	Outcome
Trial and error / Learning on the job	0.105	Not
Networking	0.038	Significant
Short business learning courses – certification programmes, diplomas, etc.	0.105	Not
Mentorship/coaching programmes	0.003	Significant
Academic courses – a degree qualification	0.642	Not
Business literature	0.760	Not
Communities of practice	0.002	Significant
SKF management development programmes such as IMP and GLP	0.042	Significant
Disciplined research	0.721	Not
Special assignments	0.000	Significant
Going for executive coaching	0.003	Significant
e-learning courses	0.025	Significant
Departmental exchange programmes	0.000	Significant
Social media – forums, blogs, groups such as LinkedIn and Google Groups	0.000	Significant

Out of the 14 variables analysed across the two samples, nine of the methodologies indicated a significant difference with p-values less than 0.05. This indicates that there are a great number of discrepancies between the

perceptions of engineers and HR managers on the methodologies that engineers undertake to acquire general management competencies. The highest methodology that was perceived the same was “Business literature” with a p-value of 0.760.

There were nine significant differences with p-values of less than 0.05. Table 23 below indicates that there were significant differences between the mean values of engineers and HR managers. The above results will be further discussed in Chapter 6.

Table 23: p-values and mean scores of significantly different outcomes

Methodologies	p-value	Mean	
		Engineering	HR
Mentorship/coaching programmes	0.003	3.10	3.85
Going for executive coaching	0.003	2.43	3.26
SKF management development programmes such as IMP and GLP	0.042	2.66	3.19
Networking	0.038	3.57	4.00
Communities of practice	0.002	2.77	3.56
e-learning courses	0.025	2.01	2.41
Social media – forums, blogs, groups such as LinkedIn and Google Groups	0.000	1.60	2.48
Special assignments	0.000	2.57	3.59
Departmental exchange programmes	0.000	1.73	3.26

Chapter 6: Discussion of Results

This chapter discusses and interprets the results distilled from the data in chapter five in more detail. A total of 116 respondents from 31 different countries participated in the research. The main aim of this chapter is to answer the research questions defined in chapter three and thus close the academic circle. The sections below detail the findings of the study by also drawing a connection to the literature review that was done in chapter two, thus highlighting the relationship between the findings of the research and the literature review.

As highlighted in chapter five above, table 12 depicts that the percentage of work related to general management increases as an engineer moves from a middle management to an executive management position. Even at the lowest level of management, on average almost 50% of work is related to general management. The result from the survey thus validates the importance of the study and reinforces the research topic.

6.1 Research Question One: What general management competencies do engineers require to make the transition from a technical position to general management?

The research question predominantly focused on determining the key competencies that engineers require to make the transition from a technical position to that of general management. Table 13 of chapter five, depicts a rank ordered list according to means of every competency. Each competency scored a mean of a minimum of 3.15. Table 13 thus highlights that each competency, according to the Likert scale used for the research, was viewed as important. However it is vital to note that some competencies were relatively more important than others. This verifies the sentiments of Petroni (2000b) that there are significant competency gaps that an engineer has to fill in order to make the transition to general management effectively. Farr and Brazil (2009) also suggested that engineers are naïve about the amount of

management competencies that are needed to be a successful leader. In addition, Brousseau *et al.* (1996) highlighted that employees must be equipped with a diverse set of skills and knowledge that can be used to achieve a company's goals and objectives efficiently. Therefore engineers cannot solely rely on their technical abilities when promoted to a management or leadership position. It is also imperative that they develop a wide range of additional and complementary business skills. These business skills need to ideally constitute of a combination of hard and soft skill competencies.

6.1.1 Top Ten Competencies

As depicted from the 28 competencies listed in table 13, it is noted that the top six competencies belong to interpersonal and leadership skills, with the most important competency being "Interpersonal skill – managing people." During phase one of the research project it was noted that many of the respondents highlighted managing people as something that is learnt over a period of time and can not be taught in a classroom or from a textbook. Therefore it is not surprising that the competency "Interpersonal skill – managing people," ranked as the most important competency. Table 24 below lists the top ten competencies as chosen by middle, senior and executive managers grouped into the three categories of interpersonal, leadership and business skills.

The rating of interpersonal and leadership skills as the top six competencies is in accordance with the research done by Molen *et al.* (2007) on a group of engineers with different levels of management, as well as Balaji and Somashekar (2009). Molen *et al.* (2007) noted that engineers should pay a lot more attention to interpersonal competencies which are vital when in a management role. Interpersonal competencies inevitably help the engineer to build their emotional intelligence. Balaji and Somashekar (2009) suggested that soft skills are critical for engineers specifically in the global environment as those engineers that possess the appropriate competencies will be able to withstand organisational retrenchments and downsizing.

Table 24: Top ten competencies as chosen by middle, senior and executive managers with an engineering background

Categories	Competencies	Mean	Rank
Interpersonal Skills	Interpersonal skill – managing people	4.39	1
	Interpersonal skill – empowering employees so that they can discharge their responsibilities effectively	4.06	3
	Interpersonal skill – honing on employees abilities so that they can achieve their full potential	4.03	6
	Interpersonal skill – delegation	3.93	9
	Interpersonal skill – working across cultures	3.90	10
Leadership Skills	Leadership – communicate direction including a shared understanding of the direction	4.10	2
	Leadership – influential, how to have influence over others	4.06	4
	Leadership – to make decisions ethically and understanding ethical responsibility	4.03	5
Business Skills	Business – determine priorities	4.01	7
	Business – set direction including establishing a strategy	4.01	8

Leadership, as depicted by Bowman and Farr (2000), is a key element in satisfying the needs for the engineering profession. These sentiments are illustrated in table 24 above, whereby leadership occurs three times within the top six competencies. The theory of leadership was also reinforced by the sentiments of a senior manager who was interviewed in phase one of the research, who stated the following:

> *"The moment you move into a management position, what's very important and stood out for me was leadership. How to lead people to achieve a common objective and making sure that your team is motivated." – Senior Manager*

In table 24 above, the two business skills that ranked in the top ten competencies can be interpreted as business leadership skills. The two business skills of setting direction and determining priorities are not hard skills

and can not be gained through some academic course. Therefore, the two business skills can be viewed as being very closely related to leadership.

The consensus between the findings of table 13, Molen *et al.* (2007) and Balaji and Somashekar (2009) portray that engineers, irrespective of years of experience, should take into account the career advancing importance of soft skills which comprises both leadership and interpersonal skills and rank within the top six competencies as depicted in table 24.

6.1.2 Bottom Ten Competencies

The bottom ten competencies are grouped together and highlighted in table 25 below. The table illustrates that the least important skill, with a mean of 3.15, is “Business – a knowledge of contemporary issues.” However, on evaluating the bottom ten competencies, it is apparent that nine of the ten competencies are focused on hard skills. As per Crosbie (2005), hard skills are made up of the technical competencies that an individual possess. These are the skills that can be easily developed through some sort of academic course via a tertiary institute. Crosbie (2005) further highlighted that soft skills are intangible and are much harder to learn and develop. In line with the thinking of Crosbie (2005), it is therefore no surprise that engineers chose soft skills as the majority of the top ten competencies that they need to develop to transition from a technical to a general management position.

