



MBA Thesis

From Engineering to Management

Factors affecting engineer's transition process toward management roles

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The author(s) declare(s) that they have completed the thesis work independently. All external sources are cited and listed under the References section. The thesis work has not been submitted in the same or similar form to any other institution(s) as part of another examination or degree.

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Abstract

The transition from engineering roles to management positions is a critical phase in engineers' career development. However, this transition process often presents significant challenges and necessitates specific personal characteristics, skills, and motivators. This study aims to identify the impact of these factors on the transition from engineering to management roles and investigate their influence on engineers' career development.

Employing a qualitative approach, this study utilizes thematic analysis to analyze data derived from in-depth interviews with eight engineers transitioned to management roles. Transcribed interviews were examined to recognize key themes related to the research questions.

Thematic analysis uncovered three central themes linked to the transition process: personal characteristics, skills, and motivators. Personal characteristics encompassed leadership, communication, and adaptability. Skills comprised technical and business acumen, project management, and people management. Motivators encompassed career advancement, financial rewards, and personal growth. The analysis also revealed prevalent challenges encountered during the transition process, including adapting to new roles, and managing workload demands.

This study emphasizes the critical importance of effective career planning and development to facilitate engineers' successful transition into management roles. The findings suggest that transitioning from engineering roles to management positions necessitates a distinct set of personal characteristics, skills, and appropriate motivators. By actively cultivating these attributes, engineers can overcome the challenges encountered during the transition process.

Future research is recommended to explore the efficacy of diverse training and development programs aimed at equipping engineers with the requisite skills and characteristics essential for a successful transition into management roles.

Keywords: Management, Transition, Career Development

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Table of contents

1.	Introduction	1
2.	Purpose and research questions	2
3.	Previous research and Theory	3
3.1	Previous research	3
3.1.1	Career Development Theories	3
3.1.2	Engineer education and training	11
3.1.4	Management and Leadership	13
3.1.5	Engineer Vs Manager	21
3.1.6	The transition from Engineering to Management	22
3.1.7	Challenges in the transition phase	25
3.2	Theory	28
4	Methodology	31
4.1	Data collection method	32
4.2	Selection	33
4.3	Ethical considerations	35
4.4	Analysis method	36
4.5	Credibility and validity	38
4.6	Approach	40
5	Results and analysis	42
5.1	Personal Characteristics and Skills in the Transition to Management Roles	44
5.2	Challenges in the Transition to Management Roles	48
5.3	Motivators for Transitioning to Management Roles	51
6	Discussions	57
	Reference list	62
	Appendix 1 – The Questionnaire	67

Appendix 2 – Informed Consent Statement _____ 68

Appendix 3 – Initial Codes _____ 69

List of Tables

Table 1. Summary of the history of career development theories (CareersNZ 2018)	4
Table 2. Super's five life and career development stages (CareersNZ 2018)	10
Table 3. Differences between engineers and managers (Bhattacharya 2018)	21
Table 4. Challenges Experienced by Engineers Transitioning into Management (Howard 2003)	26
Table 5. Overview of the Interviewees	42

List of Figures

Figure 1. Holland's Theory RIASEC (CareersNZ 2018)	6
Figure 2. Krumboltz top five for Happenstance (CareersNZ 2018)	9
Figure 3. Engineering career path (Wilde 2009)	13
Figure 4. Seven steps to practice critical thinking (Neck 2022)	19
Figure 5. Bridges transition model. (Bridges 2013)	23
Figure 6. Initial Thematic Map	43
Figure 7. Final Thematic Map	44

1. Introduction

Employment in a managerial position carries with it various challenges. As well transition from one role to another one also has some challenges. Engineering is one of the most seen careers among managerial positions (Howard 2003). An annual survey from Harvard Business Review year 2018 found that 34 of the top 100 CEOs list have engineering degrees ("The Best-Performing CEOs in the World 2018", 2018).

One of the engineer's natural career goals is to advance to management. As their careers progress, they face the daunting task of quickly transitioning into a management role and realize they are missing skills not yet developed (Custovic & Insaurralde 2016).

In the transition to a management role, many engineers find themselves challenged by the new role, the change is challenging for them and people with powerful technical skills (Galli 2019). The success of the transition could also impact organizations and firms. The literature shows a lack of research on the development level of management skills and factors concerning managers from technical backgrounds (Mancuso & Barbera 2020).

Therefore, our study aimed to explore the personal characteristics, skills, challenges, and motivators that impact the transition from engineering roles to management roles and how they influence engineers' career development in this transition process. To achieve this, we have conducted semi-structured interviews with engineers who have undergone this transition in the past 15 years. Our study is geared toward providing a practical recommendation for individuals and organizations involved in transitioning from engineering to management roles.

2. Purpose and research questions

The thesis aims to comprehensively understand the factors affecting the transition from engineering to management roles. Specifically, the study will investigate the managerial skills engineers may lack, their challenges when starting a new position, and how to overcome them. Additionally, the research will explore the impact of personal characteristics on the transition process and identify the motivations that prompt engineers to take on management positions.

The study's primary objective is to offer practical recommendations for strategies that support engineers in successfully transitioning to management roles. The research seeks to fill a gap in the current literature by better understanding the transition process, highlighting the main obstacles engineers face, and offering insights into overcoming them. Ultimately, the research will contribute to developing structure that can be used to support engineers in their career progression from engineering to management roles.

Based on this purpose, the following research questions have been formulated:

1. What are the personal characteristics, skills, challenges, and motivators impacting the transition from engineering to management roles?
2. How do these factors influence the career development of engineers in the transition process from engineering to management roles?

3. Previous research and Theory

3.1 Previous research

This chapter looks at the relevant theories of career development, engineering career path, and much more to understand the factors engineers experience when transitioning to a management position. This is done by looking at literature and relevant research that has already been done in the field.

Wilde (2009) claimed that the days of engineers working in isolation and the stereotype of engineers mainly focusing on developing their technical skills to succeed in their jobs have passed. And they are usually seen as technical specialists but lack social skills. However, the engineer's role is rapidly changing, and it is up to engineers to adapt to it. Engineers are moved into managerial positions and thus need to learn different skills (Pratini 2017). This has changed so that engineering is the most popular undergraduate degree amongst many company managers, such as CEOs of Fortune 500 companies, General Motors, Microsoft, and Amazon (Al-Saleh 2014). A study looked closely at the educational background of S&P 500 CEOs and found that 33% of the S&P 500 CEOs' undergraduate degrees are in engineering (Aquino 2011).

3.1.1 Career Development Theories

This chapter will first look at the career development theories. There are many career theories, and no one fully describes the career development field (CareersNZ 2018). However, Chism (2018) said that the investigation into career development is seen as essential and it analyses how an individual's work identity is formed throughout their lives and understands why they make their decisions.

Career Development is a "continuous lifelong process of developmental experiences that focuses on seeking, obtaining and processing information about

self, occupational and educational alternatives, lifestyles and role options" (Hansen 1976). Put another way; Career development can be seen as a process of determining where people fit into the world of work and their role in it. CareersNZ (2018) summarized the history of career development over time and outlined how career theories have evolved over time. The history timeline of some career theories and models is briefly summarized in Table 1.

Table 1. Summary of the history of career development theories (CareersNZ 2018)

Timeline	Theory name	Author name	Theory description
1900s	Person-environment fit, trait factor.	Parsons, Williamson, Holland	" Vocational guidance is accomplished first by studying the individual, then by surveying occupations, and finally by matching the individual with the occupation."
1950s	Developmental	Ginzberg & Associates, Tiedman, Super, Gottfredson, Roe	"Career development is a process that takes place over the life span. Career development activities should be designed to meet the needs of individuals at all stages of life. "
1960s	Client-centred	Rogers	"Career development is focused on the nature of the relationship between the helper and client. It encompasses the core conditions of unconditional positive regard, genuineness, congruence, and empathy. "
1970s	Social learning	Krumboltz	"The individual's unique learning experiences over their lifespan develop primary influences that lead to career choice. "

1980s	Post-modern	Kelly, Cochran, Jepsen	"Truth is discovered subjectively through dialogue rather than through objective testing. This approach emphasises the individual's experience and decision making through exploring personal constructs and the client's narrative about their life."
1990s	Happenstance	John Krumboltz	"Chance events play a role in every career. The goal for clients is to generate beneficial chance events and have the ability to take advantage of them. "
2000s	Coaching	James Flaherty	"A model of practice. All parts of the client's life are considered through regular sessions. "
2010s	Relational and Cultural	Schultheiss	"A novel paradigm that emphasises the cultural shaping of meaning-making through relationships as central to the understanding of work in people's lives. "

Many career guidance and counselling worldwide, most notably in the United States (USA), have developed a complete system of theories of more than 100 years of history (Leung 2008). The five significant career theories have the prospect of providing an international framework for career decision-making. Leung (2008) identifies these prominent career theories that have applications across cultures in five theories. These five theories are (1) Theory of Work Adjustment, (2) Holland's Theory, (3) Self-concept Theory of Career Development, (4) Gottfredson's Theory of Circumscription and Compromise, and (5) Social Cognitive Career Theory. While McMahon & Patton (2014) categorizes career theories into five categories. These five theories are (1) Theory of process, (2) Theory of content, (3) Theory of content and process, (4) Wider explanations, and (5) Constructivist/Social Constructionist Approaches). For each of these categories, there are sub-theories. For this study, we discuss the most prominent theories which closely related to the topic of our research as follows:

A. Theory of Career Choice by John Holland (1997)

We like jobs with people like us. In John Holland's Theory of Career Choice, Careers are specified by an interaction between personality and the environment. Therefore, people look for a domain that fits their skills and abilities and, at the same time, enjoys problems and roles. Holland's Theory focuses on the idea that individuals tend to fall into six categories based on their personality traits: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (RIASEC) (CareersNZ 2018), as shown in Figure 1.



Figure 1. Holland's Theory RIASEC (CareersNZ 2018)

Realistic types usually like to work with things more than humans. They are often characterized as real, practical, natural, economical, modest, and honest. While Investigative types generally like to work with ideas more than humans or things. They are typically logical, intelligent, cautious, curious, independent, and quiet. The Artistic types commonly like to work with ideas more than things. They are usually creative, emotional, passionate, impulsive, and independent. Social classes typically want to work with someone more than with things. They are often

described as helpful, understanding, warm, convincing, responsible, kind, and friendly. But Enterprising types commonly like to work with humans and ideas more than with things. They are usually characterized as adventurous, energetic, friendly, sociable, and optimistic. Finally, Conventional types typically like to work with papers and numbers. They are generally described as practical, careful, efficient, and orderly (CareersNZ 2018)

B. Theory of Trait and Factor by Frank Parsons (2008)

Parsons' Theory states that occupational decision-making happens when people have achieved (Parsons 2008):

- A precise understanding of their traits includes skills, interests, and personal abilities.
- Knowledge of careers and the labour market.
- Rational judgment about the relationship between their traits and the labor market.

Parsons (2008), in his book 'Choosing a Vocation', argues that personal counsel is essential to the career search. In particular, he states seven stages for a career counsellor to follow with their clients:

1. Personal data: create a statement of fundamental facts about the person, including every fact that affects the vocational problem.
2. Self-analysis: a self-examination is done by a private or counsellor. Every interest that might influence the choice of life work should be documented.
3. The client's choice and decision: The counsellor must keep in mind that the client's choice of career should be made with the counsellor's guidance.
4. Counsellor's analysis: the counsellor examines the client's decision to see if it aligns with his career choice.
5. Outlook on the vocational field: the counsellor should be aware of industrial knowledge such as lists and classifications of industries and vocations and locations of training,

6. Induction and advice: clear reasoning and a broad-minded attitude are necessary.
7. General helpfulness: the counsellor assists the client in fitting into the chosen work and thinking about the decision.

Parsons' works still guide career counselling today. Yet, the fact is that the market's changes mean people must be ready to change and adapt to their circumstances.

C. Theory of Happenstance by John Krumboltz (2013)

Krumboltz (2013) states that uncertainty is acceptable and sensible, allowing people to benefit from unplanned events. It is ok not always to plan because unplanned events could lead to promising careers. Also, this theory is called 'Planned Happenstance'. (CareersNZ 2018)

At the soul of this theory is that unexpected social factors, chance events and environmental factors significantly influence people's lives. Therefore, counsellors encourage clients to be curious, explore learning opportunities, be patient in handling obstacles and have the flexibility to manage a variety of circumstances and events, and be optimistic about gaining advantages from unplanned events. (CareersNZ 2018)

How does happenstance happen? Krumboltz's top five for Happenstance, as shown in Figure 2

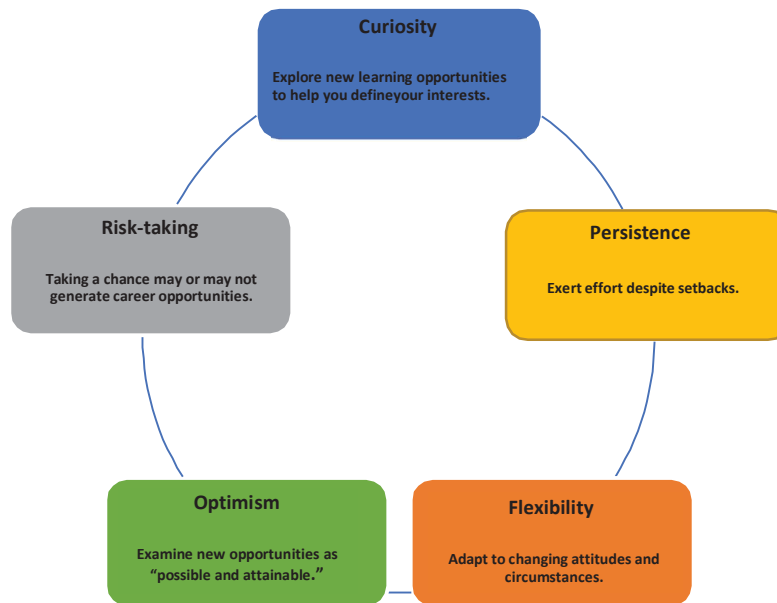


Figure 2. Krumboltz top five for Happenstance (CareersNZ 2018)

Furthermore, Krumboltz (2018) highlighted several factors as being helpful in career management, such as:

- The commitment to continuous learning and skill development
- Ongoing self-assessment
- Others' assessments and feedback
- Effective networking and interactions
- A balance between work and life
- Financial planning

D. Theory of Social-cognitive by Albert Bandura (1997)

Bandura's theory is based on the idea that people learn by observing what others do and that human thought processes are essential to understanding personality (Bandura 1997). This theory provides a framework for understanding human behaviour based on four factors. The first factor is attention; one needs to pay attention to learn something new. The second factor is Retention; one must

remember what you have paid attention to. The third factor is Reproduction; one must be able to translate the image into actual behavior in the first place. The last factor is motivation. Bandura (1997) also mentioned several motives, for example, past, promised, and vicarious reinforcement.

Bandura (1997) has significantly affected personality theory and therapy. His action-oriented, problem-solving strategy suits people who want to make changes instead of philosophizing.