What is important to note is that although the bottom ten ranked competencies are focused on hard skills, all the competencies scored a mean value above three, which indicates that hard skills are important. This is in line with the thinking of Farr and Brazil (2009) who suggested that in order for an engineer to make the transition from a technical position to general management, a combination of both hard and soft skills are required.

Table 25: Bottom ten competencies as chosen by middle, senior and executive managers with an engineering background

Categories	Competencies	Mean	Rank
Leadership	Leadership – how to manage your reputation	3.47	19
Economics	Economics – being able to understand the functional drivers of the business	3.41	21
	Economics – being able to understand the economic operating environment	3.33	22
Marketing	Understanding marketing concepts – product positioning, advertising, promotions, etc.	3.22	26
Sales and Finance	Sales – how to sell engineering products, different sales techniques, buying behaviour, etc.	3.29	24
	Finance skills – budgets, quotes, forecasting, etc.	3.30	23
Business Skills	Business – business writing skills	3.20	27
	Business – a knowledge of contemporary issues	3.15	28
	Business – anticipate the business operating environment in the next five years	3.46	20
	Business – business processes adopted by SKF	3.24	25

6.1.3 Conclusion to Research Question One

The results of the research indicate that a wide range of skills needs to be developed for engineers to effectively transition to general management. Of the 28 competencies, soft skills have proved to be the most important, as depicted in table 24 above. Soft skill competencies will assist engineers to develop their emotional intelligence and will inevitably assist engineers in being better more efficient managers.

6.2 Research Question Two: What learning and methodology practices do engineers undertake to acquire the identified general management competencies?

Research question two focused on determining the key learning methodologies that engineers undertake to make the transition from a

technical position to general management. Table 14 of chapter five is a rank ordered list according to the means of the methodologies that engineers used to acquire general management competencies. Table 14 thus highlights that only the top four methodologies scored a mean higher than three and were rated as used, whilst the remaining ten methodologies were rated as somewhat used or not used at all. The results listed in table 14 depict that there is no dominant methodology that engineers use. This reinforces the thinking of McGurk (2010), who is of the opinion that investments in management and leadership development plans by organisations are therefore imperative for effective organisational performance. This will provide a dominant methodology that engineers will use to acquire general management competencies and verifies the view of Wright and Belcourt (1994), that management and leadership development can be viewed as the anchors of a triumphant career. Crosbie (2005) further identified the four stages of learning that organisations need to take note of when developing management and leadership development plans for either soft or hard skills.

6.2.1 Top five methodologies grouped into four

The top five methodologies were grouped into four categories. Table 26 below lists the top five methodologies as chosen by middle, senior and executive managers with an engineering background. The survey also comprised of an open-ended question that was constructed with the aim of determining the techniques that assisted the most in transitioning from an engineer to general management. Table 15 of chapter five is a content analysis of the techniques that assisted the most.

Table 26: Top five methodologies as chosen by middle, senior and executive managers with an engineering background

Methodologies		Mean	Rank
Trial and error / Learning on the job		3.80	1
Networking		3.57	2
Academic studies	Short business learning courses – certification programmes, diplomas, etc.	3.13	3
	Academic courses – a degree qualification	2.94	5
Mentorship / Coaching programmes		3.10	4

6.2.1.1 Trial and error / Learning on the job

"Trial and error / Learning on the job" was ranked one on table 14 and was ranked two on table 15. Trial and error is a common method of learning, however it was surprising that it was ranked the highest. Based on this ranking it is clear that people learn more effectively by doing, and more importantly, by analysing the error. Practice is a key enabler that makes trial and error an effective methodology. This result is in line with the research done by Homer (2001), who concluded that engineers have no formal methodology in developing competencies.

6.2.1.2 Networking

"Networking" was ranked two on table 14 and was ranked five on table 15. Nienaber (2010) described networking as a socioeconomic activity that brings individuals together in the hopes of creating sustainable business relationships. Networking supports the theory of trial and error and it is therefore not surprising that it ranked second.

6.2.1.3 Academic studies

Academic studies ranked three and five of the top five methodologies, whereas in table 15 it ranked number one as the technique that assisted the most in acquiring general management competencies. This is the only structured methodology that engineers listed as used and somewhat used to

acquire general management competencies. The theory of academic studies being an effective methodology was also reinforced by the sentiments of a HR manager who was interviewed in phase one of the research, who stated the following:

> *"Those engineers that have made the transition successfully have always acquired the skills through some academic business course." – HR Manager*

Based on the ranking of academic studies, it can be highlighted that academic studies are not the most fundamental method of learning, however the sentiments of the HR manager suggest that it underpins an individual's potential to absorb information. Academic graduates generally have the ability to absorb and comprehend information at a prolonged rate. Their learning potential has longevity and therefore those individuals that have formal qualifications are able to transition successfully through academic business courses.

6.2.1.4 Mentoring and coaching

"Mentoring and coaching" was ranked four on both tables 14 and 15. Wright and Belcourt (1994) highlighted that mentoring and coaching can release large amounts of management and leadership skills through the process of constructive feedback. The actual mentoring and coaching process must be specific and linked to a well-understood career plan (Wright & Belcourt, 1994). The findings regarding mentoring and coaching show that they are unlike the previous three methodologies which are based on knowing what you don't know, in other words the consciously incompetent stage of Maslow's theory (Crosbie, 2005). Mentoring and coaching is based on not knowing what you don't know, that is the unconsciously incompetent stage of Maslow's theory (Crosbie, 2005). As soon as the mentor or coach informs the individual of the competencies that need to be developed, the individual moves from an unconsciously incompetent stage to a consciously incompetent stage and

commences to search for methods to gain these competencies - through trial and error, networking or academic studies.

6.2.2 Conclusion to Research Question Two

The results show that engineers do not acquire competencies through a single particular dominant methodology, because all the methodologies scored a mean of less than four. However the findings from table 26, illustrate that there are a large number of engineers that acquire their skills through formal academic studies and learning on the job / trial and error. As per table 15 formal academic studies appear to be the technique that assisted engineers the most in acquiring general management competencies. For those engineers who acquire their skills through trial and error / learning on the job and any other methodology listed in table 14, it is imperative that organisations develop structured management development plans, which will assist engineers through a formal learning process similar to academic studies, and as per the learning process highlighted by Crosbie (2005), to acquire a wide range of soft and hard skills.

6.3 Research Question Three

Research question three takes the form of hypothesis testing as follows:

Ho: The competencies that engineers require to make the transition from a technical position to general management are the same for middle, senior and executive engineers.

Ha: The competencies that engineers require to make the transition from a technical position to general management are different for middle, senior and executive engineers.

6.3.1 Discussion of the differences and/or similarities of competencies required to make the transition from a technical position to general management across the three levels of engineering managers (middle, senior and executive).

This section discusses the findings on the differences and/or similarities of competencies required to make the transition to general management across the three levels of management, with a link to the literature review. Out of the 28 competencies that were analysed across the three levels, 24 of the competencies were perceived the same. The finding is that no matter what level of management an engineer aspires to, all levels of engineers have to develop the same competencies and there are no real differences. This result verifies the study done by Brousseau *et al.* (1996), who suggested that employees must be equipped with a diverse set of skills and knowledge that can be used to achieve the company's goals and objectives. Employees need to be more flexible and must be willing to take on assignments that are outside their job descriptions and hence develop a broad range of competencies (Brousseau *et al.*, 1996).