E. Theory of Developmental Self-Concept by Donald Super (1957)

Donald Super affected the belief that developing a feeling of self and realizing that you change over time is crucial when planning your career. Super's Theory combines stage development and social role theory (Super et al. 1996), he claims that people progress through five stages: growth, exploration, establishment, maintenance, and disengagement during their career development process (CareersNZ 2018) Table 2.

Table 2. Super's five life and career development stages (CareersNZ 2018)

Stage	Age	Description
Growth	birth-14	Development of self-concept, attitudes, needs and the general world of work
Exploration	15-24	Tentative choice and skill development. Doing through work, hobbies, and classes
Establishment	25-44	Entry-level skill-building and stabilization through work experience
Maintenance	45-64	Continual adjustment process to improve the position
Decline	65+	Reduced output, prepare for retirement

We can now look at the formal development of an engineer's education by investigating the various career development theories.

3.1.2 Engineer education and training

ECSA (2018) stated that engineering is one of the familiar fields that was known early. Moreover, many different types of engineering are often divided into fields in which the Engineer operates. For example, petroleum engineers work in the oil and gas industry. And whose building software and applications could be called software engineers. Cambridge English Dictionary defines engineering as "the work of an engineer", and it establishes an Engineer as "a person whose job is to design or build machines, engines, or electrical equipment, or things such as roads, railways, or bridges, using scientific principles: a civil engineer, a mechanical/structural engineer, a software engineer". While the definition in the South African context is that: "Engineering is the practice of science, engineering science and technology concerned with the solution of problems of economic importance and those essential to the progress of society. Solutions rely on basic scientific, mathematical, and engineering knowledge". So, anyone who practices engineering is then considered an engineer.

To become an engineer, you have two routes that you can follow considering the core disciplines within engineering: mechanical, civil, software, chemical, and electrical. The first way is the educational route, whereby you gain a degree in engineering from a university or an institute. The second route is an apprenticeship that supposes working in a particular work environment and prepares you to become an engineer if you complete some technical education. Therefore, a degree in engineering or technology-related is essential to work in the engineering sector.

As an expression of the pronounced need for engineering managers, the mid-twentieth century noticed the founding of the Departments of Engineering Management, the first at universities in the United States, considered the profession's starter. Later such departments spread to European and Asian

countries, as Fischer et al. (2019) mentioned. He also adds that this contributed to fast growth in the infrastructure, supporting engineering managers with different educational degrees, professional organizations, research projects, and academic journals. Furthermore, he added that this new managerial profile is required because of increased competition in the labor market. And the corresponding need to enhance productivity in manufacturing and services sets a requirement for more effective management of firms' technical practices. Therefore, many organizations have created a more stable organizational structure by combining engineering and managerial jobs to increase efficiency, productivity, and flexibility (Fischer et al. 2019). By understanding an engineer's technical training and educational background, we can now look at the potential career paths that the engineering career typically follows.

3.1.3 Engineer career paths

The engineering career path had two routes to follow in the 2000s. Engineers were employed as technical employees, accumulated around five years of specialized experience, and have to choose between a technical or a management path (Wilde, 2009). This is no longer the case, as managerial responsibilities are given to engineers earlier in their careers, as claimed (Custovic & Insaurralde 2016). He said even if they follow the technical career path, they are soon responsible for leading a team, managing multi-disciplined teams, or even project management.

Nearly half of the people attempting the managerial transition fail, making it one of the most difficult challenges first-time managers can face (Biddle & Roberts 1994). Normally engineers are expected to transition without any preparation or typical 'know-how'. But the case is different as they focus on technical aspects in their early career, and only a few organizations provide the necessary managerial training or transition support (Custovic & Insaurralde 2016). Wilde (2009) addressed that social and leadership aspects must be invested in an engineer to have a more promising opportunity to succeed. And the competition in the labor market has

fueled this need further. A simplified engineering career is proposed by (Wilde 2009) in Figure 3 below:



Figure 3. Engineering career path (Wilde 2009)

This change in the engineer career lifecycle goes with difficulties; one of them is the incumbent managerial roles engineers have due to their career experience (Wilde 2009). The effect thereof will be examined in more detail throughout this study.

In the following sections, we investigated the principles of management and leadership and their relationship with others, particularly with engineering, to give insight into what is required to be a successful manager.

3.1.4 Management and Leadership

To understand management as a construct, we need to investigate the underlying values and skills that made it up. Cambridge English Dictionary defines a manager as "the person who is responsible for managing an organization". Peter Drucker (1954), in his book 'The Practice of Management ', defines a manager as someone who manages a particular part of an organization and its resources. The managers' role is to steer these resources to benefit the company. And "make people productive".

The higher the management level in the organization hierarchy, the minor manager is involved in the daily activities, and the more they engage in the strategies and general coordination (Maccarthy 2018). To understand management and the roles that managers fill, we need to investigate more about the skills required to perform

manager responsibilities, what companies expect from a manager and what difficulties managers typically experience. Therefore, this section focused on managers' duties and the skills required to perform these managerial responsibilities effectively.

3.1.4.1 Essential Responsibilities of a Manager

It is hard to identify the responsibilities required to be a good manager accurately, but Heathfield (2017) identified typical management responsibilities and a manager's role within a business, such as planning, organizing, leading, monitoring, evaluating and miscellaneous.

These responsibilities address certain aspects apparent that are of significance for this study. Heathfield (2017) mentioned that the duties between an engineer and a manager have fundamental differences; engineers are much more technical orientated, and the responsibility of managing others is an addition. While managers lead, guide others, and monitor and evaluate the team. Also, he addressed that transitioning from typical engineering roles to managerial roles encompasses a broader view of the overall organization since the role changes focus from specific design or tasks to strategic implementation, with a critical difference being delegating tasks to others. And it is not explicitly stated in the description, but giving up control of technical matters allows a manager to focus on overall management.

3.1.4.2 Essential Skills of a Manager

The earlier section leads us to various skills needed to perform managerial responsibilities effectively. Managers need to develop six skills (Reh 2018):

1. Leadership Skill

Leadership is a vital management skill that helps direct an organization's resources for improved efficiency and achieving aims. Influential leaders provide clarity of purpose and motivate and steer the organization to accomplish its mission (Ward

2017). In this section, the definition of leadership and its importance will be peered at as management requires leadership properties, and separating the two would be destructive (Mallaby 2014). It also applies in engineering as leadership must be present for an influential manager engineer role.

The definition of leadership varies in the literature, and although the term is mentioned regularly, the description is hard to put into words. Ward (2017) stated that leadership motivates people to work towards a common predetermined outcome. He says it simply: “The leader is the inspiration and director of the action”. Modestino et al. (2020) stated that a leader has certain qualities and skills that make team members work together and follow him towards the goal. These skills are wide-ranging, and different people experience different weightings of importance. They identified trustworthiness, motivation, communication, confidence, and creativity as the most vital skills for a leader.

Leadership theories, such as the Transformational Leadership Theory, have also developed, focusing on human behavior, charisma, values, vision, and inspiration (Mallaby 2014). In addition, some arguments discuss whether leaders are born or made. Avolio et al. (2009) argue that leadership is not based on hereditary traits but on the experiences of an individual. Similarly, Mallaby (2014) supported this argument by highlighting that leaders must be developed over time, matching the leadership maturity model. Both researchers believe that the career transition to management and success depends on the preparation for it by designing a development plan containing driving, education, communication, and work experiences, as the fastest way to learn is to experience it.

Leadership and management overlap but are not the same as Kotterman (2006) mentioned. He said leaders' and managers' primary mission is to control and influence their teams.

The Guardian (2013) identified the most crucial difference between managers and leaders is their approach to reaching goals. Managers exert their control through

formal power, but leaders influence their followers by using their vision, inspiration, and motivation. A balance between the role of both management and leadership is essential to the organization's success. Moreover, sometimes managers need to be successful in working as leaders (Mullins 2010)

2. Communication Skill

This section identifies communication and its importance as a superior skill in a successful manager. The communication transmits information from one entity to another (Skillsyouneed 2018). In a managerial career, communication is needed through speeches, presentations, and meetings; without proper communication, uncertainty arises, and the aim is lost (Eisenhauer 2016). This definition has a vast range of enclosing elements, but Skillsyouneed (2018) divided it into four main groups as the following:

- Verbal: face-to-face, telephone, radio, television, videos, etc.
- Non-Verbal: body language, expressions, clothes, smell etc.
- Written: letters, email, internet, ads, etc.
- Visualizations: pictures, charts, maps, graphs, etc.

Menon (2015) claimed that communication can be seen to extend over all interpersonal events. Therefore, poor communication can transfer a wrong message. Add more, he said that new forms of communication are introduced, such as instant messaging, that need a new set of control measures to avoid the "wrong" communication problem. For effective communication, Menon (2015) developed the seven C's of communication, a list of principles to which you should ensure all your contacts adhere. They help ensure that the person you're communicating with listens to what you're trying to say. The seven C's are: Clear, Correct, Complete, Concrete, Courteous, Considered and Concise. Like other skills, communication can also be developed and improved. Different skills will make for more effective communication, such as learning to listen, learning non-verbal cues, being direct, and showing empathy (Pinola 2014).

Since communication forms part of the core path to becoming an efficient manager thus, Wolff (2016) suggested three techniques; First, put down your mobile phone while communicating with others. Secondly, learn from the people you admire and respect. Thirdly, role-playing with friends in a challenging conversation or a stressful situation could help too.

As communication plays a role in the other responsibilities within the managerial context, we continued in the following section investigating the next skill, collaboration.

3. Collaboration Skill

Hansen (2016) identified collaboration as working with others towards an expected outcome. And the phrase refers to coordinating the efforts of many towards a particular purpose while meeting the group's needs. He incorporates that working together with other teams and people is part of day-to-day activities. Therefore, as managers typically drive teams from different backgrounds with various opinions, they must know how to collaborate and motivate others. Collaboration could involve people within the same organization or from different organizations. It is even more challenging nowadays as global communications have made it possible to be anywhere and still need to deliver the required outcomes. These outcomes could be tenders, services, products, designs, and projects. Hence, the efficiency of these collaborations is crucial to their success and needs not only technically sound managers but also the required environment to obtain optimal outcomes (Fitzell 2014).

Because collaboration forms part of managers' responsibilities, there is a great benefit to be found therein. Hansen (2016) looked at elements that impact the efficiency of cooperation. These elements include the following:

- Active communication- through open-mindedness, being receptive, listening to others, not judging others, and being straightforward.

- Engage everyone correlating with the problem or the situation.
- Trust and Respect- are essential to any interaction between people; when a leader loses the trust and respect of their employees, it will negatively impact your organization's results.
- Define problem-solving mechanisms- by setting out rules, directions or guidelines for conflict or problem resolutions.
- Tolerance and compromise- are used to ensure a peaceful environment. In collaboration, it can help smooth over conflicts in various situations.
- Positivity and authenticity- increase the ability to think creatively, progress in our careers, cope with challenges, and work with others.

4. Critical Thinking Skill

Critical thinking uses knowledge and skills to examine and carefully explore situations and come to thoughtful conclusions based on evidence and reason. The critical-thinking approach is a powerful analytical technique that allows managers and leaders to consider behaviours' intended and unintended effects on their teams, organizations, and communities. (Neck 2022)

Critical thinking gives managers the tools to make better decisions and helps predict the effects and consequences. Neck (2022) suggests seven steps to practice critical thinking, illustrated in Figure 4.



Figure 4. Seven steps to practice critical thinking (Neck 2022)

Critical thinking skills are essential to organizations and necessary to being a good manager. The ability to make decisions via what is familiar at a phase could be the difference between success and failure, such as in the case of tenders, deadlines, and overall effectiveness. Glaser (2019) said it could further be seen to have two components: a set of information-generating and handling skills and the second is directed behaviors through habit.

5. Finance Skill

Budget management and understanding cost control must be part of a manager's skill set (Reh 2018). The need to set financial targets and manage certain impacting factors to obtain these targets also forms part of managerial responsibilities. However, it only contains organizational finance aspects driven mainly by assessing situations. Financial management is the planning, organizing, directing, and controlling of economic activities and resources for the best result for the organization. The scope of these determinations is divided into three areas: financial

planning, financial decision-making, and financial control. It generally contains procurement, distribution, and control of financial resources. Simply put, the accounting assigned to managerial functions considers the daily operations and drives the organization's operations and strategy (Ohio University 2018).

Juneja (2018) proposed the main objectives of financial management as follows:

- Ensure adequate monetary support to the organization in the form of capital
- Provide sufficient returns on economic investments and to shareholders
- Ensure monetary assets fully and optimally are used
- Ensure financial assets are invested in the proper ventures
- Ensure optimal capital structure between equity and debt.

Furthermore, Juneja (2018) claimed that finance is a critical part of any managerial role but may vary in procedure from position to position. With the basic knowledge of financial indicators, assessment and the reason rectification measure, financial guidance and management as a leadership role are simplified to understand how to make money. The core principles still require to be understood and involved accordingly. Applying these principles carries over to other responsibilities in the managerial context. A skill that is mainly influenced by finances is project management which will be discussed in the next section.

6. Project Management Skill

In the assignment of responsibility, knowing that an individual can initiate, plan, and execute a project to completion is necessary. Project management is essential to managerial functions and must be combined into a manager role.

Managers typically undertake various projects, and the success thereof is vital to any organization and, thus, every manager. A good manager needs many skills to achieve endeavors and finish with the required outcome. Project management can then be seen as applying particular skills and tools to ensure the project's outcome (Project Management Institute 2018). Joubert (2019) mentioned the essential skills for project managers: effective communication, negotiation, time management,

leadership, technical expertise, risk management and problem-solving.

Project management skills help in many ways while practicing management roles. This skill can be developed and learned. Joubert (2019) suggested three techniques that could be useful to be a good project manager; the first technique is to practice, practice, practice. The second technique is to attend industry events and workshops. The third is to earn a degree or certificate in project management.

3.1.5 Engineer Vs Manager

Bhattacharya (2018) claimed that engineering and management are two paths in education and work. But their distinction becomes blurred in real-life situations when an engineer is involved in a managerial role. Since this study aims to identify the success factors affecting the transition from engineer to a manager role, this section used a MAIR Model (Motivation and Confidence, Abilities & Skills Development, Ideas and Resources) to make distinctions between managers and engineers (Bhattacharya 2018) as shown in Table 3.

Table 3. Differences between engineers and managers (Bhattacharya 2018)

Engineers	Managers
Technology- centered	People-centered
Depend solely on his technical skills.	Depend on the skills of his team of people.
Concentrate on the task at hand.	Look at a task from the point of view of the value it adds.
Daring and concentrating on the technical tasks	Looks at the budget, resources available to them and the time constraint
Take decisions based on their knowledge and skills	Takes decisions based upon many constraints such as capital, process, and his team
Pursue one job at a time.	Pursue multiple objectives concurrently.

The engineer's work is quantifiable and can be measured	Qualitative analysis of the work
Involve in technical/scientific tasks.	Involve in planning, leading, controlling, and organizing.

3.1.6 The transition from Engineering to Management

Much of the earlier literature conceptualized the move to management by engineers becoming a manager as leaving the engineering profession, “track switching” (Biddle & Roberts 1994), an “exit of engineers from their original profession” (Johnson & Sargeant 1998) and a “huge occupational shift” (Rynes 1987). This change is frequently presented as a problem for individuals and organizations or an unpleasant career move that often fails.