The four significant differences with p-values of less than 0.05 are listed in table 17. According to means, table 17 illustrates that executives find working across cultures very important. A possible reason for this view is that the higher the management level reached by the engineer, the more prone he/she is to working across different cultures.

Table 17 also shows that three of the four significantly different perceived competencies were hard skills, being economics, finance and marketing skills. A closer evaluation of table 17 reveals that the means of the middle managers are different when compared to the means of both the senior and executive managers for the same competencies. It can thus be concluded that middle managers find these competencies to be of very little importance because they are still more involved with the technical side of the business, as is depicted in table 12.

6.3.2 Summary of differences and similarities of competencies across the three levels of management

A 95% significance level was used for the analysis. Out of the 28 competencies that were used for the research, 24 accepted the null hypotheses (**Ho**) and four competencies accepted the alternate hypothesis (**Ha**). Based on the results obtained above, the null hypothesis (**Ho**) is accepted. This implies that there is a great deal of consistency in the perceptions of competencies between the three levels of management.

6.4 Research Question Four

Research question four takes the form of hypothesis testing as follows:

Ho: The perceptions of engineers and HR managers of the competencies that engineers require to make the transition from a technical position to general management are the same.

Ha: The perceptions of engineers and HR managers of the competencies that engineers require to make the transition from a technical position to general management are different.

6.4.1 Discussion of the differences and/or similarities of the perceptions of engineers and HR managers of the competencies that engineers require to make the transition from a technical position to general management.

This section discusses the findings on the differences and/or similarities of the perceptions of HR managers and engineers of the competencies required to make the transition to general management. Based on the conclusion of research question three, 24 out of 28 competencies were perceived the same throughout the different levels of management. Consequently, the three levels of management were combined to form one sample.

Out of the 28 competencies that were analysed between HR managers and engineers, 21 of the competencies, with p-values greater than 0.05, were

perceived the same. The findings are that the perceptions of HR managers are in line with the perceptions of engineers regarding the competencies that need to be developed to transition to general management, and there are no real differences between the perceptions of engineers and HR managers. The findings depict that interpersonal skills are the most important. Table 18 depicts that the competency of "Interpersonal skill – considering the emotion of staff which contributes to building trust," as one of the highest competencies that was perceived the same, is in line with the research done by Weber *et al.* (2012). Weber *et al.* (2012) conducted a study which involved human resource professionals rating the importance of soft skills competencies found in literature. The results of the study suggested that of the 116 soft skill competencies that were assessed by human resource professionals, the majority of them were deemed important. It is therefore no surprise that HR managers also perceive soft skills as the most important competencies for engineers to make the transition to general management effectively. Sahni (2011) further highlighted the importance of soft skills as, amongst others, being able to communicate effectively and facilitating interpersonal relations.

The seven significant differences with p-values of less than 0.05 are listed in table 19. According to means, table 19 illustrates that HR managers place more emphasis on developing competencies to transition to general management. However, more emphasis is placed on developing soft skills competencies, such as interpersonal and leadership skills.

6.4.2 Summary of differences and similarities of the perceptions of engineers and HR managers of the competencies that engineers require to make the transition to general management.

A 95% significance level was used for the analysis. Out of the 28 competencies that were used for the research, 21 competencies accepted the null hypotheses (**Ho**) and seven competencies accepted the alternate hypothesis (**Ha**). Based on the results obtained above, the null hypothesis

(**Ho**) is accepted. This implies that there is a great deal of consistency in the perceptions of competencies between engineers and HR managers.

6.5 Research Question Five

Research question five takes the form of hypothesis testing as follows:

Ho: The learning and methodology practices that engineers undertake to acquire general management competencies are the same for middle, senior and executive engineers.

Ha: The learning and methodology practices that engineers undertake to acquire general management competencies are different for middle, senior and executive engineers.

6.5.1 Discussion of the differences and/or similarities of learning methodologies adopted by engineers across the three levels of engineering managers (middle, senior and executive).

This section discusses the findings on the differences and/or similarities of methodologies adopted to acquire general management competencies across the three levels of management with a link to the literature review. Out of the 14 methodologies that were analysed across the three levels, 12 of the methodologies, with p-values greater than 0.05, were perceived the same. The results conclude that no matter what learning method is chosen to develop general management competencies, all methodologies are important and there is no real differences between the three levels of management.

Taking into consideration table 14 rank ordered methodologies, it can be concluded that “Going for executive coaching,” with a mean of 2.43, was mostly perceived the same by all three levels of management as somewhat used. This is in accordance with the studies conducted by Petroni (2000b). Petroni (2000b) suggested that in order for engineers to make an effective transition to management, it is necessary that they receive special attention, irrespective of the usual control and management practices. This is therefore the reason that “Going for executive coaching” was ranked 11th, whereas “Mentorship / coaching programmes,” which offer the engineer much more

personal attention, was ranked fourth out of the 14 methodologies. (Refer to table 14 for rank ordered methodologies.) The need for particular attention as described by Petroni (2000b) is based on two central theories. The first is that it is extremely difficult to retain engineers in the organisation and secondly it is problematic for engineers to make the transition into management (Petroni, 2000b).

The two significant differences with p-values of less than 0.05 are listed in table 21. According to means, table 21 depicts that senior and executive managers find the organisations' management development programmes more important than middle managers. A possible reasoning for this view is that it is only senior and executive managers who are rewarded the opportunity to be part of these organisation's management development programmes.

A closer evaluation of table 21 reveals that the means of the middle managers are different when compared to the means of both senior and executive managers for the same methodologies. It can thus be concluded that as an individual moves from a middle management to a senior and then an executive management position, academic studies in the form of a degree qualification and SKF management development programmes become more important. The result therefore highlights that senior and executive levels of management prefer structured programmes to acquire general management competencies. This is in line with the research conducted by Homer (2001), who suggested that skills management should be encouraged by organisations and should be implemented through a structured development and leadership programme.

6.5.2 Summary of differences and similarities of methodologies across the three levels of management

A 95% significance level was used for the analysis. Out of the 14 methodologies that were used for the research, 12 methodologies accepted

the null hypotheses (**Ho**) and two methodologies accepted the alternate hypothesis (**Ha**). Based on the results obtained above, the null hypothesis (**Ho**) is accepted. This implies that there is a great deal of consistency in the perceptions of learning methods between the three levels of management.

6.6 Research Question Six

Research question six takes the form of hypothesis testing as follows:

Ho: The perceptions of engineers and HR managers of the learning and methodology practices that engineers undertake to acquire general management competencies are the same.

Ha: The perceptions of engineers and HR managers of the learning and methodology practices that engineers undertake to acquire general management competencies are different.

6.6.1 Discussion of the differences and/or similarities of the perceptions of engineers and HR managers of the methodologies that engineers undertake to acquire general management competencies

This section discusses the findings on the differences and/or similarities of the perceptions of HR managers and engineers of the methodologies used to acquire general management competencies. Based on the conclusion of research question five, 12 out of the 14 methodologies were perceived the same throughout the different levels of management. Consequently, the three levels of management were combined to form one sample.