At this stage, management is a social science, as Bridges (2013) said. He said that the difference between change and transition is that change occurs without people transitioning and is situational. But a transition is psychological and accepting the new situation forms part of it. In this study, the transition from engineer to manager role considers a phase of change that encompasses the change and the time frame. This occurs in two parts: the title changes and the duties change (Bridges 2013). The transition process varies for various situations, but the fundamental aspects must be known. Three-core phases of job market transitions are namely (i) the ending phase, (ii) the neutral zone, (iii) and the new beginning phase (Bridges 2013), illustrated in Figure 5.

- The ending phase comes with the realization of change—excitement, worries, suffering and detachment.
- The neutral phase involves discharging your old position, habits, and routines. The scenario of what ‘was’ and what ‘is’ creates a high-risk tension zone that concerns and ruins confidence.

- Establishing and settling in your new "situation" is the starting phase.

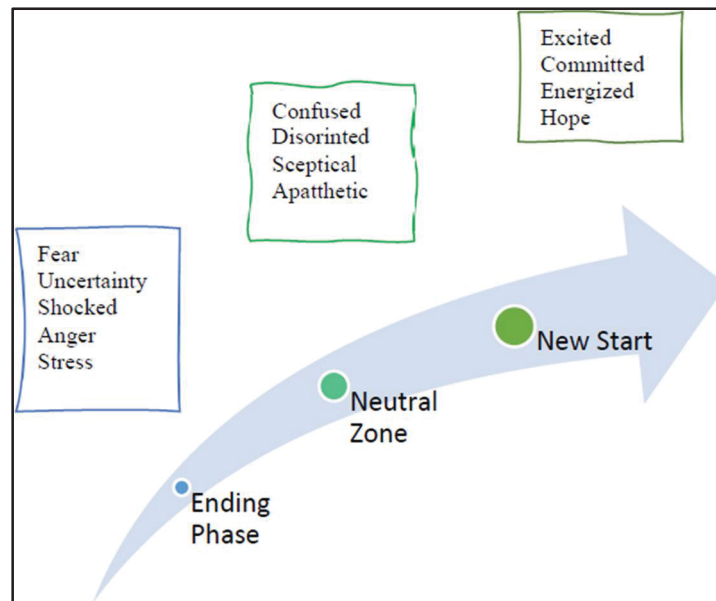


Figure 5. Bridges transition model. (Bridges 2013)

Various trains of thought have been spurred from the Bridges transition model, such as the Prosci model, which describes what is required at an individual level to successfully manage transition psychologically (Prosci 2017).

3.1.6.1 The transition from engineering to management as a disadvantage

The transition of engineers to managers is a challenging task and challenge for management (Badawy 1995). The difficulty of becoming a manager may arise from the historical uncertainty between engineering and managerial roles (Hodgson et al. 2011), stemming from differences between engineering and managerial career and the unsuitability of engineers for managerial positions. Morrison (1986) summarizes the differences between engineer and manager roles regarding several criteria, including role priority, responsibility, and results. Engineering roles are described as having a technical focus and fact-based decision-making to achieve quantifiable results. In contrast, managerial positions have higher interpersonal dependence, vagueness, and uncertainty (Evans & Bredin 1987).

The literature ascribes the engineers' drought of suitability for management to many reasons such as traits, principles and motivations and a lack of necessary skills. Engineers are seen as oriented toward technological rather than administrative goals, as Biddle & Roberts (1994) mentioned. According to Morrison (1986), engineers typically prefer to work individually to solve problems, relying on their technical expertise and awareness of detail to reach results. In contrast, managers rely on the team to achieve outcomes. Different skills are seen as necessary to perform managerial work. Therefore, Thamhain (1991) developed a skill list for engineering managers, including leadership, technical and organizational skills.

The technological focus of engineering may leave engineers not prepared to deal with the expanded scope and priorities of a managerial role (Morrison 1986). Engineers may lack interpersonal skills (Biddle & Roberts 1994), teamwork orientation, and the ability to communicate with a new team and senior managers (Morrison 1986). Other research highlights a lack of leadership and business management skills (Biddle & Roberts 1994) and skills relating to decision-making (Morrison 1986). Further, Morrison (1986) remarks that new managers do not receive sufficient training and preparation, suffering from a lack of orientation to managerial tasks and a lack of clarity of the responsibilities and expectations of a leadership role.

3.1.6.2 The transition from engineering to management as an advantage

An alternative viewpoint suggests that engineers are well-suited for managerial positions, particularly in technical organizations. Engineers' analytical and organizational skills could help them in managerial work (Badawy 1995). Engineers' technical experiences are seen as valuable by some researchers. Biddle and Roberts (1994) prove that technical and managerial skills help more successful technical workers become successful managers. The specialised experience is a needed resource for driving other specialized employees, especially as a resource of credibility and respect from their team regarding their technical expertise (Mael et al. 2001). Additionally, managers with technical knowledge are perceived as

necessary for the successful process of specialized organizations and the development of new technology (Kocaoglu 1994).

More recent research in engineering practice questions this division between management and engineering work and sees the opposite. Rather than separate and conflicting, research on engineer jobs implies that technical coordination is the basis of engineering jobs and that most engineers perform organizational and technical tasks from their early careers (Williams & Figueiredo 2011). This gradual expansion of engineering roles is an admitted career path within the engineering profession, described as a transition to a less technical role and more managerial role (Williams & Figueiredo 2011). Besides, Seethamraju (2004) describes the changing roles of engineers in modern organizations and the vagueness between technical and managerial positions. He said this concept of engineering work as a combination of technical managerial is not considered in engineer-manager transition investigations. Instead, most studies consider the transition as leaving one role and entering a different and incompatible one Seethamraju (2004).

3.1.7 Challenges in the transition phase

The differences between engineers (skills and qualities) and managerial work nature are supposed to result in issues during the transition that may influence both the individual and the organization. Difficulties may lead to displeasure or poor performance (Bailyn & Lynch 1983). Engineers not fulfilling their organizations' performance expectations may derail (Yeh 2008). From an administrative-level standpoint, engineers' transition into management has been questioned as efficient usage of human resources, mentioning that the change can result in a waste of technical investment (Roberts & Biddle 1994).

Howard (2003) observed little research on the nature of the engineer-to-manager role transition and that practical analysis does not identify the sources of the difficulty. To fill this gap, he explored the challenges experienced by some engineers who had become managers in the American aerospace industry. He

identified nine challenges engineers experienced during the transition listed in Table 4.

Table 4. Challenges Experienced by Engineers Transitioning into Management (Howard 2003)

Challenge	Description
Role and responsibility	"So much going on; more tasks and responsibilities"
Communication and Relationship	"More personal relationships and more interaction"
Delegation	"Leaving the hands-on technical behind and learning to rely on others"
Pressure and Stress	"Time frames and meeting deadlines increased pressure and stress"
Developing skills	"Learn new managerial and leadership skills"
Resources	"Finding the staff and managing the time to get the work done"
New guy	"Change from being technical to being a manager"
Organizational Issues	"New organization level with its issues"
Choose the management career path	"Questions experienced during and after the transition"

Wilde (2009) built on Howard's study to better understand the difficulties engineers experienced as they transitioned into management roles. He asked more than 200 engineering managers working in a large technology company in the USA to rank their challenges by difficulty level. Wilde's study identified the most difficult challenges as 1) leaving behind them the technical work, 2) balancing all the new responsibilities, and 3) the increased stress and pressure connected with their

management positions. This agreed with Howard's challenges of 'more tasks and responsibilities and 'Delegation'. Nevertheless, Wilde's respondents did not rate relationships and interactions as one of the most challenging. Wilde also set the connections between transition challenges. He found that developing managerial skills is significantly associated with all the other challenges. Wilde (2009) also pointed out that identifying and developing the required managerial skill set can dramatically reduce the discomfort associated with the transition.