Out of the 14 methodologies that were analysed between HR managers and engineers, five of the methodologies, with p-values greater than 0.05, were perceived the same. The findings are that there are significant discrepancies between the perceptions of engineers and HR managers on the methodologies used to acquire general management competencies.

Table 22 depicts that the top three methodologies that were perceived the same were “Business literature, Disciplined research and Academic courses.” This implies that both HR managers and engineers perceive these

methodologies as being effective for acquiring general management competencies. A closer evaluation of the three methodologies suggests that the methodologies require a structured approach by the engineer, whereby the engineer is almost creating his/her own management development programmes. This is in line with the research undertaken by Simpson and Lyddon (1995) and Weber *et al.* (2012). Simpson and Lyddon (1995) agreed with Weber *et al.* (2012) that management development programmes are essential for individuals to develop general management competencies. In addition, Sahni (2011) suggested that a significant amount of time and effort are invested so that technical managers can develop their soft skills. Consequently, many organisations thus develop management development programmes commonly known as MDP for their managers (Sahni, 2011).

The nine significant differences with p-values of less than 0.05 are listed in table 23. The results show that HR managers scored these methodologies much higher than the engineers did. Consequently it can be concluded that HR managers are of the opinion that these methodologies are effective learning methods for engineers to acquire general management competencies, whereas engineers are of the opinion that these methodologies, according to the Likert scale used for the analysis, should be not used at all or somewhat used.

6.6.2 Summary of differences and similarities of the perceptions of engineers and HR managers of the methodologies that engineers undertake to acquire general management competencies

A 95% significance level was used for the analysis. Out of the 14 methodologies that were used for the research, five methodologies accepted the null hypotheses (**Ho**) and nine methodologies accepted the alternate hypothesis (**Ha**). Based on the results obtained above, the null hypothesis (**Ho**) is rejected in favour of the alternate hypothesis (**Ha**). This implies that there are a large amount of discrepancies between the perceptions of HR managers and engineers of the learning methods used to acquire general

management competencies. This inevitably means that the two parties, engineers and HR managers need to be in full alignment. Without alignment, there is a danger that HR staff will work in silos not understanding the engineers' perspectives of effective learning methodologies.

Chapter 7: Conclusion and Recommendations

7.1 Introduction

This chapter provides linkages to the research problem outlined in chapter one. The major findings of competencies required to transition from a technical position to general management and methodologies used to acquire general management competencies are briefly discussed in relation to the research objectives. Recommendations for engineers and organisations are presented based on these findings. Finally, recommendations for future research are highlighted.

7.2 Major findings

7.2.1 General management competencies and methodologies used to acquire general management competencies

Managing an engineer's career in today's competitive landscape has become increasingly important for many organisations. The research above illustrates that if engineers want to make the transition from technical positions to general management, it is imperative that they acquire relevant skills and competencies.

Based on the results tabulated in tables 12, 24 and 26 above, a model was constructed to illustrate the top competencies required to transition to general management and the top methodologies used to acquire general management competencies.

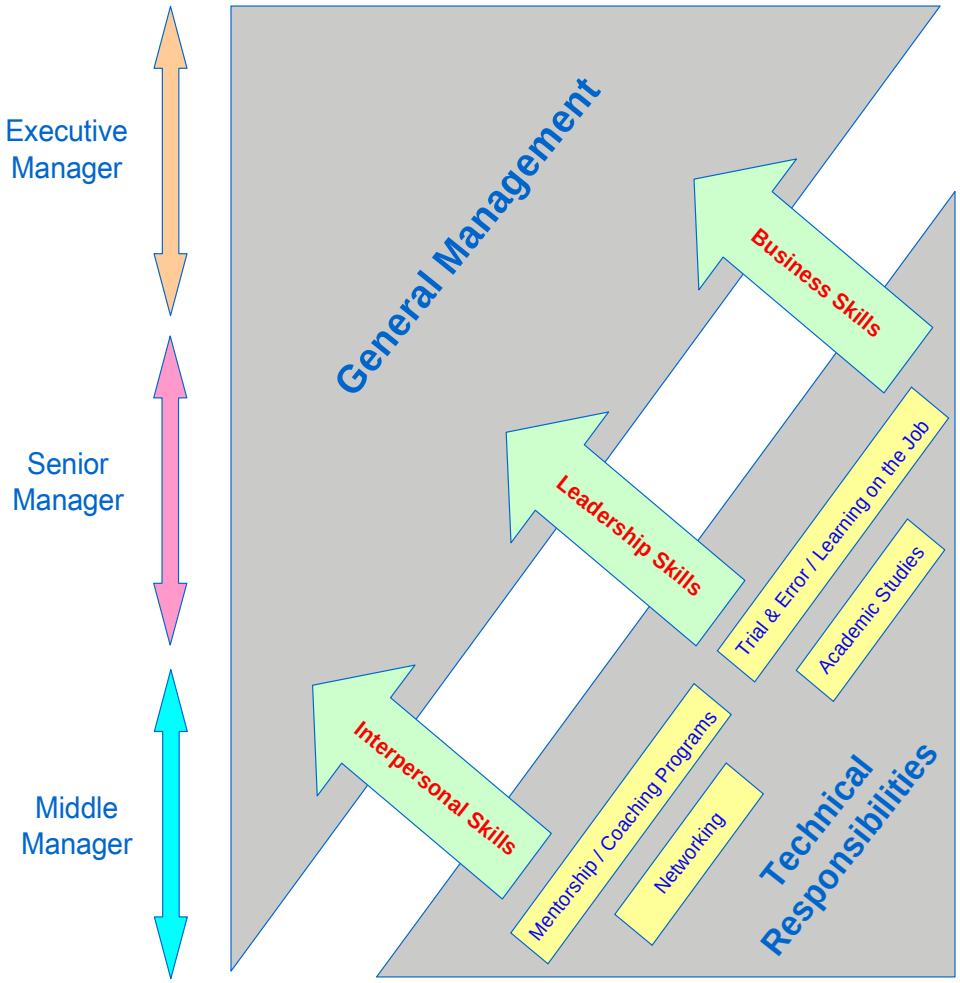


Figure 4: Model depicting key general management competencies and methodologies used to acquire competencies

The model depicts that the more an engineer progresses in an organisation, the more management competencies they require to be effective. Soft / interpersonal skills are initially required by all levels of management, however, as the individual moves from middle to senior and then executive level, hard skill competencies, such as business skills, become more important. As illustrated in table 12, an executive manager's percentage of work related to general management, according to the mean, is 70%. The model also depicts that the most important competencies, grouped into three categories as illustrated in table 24, are: interpersonal, leadership and business skills. The

most important methodologies as illustrated in table 26 are: trial and error / learning on the job, networking, mentorship and coaching programmes, and academic studies.

7.2.2 General management competencies and methodologies used across the three levels of management

The findings gave insights into the similarities and differences in general management competencies and the methods used to acquire them between the three levels of management (middle, senior and executive). The research indicated that there are similarities across the three levels of management, with the exception of hard skills becoming more important as the manager moves from middle to senior and then to an executive management position.

7.2.3 Perceptions of general management competencies and methodologies used between engineers and human resource managers

The findings further gave insights into the similarities and differences of the perceptions of general management competencies and methods used to acquire them, between engineers and HR managers. The research indicated that there are similarities of the perceptions of general management competencies between engineers and HR managers. However, there are a great deal of discrepancies between the perceptions of engineers and HR managers on the methodologies that engineers undertake to acquire general management competencies.

7.3 Recommendations for engineers

Undergraduate and young engineers are often very naïve about the optimal mix of technical and non-technical skills needed to be successful. They must be shown that a mix of both soft and hard skills are needed to ensure long-term success. Based on the engineering curriculum not including any general management subjects, an undergraduate engineer should realise the potential of management competencies as soon as possible and hence choose

electives that will assist them at an undergraduate level to start acquiring general management competencies. The earlier the development process commences, the more time there is available to grow into a management and leadership role.

Once in a working environment, the engineer needs to undergo a self actualisation phase and identify his or her career path. The research highlights that engineers can either remain in the technical field or move in to a management position. Since there is more reward in terms of recognition, most engineers find themselves transitioning to general management. It is therefore imperative that engineers determine their career paths as soon as possible in their working careers. If the engineer starts to move towards a management position, they should first test their enthusiasm and interest for management through mentoring or volunteering activities. The engineer should identify areas of development and skills that are deficient. Areas of development should be part of the engineer's development plan and must form a structured approach with clear goals set upfront. The research depicts that initially the focus should be on developing soft skills, which should then be followed by hard skills development. Academic studies should then be matched to development areas, as this methodology practice proved to be the most effective in assisting engineers to make the transition from a technical position to general management. Ultimately, when the engineer decides to make the leap into general management, the engineer should develop a plan and monitor it.

7.4 Recommendations for organisations

The results of the research depict that there is inadequate alignment between engineers and HR managers especially with regards to the methodologies used by engineers to acquire general management competencies. HR managers perceive departmental exchange programs and social media as effective methods of acquiring general management competencies whereas engineers find these methodologies least effective. This implies that there is a

definitive need for HR managers to consult the opinions of engineers when constructing career development plans.

In an effort to maintain young engineers and keep them motivated, organisations should integrate management and leadership training in to an engineer's development plan. A focus on interpersonal skills and leadership qualities, including decision making is essential. This will ultimately ensure that engineers understand the transition and what competencies are required. Organisations should take responsibility and develop programs that will assist engineers to make the transition. A good methodology is to develop mentoring programs. Mentoring programs should involve the pairing of good managers with bright engineers to establish the educational process and management skills needed in a particular setting. The research highlighted that internal mentoring / coaching programs proved to be effective in assisting engineers to make the transition.

Mentoring and coaching programs should be followed by collaboration. Due to their nature of their work responsibilities, engineers tend to work in silos. Consequently, organisations must make a concerted effort to enhance collaboration between engineers, other departments in the organisation and external stakeholders. A key method of achieving collaboration is placing the engineer in teams that have specific objectives. The objective doesn't necessarily have to be related to work. It could be a social investment project that involves different stakeholders. This forces the engineer to interact and inevitably will develop the engineer's interpersonal skills.

Ultimately, organisations need to be aware that managers deals with people rather than things. Therefore every effort needs to be made to assist technical employees such as engineers, when transitioning to a general management position.

7.5 Recommendations for structuring trial and error / learning on the job

The findings of the research highlight that trial and error / learning on the job is a key methodology to develop general management competencies. Trial and error has been viewed as the most common method of learning, but is it the most optimal learning methodology? Error immediately places the organisation at risk and depending on the level of error; the result could have severe implications.

Based on this result it is necessary to adopt a structured approach for this methodology. An individual that utilises trial and error as a key learning method needs to be mentally and physically prepared to learn otherwise the methodology is futile. The stimulus for learning needs to be very strong so that when an error is made, the individual is able to learn from the error. In other words, unsuccessful decisions must be eliminated and successful decisions must be retained. Organisations can assist engineers that learn through trial and error by giving the individual concise feedback and developing processes and preventative measures so that the error does not manifests again. In addition, continuous practice is essential for ensuring that learning is effective.

7.6 Recommendations for future research

Based on the research findings, further research in the following areas would assist in gaining a deeper understanding of the transition of engineers from technical positions to general management:

- Further research can be conducted in the field of knowledge management by identifying ways in which tacit knowledge transfer of soft skills can be extracted and disseminated from senior leaders in the organisation and utilised by junior engineers.
- Are there similarities and/or differences in competencies and methodologies between engineers of different industry sectors? The current research was conducted in one organisation.

- What are the initiating factors for engineers that transition from technical positions to general management?
- What is a logical way to optimise trial and error / learning on the job as a key learning methodology?

7.7 Conclusion

Engineers are essential for the development of South Africa and play a crucial role in executing growth for the country. However, for a variety of reasons such as attractive pay cheques and better socio-economic conditions, South Africa's best engineers are being lured abroad. This therefore creates a shortage of engineers in South Africa. In addition to the shortage of engineers, South Africa is facing a serious shortage of managers. The shortage of engineers and managers in the country creates a compounded problem and inevitably affects the growth and sustainability prospects for many South African enterprises.

As engineers develop their careers, they find themselves taking on more management responsibilities and their job role becomes less technically focused and more business management focused. As a result, engineers need to be equipped with the appropriate skills to successfully embark upon a management or leadership position. The research has provided a comprehensive review of the general management competencies required for an engineer to make the transition from a technical position to general management and the methodologies used to acquire general management competencies. The intention of the research is that the findings from the study will help assist engineers and organisations make more informed decisions around managing engineer's careers.

References

Albright, S. C., Winston, W. L. & Zappe, C. J. (2009). *Data Analysis and Decision Making.* Mason: South-Western Cengage Learning.

Balaji, K. V. A., & Somashekar, P. (2009). A Comparative Study of Soft Skills Among Engineers. *The Inter University Program Journal of Soft Skills*, *3*(3&4), 50-57.

Beaumont, S. L. (2009). Identity Processing and Personal Wisdom: An Information - Oriented Identity Style Predicts Self-Actualisation and Self-Transcendence. *Identity: An International Journal of Theory and Research, 9*, 95-115.

Bowden, P. (2010). Teaching Ethics to Engineers – a research based perspective. *European Journal of Engineering*, *35*(5), 563-572.

Bowman, B. A. & Farr, J. V. (2000). Embedding leadership in civil engineering education. *Journal of Professional Issues in Engineering Education and Practice, 126*(1), 16-20.

Britten, N. (1995). Qualitative Interviews in Medical Research. *British Medical Journal*, *311*, 251-253.

Brousseau, K. R., Driver, M. J., Eneroth, K., & Larsson, R. (1996). Career pandemonium: realigning organisations and individuals. *The Academy of Management Executive, 10*(4), 52-66.

Clardy, A. (2008). The strategic role of Human Resource Development in managing core competencies. *Human Resource Development International, 11*(2), 183-197.

Cohn, J. M., Khurana, R., & Reeves, L. (2005). *Growing Talent as if Your Business Depended on It.* Harvard Business Review.