3.2 Theory

The research questions *"What are the personal characteristics, skills, challenges, and motivators that impact the transition from engineering to management roles"*. And *"How do they influence the career development of engineers in this transition process?"* was developed based on several career development theories, including John Holland's Theory of Career Choice (Holland 1997), Frank Parsons' Theory of Trait and Factor (Parsons 2008), John Krumboltz's Theory of Happenstance (Krumboltz 2013), Albert Bandura's Social-Cognitive Theory (Bandura 1997), and Donald Super's Theory of Developmental Self-Concept (Super 1957).

The Theory of Career Choice by John Holland (1997) helped to identify and understand the personal characteristics and skills that may impact an engineer's transition to a management role. The six personality types identified by Holland's theory can be used as a framework for categorizing the engineers' characteristics, the skills they possess, and how these align with the requirements of a management role. According to the Theory of Career Choice by John Holland, individuals are more likely to pursue careers that align with their personal characteristics and interests (Holland 1997). This theory can be used to understand how engineers' personal characteristics may impact their transition to management roles and subsequent career development.

The Theory of Trait and Factor by Frank Parsons (2008) helped identify and understand the challenges engineers face when transitioning to management roles. The theory can help identify the skills and factors required for a successful transition and how these align with the engineer's existing traits and characteristics. Similarly, it emphasizes the importance of matching individual characteristics and abilities with career opportunities. This theory can help identify the specific skills and traits engineers may need to develop to transition to management roles successfully.

The Theory of Happenstance by John Krumboltz (2013) helped to understand the motivators that impact an engineer's decision to transition to a management role. The theory emphasizes the importance of chance events and personal agency in career development, highlighting the role of external factors and personal choices in deciding to take on a management role. Also, it highlights the role of chance and unexpected events in career development. This theory can help understand how external factors, such as changes in job opportunities or personal circumstances, may impact an engineer's decision to pursue a management role.

The Theory of Social-cognitive by Albert Bandura (1997) helped to understand how personal characteristics and skills can be developed and strengthened over time, providing insight into how engineers can overcome the challenges they may face during the transition process. The theory emphasizes the role of social and cognitive factors in shaping individual behavior, highlighting the importance of self-efficacy and goal setting in developing skills and traits. The Theory of Social-cognitive by Albert Bandura emphasizes the importance of self-efficacy and self-belief in career development (Bandura 1997). This theory helped to understand the role of personal motivation and confidence in an engineer's decision to transition to a management role.

The Theory of Developmental Self-Concept by Donald Super (1957) helped to understand how the transition from engineering to management roles can impact an engineer's career development. The theory emphasizes the importance of self-concept in shaping an individual's career choices and how they can impact their long-term career development. The Theory of Developmental Self-Concept by Donald Super emphasizes the importance of self-awareness and self-concept in career development (Super 1980). This theory is useful in understanding how an engineer's self-concept and identity may impact their decision to pursue a management role and navigate the transition process.

These theories provide different perspectives on the factors influencing career development and help understand the transition from engineering to management

roles. For this study, the Theory of Career Choice by John Holland (Holland, 1997) and the Theory of Happenstance by John Krumboltz (2013) are particularly relevant, as they both emphasize the role of personality and chance events in career development. The concept of personality types and the importance of being open to new opportunities and social support is essential theoretical concepts to consider in the analysis of this research.

4 Methodology

The research questions in question lend themselves well to the explanatory qualitative method. Qualitative research effectively examines complex social phenomena and comprehends people's viewpoints, behaviors, and experiences (Creswell 2014). It is a suitable research approach to explore career development and transitions as it facilitates gathering detailed data through open-ended interviews, observation, and document analysis. Qualitative research is particularly beneficial in discovering engineers' subjective experiences and perspectives as they move into management positions (Ghauri, Gronhaug & Strange 2020; Patton 2015; Stevens & Wrenn 2013; Savickas 2019).

Qualitative research can uncover individuals' meanings and interpretations of their experiences and provide insights into the personal and contextual factors that influence their career development (Creswell 2014). Moreover, this research question requires an in-depth exploration of the subjective experiences of engineers, which is best achieved through qualitative methods. Through in-depth interviews and qualitative data analysis, this study provides a detailed understanding of the personal characteristics, skills, challenges, and motivators that impact the transition from engineering roles to management roles and how they influence engineers' career development in this process.

Ghauri, Gronhaug, and Strange (2020) argue that qualitative research is beneficial when studying human experiences and behavior. It allows researchers to gather in-depth data and gain insights into individuals' subjective experiences and interpretations which is particularly relevant to the research questions. Stevens and Wrenn (2013) highlight that exploratory qualitative research is beneficial when researchers have limited knowledge of a particular phenomenon and wish to understand it better. And this is relevant to the research questions, as the transition from engineering roles to management roles is a complex phenomenon that has not been extensively studied in the literature (Howard 2003). Exploratory qualitative

research can help identify key factors influencing this transition process and generate hypotheses for further study. Patton (2015) notes that qualitative research is beneficial when studying complex social phenomena influenced by multiple factors, such as career development. Also, he said that qualitative research allows researchers to identify and explore the contextual factors that influence individuals' career development, particularly relevant to the research questions.

While the explanatory qualitative method is well-suited for exploring complex and sensitive topics, it is vital to highlight the limitations. Some of these limitations include the limited generalizability of the findings due to small sample sizes, the potential for researcher biases due to the use of interviews, focus groups, or observation, and the time-consuming and resource-intensive nature of the research process (Ghauri, Gronhaug & Strange 2020).

Denzin and Lincoln (2017), Creswell (2014), and Silverman (2017) also argue that while qualitative research may have limitations, it is still a valuable tool for exploring complex social phenomena and gaining an in-depth understanding of individuals' experiences and perspectives.

4.1 Data collection method

Open-ended questions are a common data collection method in qualitative research, particularly in the form of interviews. In the context of the research questions, open-ended interviews can be justified as they allow participants to provide rich, detailed responses that can provide valuable insights into their experiences and perspectives (Bryman 2016).

One of the advantages of using open-ended questions in interviews is that they allow participants to express their thoughts and experiences in their own words, which can provide a more comprehensive understanding of the topic being studied (Maxwell 2013). In the context of the research questions, open-ended interviews can help capture the complexities of the transition from engineering to management roles, including the various challenges, skills, and personal characteristics that

impact this process.

Another advantage of using open-ended questions is that they allow for flexibility in the interview process. Participants can provide unexpected insights or raise issues the researcher had not considered before (Patton 2015). This can help to generate new ideas or identify areas for further investigation.

However, one of the limitations of using open-ended questions in interviews is that they can be time-consuming and resource-intensive, particularly in transcription and analysis (Bryman 2016). Additionally, the quality of the data collected can be influenced by factors such as the interview setting or the participant's comfort level with the topic, which can impact the validity and reliability of the findings.

Overall, using open-ended questions in interviews can be justified as an appropriate method for data collection in the explanatory qualitative research question, as it allows for rich and detailed responses that can provide valuable insights into the experiences and perspectives of participants (smith 2018).

4.2 Selection

Purposive sampling, also known as selective or judgmental sampling, is a common method used in qualitative research to select participants who possess specific characteristics or have experienced certain events relevant to the research questions (Patton 2015). In the context of the research questions, purposive sampling can be justified as it allows the researcher to select participants who have experienced this transition, ensuring that the chosen data is relevant to the research question (Creswell 2014).

One of the advantages of purposive sampling is that it allows the researcher to select participants with specific characteristics or experiences relevant to the research questions, improving the validity and reliability of the findings (Maxwell 2013). In the case of the transition from engineering roles to management roles, purposive sampling can help to ensure that the sample includes individuals who have

experienced this transition and can provide valuable insights into the factors that impact this process.

However, one of the limitations of purposive sampling is that it can be subjective and prone to researcher bias (Bryman 2016). Since the participants are selected based on specific characteristics or experiences, the researcher's prejudices and preconceptions can influence the selection process. Therefore, in this research, selecting participants was objective to avoid potential biases.

Overall, purposive sampling can be justified as an appropriate method for data selection in the explanatory qualitative research question. It allows the researcher to select participants who possess specific characteristics or have experienced relevant events and can help ensure that the sample includes individuals with diverse experiences and perspectives.

To determine the appropriate number of interviews for a qualitative study, it is essential to consider factors such as the research questions, the sample size, and the saturation level achieved in the data. Saturation refers to the point at which additional interviews no longer yield new or relevant information. In this study, the purposive sampling method is used to select participants who have experience transitioning from engineering roles to management roles. A sample size of 8 participants is targeted as it is expected that saturation will be achieved with this number of participants. Previous research has suggested that saturation can be achieved with as few as 6-10 interviews, particularly when participants have shared experiences or backgrounds (Guest, Bunce, & Johnson 2006; Francis et al. 2010). By selecting participants with similar experiences, it is more likely that saturation will be achieved with a smaller sample size.

Moreover, recruiting participants for qualitative studies can be challenging, mainly if they are busy professionals. It is important to ensure that potential participants understand the purpose and value of the research and how their participation can contribute to new knowledge. By targeting a specific group of individuals with shared experiences and emphasizing the significance of their contributions, it is

hoped that the study will motivate the participants to engage in the interview process.

4.3 Ethical considerations

In researching the personal characteristics, skills, challenges, and motivators that impact the transition from engineering to management roles, it's crucial to consider ethical principles to ensure the protection and well-being of the research participants. To address the comments, several measures were taken to recruit participants and ensure their confidentiality and anonymity.

To recruit participants, various methods such as advertisements in professional organizations, social media groups, and online forums were used. Participants were selected based on the inclusion criteria, and the informed consent process was followed. The informed consent process included providing participants with information about the research, their rights as participants, and the data handling procedures.

Confidentiality and anonymity were ensured by collecting and storing participants' data securely. Methods such as encryption, pseudonymization, and password-protected databases were used to keep participants' identities confidential. Participants can also be assigned unique identification numbers instead of using their real names to protect their anonymity.

Regarding the potential risks and benefits to participants, the study can involve some risks, such as discomfort or anxiety during interviews or surveys. The research team minimized these risks by assuring the participants that their participation was voluntary, and they had the right to withdraw from the study at any time without consequences. Participants were provided with emotional support and resources to address any potential negative experiences.

The benefits of participating in this research can include gaining insights into personal characteristics, skills, challenges, and motivators that impact the transition

from engineering roles to management roles and contributing to the knowledge base in this area.

Ethical principles and guidelines set forth by the Swedish Research Council (2017) were followed throughout the research process to ensure the protection and well-being of the research participants. Data was stored securely, and only the research team could access it. The research team assessed and managed the potential risks and benefits to participants to ensure that the research did not cause harm or discomfort.

4.4 Analysis method

Thematic analysis is a widely used method in qualitative research for systematically and transparently analyzing data (Braun & Clarke 2006; Nowell et al. 2017), particularly in an exploratory study. It involves identifying patterns or themes within the data and can be used to uncover participants' underlying meanings, beliefs, and values. Thematic analysis is a flexible and iterative process, allowing for both inductive and deductive approaches to analysis (Braun & Clarke 2019).

Additionally, it can be used to identify commonalities and differences among participants and compare and contrast different cases. The thematic analysis also enables researchers to uncover unexpected or novel findings that may not have been anticipated (Braun & Clarke 2019).

Despite its popularity and usefulness, thematic analysis also has some limitations. One of the limitations is the potential for subjectivity in the analysis process, as researchers' interpretations of the data may vary (Nowell et al. 2017). Another limitation is the potential for researchers to overlook or discount data that does not fit into the identified themes (Braun & Clarke 2006). To overcome these limitations, researchers can involve multiple analysts to review and refine the themes and regularly revisit the data to ensure all aspects are considered (Nowell et al. 2017). One of the main limitations is the potential for researcher bias, as the interpretation of the data can be influenced by the researchers' preconceptions and assumptions.

Another limitation is the subjective nature of the analysis, making it challenging to establish inter-rater reliability. Finally, thematic analysis can be time-consuming, mainly if the data set is large (Braun & Clarke 2019).

Thematic analysis is a method for analyzing qualitative data that involves identifying patterns and themes. It involves several steps that begin with familiarizing oneself with the data and then generating initial codes based on the research questions. Next, codes are organized into potential themes, reviewed, and refined to ensure they accurately reflect the data. Finally, themes are named and described, and the analysis is interpreted considering the research questions.

According to Braun and Clarke (2006), the six steps of thematic analysis are:

- Familiarizing oneself with the data
- Generating initial codes
- Searching for themes
- Reviewing themes
- Defining and naming themes
- Producing the report

Thematic analysis is a flexible method that allows researchers to explore complex phenomena and identify patterns in the data (Braun & Clarke 2021). It is beneficial in studies exploring subjective experiences, such as transitioning from engineering to management roles.

In the context of the research questions, "What are the personal characteristics, skills, challenges, and motivators that impact the transition from engineering to management roles? ". And "How do they influence the career development of engineers in this transition process?". Thematic analysis is used to identify patterns and themes related to personal characteristics, skills, challenges, and motivators that impact engineers' transition process and career development. The initial coding for this research question could include codes such as "technical skills," "communication skills," "leadership qualities," "time management," "role ambiguity," "motivation for promotion," and "mentoring." These codes then

grouped into themes such as "skill gaps," "role ambiguity," and "career aspirations," which would be further refined and defined to provide a clear and concise summary of the data. The final write-up of the analysis would incorporate quotes and examples from the data to support the identified themes and provide insights into the factors that impact the transition from engineering roles to management roles and the career development of engineers.

Thematic analysis was conducted using a manual approach without specific software or tools. The analysis was conducted by two independent researchers who read and familiarized themselves with the data. Next, they generated initial codes based on the research questions and organized them into potential themes. The themes were then reviewed and refined to ensure they accurately reflect the data.

To enhance the reliability and validity of the analysis, both researchers coded a subset of the data independently and then compared their codes to ensure agreement. They also discussed any discrepancies and agreed on the final coding scheme. This process was repeated for the entire dataset.

As thematic analysis is a flexible and iterative process, the researchers continuously revisited the data to ensure that all aspects were considered and that themes were refined as necessary. The final write-up of the analysis incorporated quotes and examples from the data to support the identified themes and provide insights into the factors that impact the transition from engineering roles to management roles and the career development of engineers.

Overall, the thematic analysis was conducted transparently and systematically to uncover patterns and themes within the data and provide a comprehensive understanding of the research questions.

4.5 Credibility and validity

In qualitative research, credibility refers to the degree to which the findings accurately represent the experiences and perspectives of the participants.

Conversely, validity refers to the extent to which the research question is answered and the degree to which the data support the findings. Researchers need to employ various strategies to ensure credibility and validity, such as member checking, triangulation, and prolonged engagement (Lincoln & Guba 1985).