Crosbie, R. (2005). Learning the soft skills of leadership. *Industrial and Commercial Training*, *37*(1), 45-51.

Dragoni, L., Oh, I., Vankatwyk, P., & Tesluk, P. E. (2011). Developing Executive Leaders: The Relative Contribution of Cognitive Ability, Personality, and the Accumulation of Work Experience in Predicting Strategic Thinking Competency. *Personnel Psychology*, *64*, 829-864.

Duberley, J., Mallon, M., & Cohen, L. (2006). Exploring career transitions: accounting for structure and agency. *Personal Review*, *35*(3), 281-296.

Emilsson, U. M., & Lilje, B. (2008). Training Social Competence in engineering education: necessary, possible or not desirable? An explorative study from a surveying education programme. *European Journal of Engineering, 33*(3), 259-269.

Farr, J. V., & Brazil, D. M. (2009). Leadership Skills Development for Engineers. *Engineering Management Journal, 21*(1), 3-8.

Farr, J. V., Walesh, S. G., & Forsythe, G. B. (1997). Leadership Development for Engineering Managers. *Journal of Management in Engineering, 23*(2), 38-41.

Gauteng Business News (2008). *Business: Skills Shortage in South Africa*. Retrieved April 7, 2012 from: http://www.gbn.co.za/articles/dailynews/82.html

Greenhaus, J. H., Callnan, G. A., & Kaplan, E. (1995). The role of goal setting in career management. *International Journal of Career Management, 7*(5), 3-12.

Hall, D. T., & Richter, J. (1990). Career gridlock: baby boomers hit the wall. *Academy of Management Executive*, *4*(1), 7-22.

Homer, M. (2001). Skills and Competency Management. *Industrial and Commercial Training, 33*(2), 59-62.

Ismail, M. (2003). Men and women engineers in a large industrial organisation: interpretation of career progression based on subjective-career experience. *Women in Management Review*, *18*(1), 60-67.

Kumar, S. & Hsiao, J. K. (2007). Engineers Learn "Soft Skills the Hard Way": Planting a Seed of Leadership in Engineering Classes. *Leadership and Management in Engineering, 7*(1), 1-6.

Lengnick-Hall, M. L., & Lengnick-Hall, C. A. (2003). HR's role in building relationship networks. *Academy of Management Executive, 17*(4), 53-63.

Mail and Guardian (2008). *A shortage of managers.* Retrieved April 12, 2012 from: http://mg.co.za/article/2008-04-15-a-shortage-of-managers

Marshall, M. N. (1996). Sampling for qualitative research. *Family Practice, 13*(6), 522-525.

Mayrhofer, W., & Iellatchitch, A. (2005). Rites, right?: The value of rites de passage for dealing with today's career transitions. *Career Development International*, *10*(1), 52-66.

McCall, C. H. (2001). An empirical examination of the Likert scale: some assumptions, development, and cautions. *Proceedings of the 80th Annual CERA Conference*, November 15-16, 2001 South Lake Tahoe, CA.

McGurk, P. (2010). Outcomes of management and leadership development. *Journal of Management Development, 29*(5), 457-470.

Molen, H. T. V. D., Schimdt, H. G., & Kruisman, G. (2007). Personality characteristics of engineers. *European Journal of Engineering Education, 32*(5), 495-501.

Mouton, J. (2008). *How to succeed in your Masters and Doctoral studies.* Pretoria: Van Schaik Publishers.

Nienaber, H. (2010). Conceptualisation of management and leadership. *Management Decision, 48*(5), 661-675.

Petroni, A. (2000a). Strategic career development for R&D staff: a field research. *Team Performance Management, 6*(3), 52-62.

Petroni, A. (2000b). Career route preferences of design engineers: an empirical research. *Career Development International, 5*(6), 288-294.

Sahni, L. (2011). The Impact of Soft Skill Training Induction Programme on New Entrants. *Bharati Vidyapeeth Institute of Management and Research (BVIMR) Management Edge Journal, 4*(2), 40-47.

Sandelowski, M., Voils, C. I., & Barroso, J. (2006). Defining and designing mixed research synthesis studies. *Research in the Schools, 13*(1), 29-40.

Saunders, M., & Lewis, P. (2012). *Doing Research in Business & Management. An Essential Guide to Planning Your Project.* London: Prentice Hall.

Sharp, L. (2011). *South Africa's extraordinary skills shortage – Adcorp.* Retrieved May 10, 2012 from: http://www.politicsweb.co.za/politicsweb/view/politicsweb/en/page71619?oid=235542&sn=Detail&pid=71619

Simpson, P., & Lyddon, T. (1995). Different roles, different views: exploring the range of stakeholder perceptions on an in-company management development programme. *Industrial and Commercial Training, 27*(4), 26-32.

Terblanche, S. (2011). *Conundrum for engineering.* Retrieved May 15, 2012 from: http://www.achieveronline.co.za/articles/skills-development/267

Thite, M. (2001). Help us but help yourself: the paradox of contemporary management. *Career Development International, 6*(6), 312-317.

Toit, D. R., & Roodt, J. (2008). *Engineering Professional: Crucial key to development and growth in South Africa.* Research Consortium. Research Commissioned by Department of Labour South Africa.

Waters, R. C. (2009). Evolution of Leadership Development at General Electric. *Engineering Management Journal*, *21*(1), 42-46.

Weber, M. R., Crawford, A., & Dennison, D. (2012). North Carolina Human Resource Professionals' Perceptions of Soft Skill Competencies. *Journal of Human Resources in Hospitality & Tourism, 11*(3), 225-238.

Wooten, L. P., & James, E. H. (2008). Linking Crisis Management and Leadership Competencies: The Role of Human Resource Development. *Advances in Developing Human Resources, 10*(3), 352-379.

Worrall, L., & Cooper, C. (2001). Management skills development: a perspective on current issues and setting the future agenda. *Leadership and Organisational Development Journal, 22*(1), 34-39.

Wright, P. C., & Belcourt, M. (1994). Management Development: A Career Management Persepective. *International Journal of Career Management*, *6*(5), 3-10.

Appendix A: Interview Guidelines

Introduction

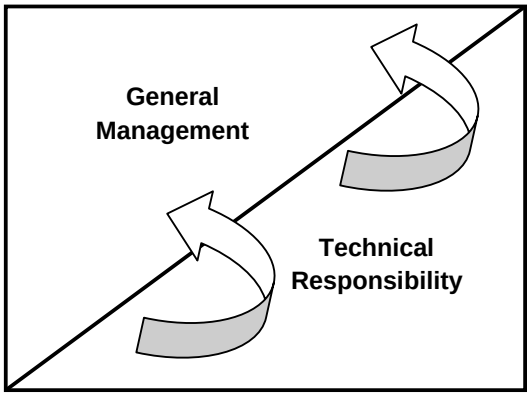
As part of the MBA qualification, every student has to complete a research project (thesis). Based on my background and undergraduate qualification, my research title is “The Transition of Engineers from Technical Positions to General Management.” Hence the reason I am interviewing you is to try and understand the competencies you required in order to make the transition.

Middle Management, Senior Management & Executive Management

- What percentage of your work is technically related and what percentage of your work is related to general management?
- What were the competencies required to make the move from a technical position to general management?
- Were the competencies’ soft skills or hard skills? (Note not to ask leading questions, for example, were they finance or marketing skills etc.)
- What steps did you take to achieve the above mentioned skills? (Was it trial and error, a one week course or MBA programme etc?)
- How could your employer have assisted you in achieving those competencies? (If only they had given you a mentor, if only they sent you for this course etc.)
- In your opinion, what is the role of the company vs the role of the individual in developing skills?

HR Managers

- When you watch engineers move through the organisation, what competencies do you think they require to make the transition from technical positions to general management?
- Show the HR manager the model below and explain in detail.



- From your experience and observations, what methods do you think they use to achieve the above mentioned competencies?
- What methods, in your opinion, do you think they should use?
- In your opinion, what is the role of the company vs the role of the individual in developing the skills?

Appendix B: Questionnaire for managers with an engineering background

Dear SKF Colleague

As part of the MBA qualification, every student has to complete a research project. Based on my background and undergraduate qualification, my research title is "The Transition of Engineers from Technical Positions to General Management." Hence the reason you have been chosen to complete a questionnaire. I am trying to understand the competencies you required in order to make the transition from a technical position to management.

You are requested to please complete the attached survey that should take no more than five minutes of your time. **A friendly tip is to complete the survey immediately. It only takes a few minutes and your participation is important for me to continue with my research.** The survey will also be used to provide SKF with insight on how to develop engineers to become effective managers. Your participation is voluntary and you may withdraw at any time without penalty. The survey does not require your name. All data will be kept confidential. If you have any concerns, please contact me or my supervisor. Our details are provided below:

	Researcher	Supervisor
Name:	Mr. Darren Chetty	Prof. Margie Sutherland
Email:	darren.chetty@skf.com	sutherlandm@gibs.co.za
Phone:	+27 83 284 4969	+27 11 771 4362

Please click on the link to complete the questionnaire:

https://www.surveymonkey.com/s/863CWT2

Questionnaire for managers with an engineering background

***1. Which category below includes your age?**

- ◯ 20-29
- ◯ 30-39
- ◯ 40-49
- ◯ >49

***2. Do you have people reporting to you?**

- ◯ Yes
- ◯ No

***3. Do you have managers reporting to you?**

- ◯ Yes
- ◯ No

***4. Are you a director or managing director or enterprise / group manager?**

- ◯ Yes
- ◯ No

***5. Years of experience at SKF?**

- ◯ Less than or equal to 1 year
- ◯ Greater than 1 year and less than or equal to 5 years
- ◯ Greater than 5 years and less than or equal to 10 years
- ◯ > 10 years

***6. Years of experience as a practising engineer?**

- ◯ Less than or equal to 1 year
- ◯ Greater than 1 year and less than or equal to 5 years
- ◯ Greater than 5 years and less than or equal to 10 years
- ◯ > 10 years

Questionnaire for managers with an engineering background

***7. Which country do you currently work in?**

***8. What engineering qualification do you have?**

- [ ] Technical qualification from a college eg. Diploma, certification, etc
- [ ] Bachelor of Technology in Engineering (BTech Eng)
- [ ] Bachelor of Engineering (BEng) or Bachelor of Science in Engineering (BSc Eng)
- [ ] Masters in Engineering (MSc or MEng)
- [ ] Doctorate in Engineering (PhD)
- [ ] Other

Please specify

***9. What, if any, business qualifications do you have?**

Questionnaire for managers with an engineering background

***10. What were the skills you felt you required to make the move from a technical position to management?**

Please rank your response according to the scale below. Please make full use of the whole scale.

	Not important at all	Some-what important	Important	Very important	Critically important
Finance skills – budgets, quotes, forecasting, etc.	◯	◯	◯	◯	◯
Understanding marketing concepts – product positioning, advertising, promotions, etc.	◯	◯	◯	◯	◯
Sales – how to sell engineering products, different sales techniques, buying behaviour, etc.	◯	◯	◯	◯	◯
Interpersonal skill – managing people	◯	◯	◯	◯	◯
Interpersonal skill – working across cultures	◯	◯	◯	◯	◯
Interpersonal skill – delegation	◯	◯	◯	◯	◯
Interpersonal skill – being able to have tough conversations	◯	◯	◯	◯	◯
Interpersonal skill – public speaking	◯	◯	◯	◯	◯
Interpersonal skill – empowering employees so that they can discharge their responsibilities effectively	◯	◯	◯	◯	◯
Interpersonal skill – honing on employees abilities so that they can achieve their full potential	◯	◯	◯	◯	◯
Interpersonal skill – considering the emotions of staff which contributes to building trust	◯	◯	◯	◯	◯
Business – assume responsibility for the survival and growth of the business	◯	◯	◯	◯	◯
Business – anticipate the business operating environment in the next 5 years	◯	◯	◯	◯	◯
Business – set direction including establishing a	◯	◯	◯	◯	◯

Questionnaire for managers with an engineering background

strategy

Business – determine what goods and services customers desire, including the price they are willing to pay	◯	◯	◯	◯	◯
Business – business writing skills	◯	◯	◯	◯	◯
Business – business processes adopted by SKF	◯	◯	◯	◯	◯
Business – determining what constitutes customer value	◯	◯	◯	◯	◯
Business – determine priorities	◯	◯	◯	◯	◯
Business – a knowledge of contemporary issues	◯	◯	◯	◯	◯
Project management skills	◯	◯	◯	◯	◯
Economics – being able to understand the economic operating environment	◯	◯	◯	◯	◯
Economics – being able to understand the functional drivers of the business	◯	◯	◯	◯	◯
Leadership – influential, how to have influence over others	◯	◯	◯	◯	◯
Leadership – how to manage the way people perceive you	◯	◯	◯	◯	◯
Leadership – how to manage your reputation	◯	◯	◯	◯	◯
Leadership – to make decisions ethically and understanding ethical responsibility	◯	◯	◯	◯	◯
Leadership – communicate direction including a shared understanding of the direction	◯	◯	◯	◯	◯

Other (please specify)

Questionnaire for managers with an engineering background

***11. What steps did you take to achieve the above mentioned skills? Please rank your response according to the scale below. Please make full use of the whole scale.**

	Not used at all	Some-what used	Used	Used a great deal	Extensively used
Academic courses – a degree qualification	◯	◯	◯	◯	◯
Short business learning courses – certification programs, diplomas, etc.	◯	◯	◯	◯	◯
Trial and error / Learning on the job	◯	◯	◯	◯	◯
Disciplined research	◯	◯	◯	◯	◯
Mentorship/coaching programs	◯	◯	◯	◯	◯
Going for executive coaching	◯	◯	◯	◯	◯
SKF management development programs such as IMP and GLP	◯	◯	◯	◯	◯
Networking	◯	◯	◯	◯	◯
Communities of practice	◯	◯	◯	◯	◯
e-learning courses	◯	◯	◯	◯	◯
Social media – forums, blogs, groups such as Linkdin and Google Groups	◯	◯	◯	◯	◯
Special assignments	◯	◯	◯	◯	◯
Departmental exchange programs	◯	◯	◯	◯	◯
Business literature	◯	◯	◯	◯	◯

Other (please specify)

***12. What techniques would you say assisted you the most in the transition from an engineer to general management?**

***13. What percentage of your work is currently technically related and what percentage of your work is related to general management? NB: Your answer must add up to 100%. Only enter the numbers.**

Technically related

General managment related

Appendix C: Questionnaire for HR Managers

Dear SKF Colleague,

As part of the MBA qualification, every student has to complete a research project. Based on my background and undergraduate qualification, my research title is "The Transition of Engineers from Technical Positions to General Management." Hence the reason you have been chosen to complete a questionnaire. I am trying to understand the competencies required in order for an engineer to make the transition from a technical position to management.

You are requested to please complete the attached survey that should take no more than five minutes of your time. **A friendly tip is to complete the survey immediately. It only takes a few minutes and your participation is important for me to continue with my research.** The survey will also be used to provide SKF with insight on how to develop engineers to become effective managers. Your participation is voluntary and you may withdraw at any time without penalty. The survey does not require your name. All data will be kept confidential. If you have any concerns, please contact me or my supervisor. Our details are provided below:

	Researcher	Supervisor
Name:	Mr. Darren Chetty	Prof. Margie Sutherland
Email:	darren.chetty@skf.com	sutherlandm@gibs.co.za
Phone:	+27 83 284 4969	+27 11 771 4362

Please click on the link to complete the questionnaire:

https://www.surveymonkey.com/s/8Z9Y38V

Questionnaire for HR managers

***1. Which category below includes your age?**

- ◯ 20-29
- ◯ 30-39
- ◯ 40-49
- ◯ >49

***2. Years of experience at SKF?**

- ◯ Less than or equal to 1 year
- ◯ Greater than 1 year and less than or equal to 5 years
- ◯ Greater than 5 years and less than or equal to 10 years
- ◯ > 10 years

***3. How many years of HR experience do you have?**

- ◯ Less than or equal to 1 year
- ◯ Greater than 1 year and less than or equal to 5 years
- ◯ Greater than 5 years and less than or equal to 10 years
- ◯ > 10 years

***4. Which country do you currently work in?**

Questionnaire for HR managers

***5. When you watch engineers move through the organisation, what skills do you think they require making the transition from technical positions to general management? Please rank your response according to the scale below. Please make full use of the whole scale.**

	Not important at all	Some-what important	Important	Very important	Critically important
Finance skills – budgets, quotes, forecasting, etc.	◯	◯	◯	◯	◯
Understanding marketing concepts – product positioning, advertising, promotions, etc.	◯	◯	◯	◯	◯
Sales – how to sell engineering products, different sales techniques, buying behaviour, etc.	◯	◯	◯	◯	◯
Interpersonal skill – managing people	◯	◯	◯	◯	◯
Interpersonal skill – working across cultures	◯	◯	◯	◯	◯
Interpersonal skill – delegation	◯	◯	◯	◯	◯
Interpersonal skill – being able to have tough conversations	◯	◯	◯	◯	◯
Interpersonal skill – public speaking	◯	◯	◯	◯	◯
Interpersonal skill – empowering employees so that they can discharge their responsibilities effectively	◯	◯	◯	◯	◯
Interpersonal skill – honing on employees abilities so that they can achieve their full potential	◯	◯	◯	◯	◯
Interpersonal skill – considering the emotions of staff which contributes to building trust	◯	◯	◯	◯	◯
Business – assume responsibility for the survival and growth of the business	◯	◯	◯	◯	◯
Business – anticipate the business operating environment in the next 5 years	◯	◯	◯	◯	◯
Business – set direction including establishing a	◯	◯	◯	◯	◯

Questionnaire for HR managers

strategy

Business – determine what goods and services customers desire, including the price they are willing to pay	◯	◯	◯	◯	◯
Business – business writing skills	◯	◯	◯	◯	◯
Business – business processes adopted by SKF	◯	◯	◯	◯	◯
Business – determining what constitutes customer value	◯	◯	◯	◯	◯
Business – determine priorities	◯	◯	◯	◯	◯
Business – a knowledge of contemporary issues	◯	◯	◯	◯	◯
Project management skills	◯	◯	◯	◯	◯
Economics – being able to understand the economic operating environment	◯	◯	◯	◯	◯
Economics – being able to understand the functional drivers of the business	◯	◯	◯	◯	◯
Leadership – influential, how to have influence over others	◯	◯	◯	◯	◯
Leadership – how to manage the way people perceive you	◯	◯	◯	◯	◯
Leadership – how to manage your reputation	◯	◯	◯	◯	◯
Leadership – to make decisions ethically and understanding ethical responsibility	◯	◯	◯	◯	◯
Leadership – communicate direction including a shared understanding of the direction	◯	◯	◯	◯	◯

Other (please specify)

Questionnaire for HR managers

***6. From your experience and observations, which of the following learning methodologies are the most effective to help engineers transition from a technical position to general management?**
Please rank your response according to the scale below. Please make full use of the whole scale.

	Not effective at all	Some-what effective	Effective	Very effective	Extremely effective
Academic courses – a degree qualification	◯	◯	◯	◯	◯
Short business learning courses – certification programs, diplomas, etc.	◯	◯	◯	◯	◯
Trial and error / Learning on the job	◯	◯	◯	◯	◯
Disciplined research	◯	◯	◯	◯	◯
Mentorship/coaching programs	◯	◯	◯	◯	◯
Going for executive coaching	◯	◯	◯	◯	◯
SKF management development programs such as IMP and GLP	◯	◯	◯	◯	◯
Networking	◯	◯	◯	◯	◯
Communities of practice	◯	◯	◯	◯	◯
e-learning courses	◯	◯	◯	◯	◯
Social media – forums, blogs, groups such as Linkdin and Google Groups	◯	◯	◯	◯	◯
Special assignments	◯	◯	◯	◯	◯
Departmental exchange programs	◯	◯	◯	◯	◯
Business literature	◯	◯	◯	◯	◯

Other (please specify)

Questionnaire for HR managers

***7. What methods, in your opinion, do you think engineers should use? Please rank your response according to the scale below. Please make full use of the whole scale.**

	Should not be used at all	Should be some-what used	Should be used	Should be regularly used	Should be extensively used
Academic courses – a degree qualification	◯	◯	◯	◯	◯
Short business learning courses – certification programs, diplomas, etc.	◯	◯	◯	◯	◯
Trial and error / Learning on the job	◯	◯	◯	◯	◯
Disciplined research	◯	◯	◯	◯	◯
Mentorship/coaching programs	◯	◯	◯	◯	◯
Going for executive coaching	◯	◯	◯	◯	◯
SKF management development programs such as IMP and GLP	◯	◯	◯	◯	◯
Networking	◯	◯	◯	◯	◯
Communities of practice	◯	◯	◯	◯	◯
e-learning courses	◯	◯	◯	◯	◯
Social media – forums, blogs, groups such as Linkdin and Google Groups	◯	◯	◯	◯	◯
Special assignments	◯	◯	◯	◯	◯
Departmental exchange programs	◯	◯	◯	◯	◯
Business literature	◯	◯	◯	◯	◯

Other (please specify)