Several measures were taken to ensure credibility and validity in this study. Firstly, the research followed ethical guidelines set forth by the Swedish Research Council to ensure that the participants are treated with respect and that their privacy is protected (Swedish Research Council 2017). Secondly, purposive sampling was used to select participants with experience transitioning from engineering to management roles, ensuring that the participants have relevant knowledge and expertise (Palinkas et al. 2015). Thirdly, the open-ended interview questions were designed to extract detailed and refined responses from the participants, allowing for a deeper understanding of their experiences and perspectives (Lincoln & Guba 1985). Finally, the thematic analysis method was applied, which involves a systematic and strict process of identifying patterns and themes in the data to ensure the validity of the findings (Braun & Clarke 2006).

By incorporating these measures, the study aims to increase the credibility and validity of the findings, allowing for a deeper understanding of the personal characteristics, skills, challenges, and motivators that impact the transition from engineering roles to management roles and how they influence the career development of engineers in this transition process.

To enhance the generalizability of the findings, several measures were taken. Firstly, purposive sampling was used to select participants who have experience transitioning from engineering to management roles. This sampling strategy ensured that the participants had relevant knowledge and expertise, which increased the likelihood that the findings would apply to others who have made a similar career transition.

Secondly, the study utilized multiple sources of data. In addition to the interviews with participants, data was also collected through a review of relevant literature,

such as studies on career transitions and leadership development. This approach provided a broader perspective on the topic and allowed for a more comprehensive understanding of the factors influencing the transition from engineering to management roles.

Furthermore, to increase the transferability of the findings, the study provided detailed descriptions of the research methods and procedures and the characteristics of the participants. This will allow readers to assess the extent to which the findings may apply to their contexts.

By incorporating these measures, the study aims to enhance the generalizability of the findings and contribute to a more comprehensive understanding of the transition from engineering roles to management roles.

4.6 Approach

Based on the research questions and purpose, we first thoroughly reviewed the literature on transitioning from engineering to management roles. This helped us identify key themes and concepts we wanted to explore in our study. We then developed an interview guide, which included open-ended questions that were designed to obtain informative and detailed responses from the participants. The interview guide was pilot-tested with a small group of participants to ensure the questions were clear and effective.

To drive open-ended interview questions that can be used in thematic analysis, the research questions were divided into sub-questions to achieve the detailed information needed, as shown in Appendix 1.

After the interview guide was finalized, we used purposive sampling to select participants who had experience transitioning from engineering roles to management roles. We contacted potential participants and provided them with an information letter, as shown in Appendix 2, explaining the purpose of the study and what their participation would entail. We took detailed notes during the interviews

and recorded the conversations for later transcription. The transcripts were then analyzed using thematic analysis, which involved a systematic and rigorous process of identifying patterns and themes in the data. By asking open-ended questions related to the research questions, the responses are used to identify patterns and themes in the data through thematic analysis.

To connect the interview questions to thematic analysis coding, first, we reviewed the responses and identified recurring patterns or themes. These themes can then be assigned codes, which are labels that represent the theme or pattern. For example, if multiple interviewees mention the communication challenges in their transition from engineering to management, the code "communication challenge" could be assigned to those responses. Once the codes have been given to the responses, the next step is to organize them into broader categories or themes. This can be done by reviewing the codes and looking for similarities and connections. For example, coding related to challenges could be grouped under a broader theme of "challenges faced during the transition". Once the themes and categories have been identified, they can be further analyzed to draw conclusions and insights related to the research questions. This may involve comparing and contrasting the experiences of different interviewees, identifying commonalities and differences, and exploring the relationship between the themes and the overall research question.

To ensure the credibility and validity of the findings, we took several measures, such as following ethical guidelines set forth by the Swedish Research Council, pilot-testing the interview guide, and using a rigorous analysis method.

5 Results and analysis

This study aimed to identify the personal characteristics, skills, challenges, and motivators that impact the transition from engineering to management roles. Also, how they influence the career development of engineers in this transition process. To accomplish this objective, we conducted semi-structured interviews with eight engineers who had undergone this transition in the past 15 years. The interview questions were divided into two sections. In the first section, we gathered data about the interviewees, which is presented in Table 5. In the second section, we gathered all the data needed to answer the research questions and help us achieve the aim of this study.

Table 5. Overview of the Interviewees

Interviewee	Education	Current position	Field/ Industry
Interviewee 1	Master's degree	Sales General Manager	Electrical
Interviewee 2	Bachelor's degree	Facility Management Head	Architectural
Interviewee 3	Master's degree	Business Development Manager	Civil
Interviewee 4	Bachelor's degree	Chief Executive Officer	Civil
Interviewee 5	Master's degree	Team leader	Electrical
Interviewee 6	Master's degree	Presales Manager	Environmental
Interviewee 7	Bachelor's degree	Business Delivery VP	Civil
Interviewee 8	Bachelor's degree	Field Team Head	Geological

To analyze the results from the interview questions using thematic analysis, first, we transcribe the interview to ensure the accuracy of the data. Then we read and re-read the transcript to become familiar with the data and identify initial codes or themes that emerge from the data. Next, we start coding the data by assigning codes

to the data representing different concepts or themes that appear. This code is shown in Appendix 3. Afterwards, we reviewed and refined the potential themes, and an initial thematic map was developed, as shown in Figure 6, including three main themes and some associated sub-themes. The main themes in this step were aligned with the research questions.

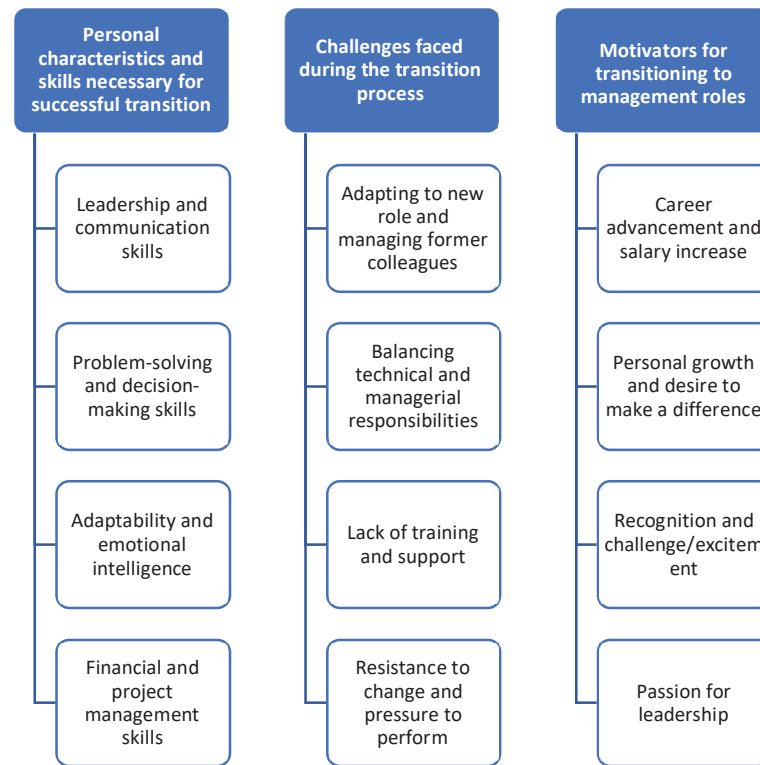


Figure 6. Initial Thematic Map

After a few iterations and refinements of the themes defined in the initial thematic map, the last name of the themes and subthemes were decided, as shown in Figure 7. In addition, some subthemes were chosen to be removed from the analysis since they were included in other sub-themes, e.g., problem-solving and decision-making are included in the leadership and communication skills sub-themes. Furthermore, the four sub-themes in the third theme were merged into three sub-themes: Desire for Career Advancement, Passion for Leadership, and Interest in Business Operations.

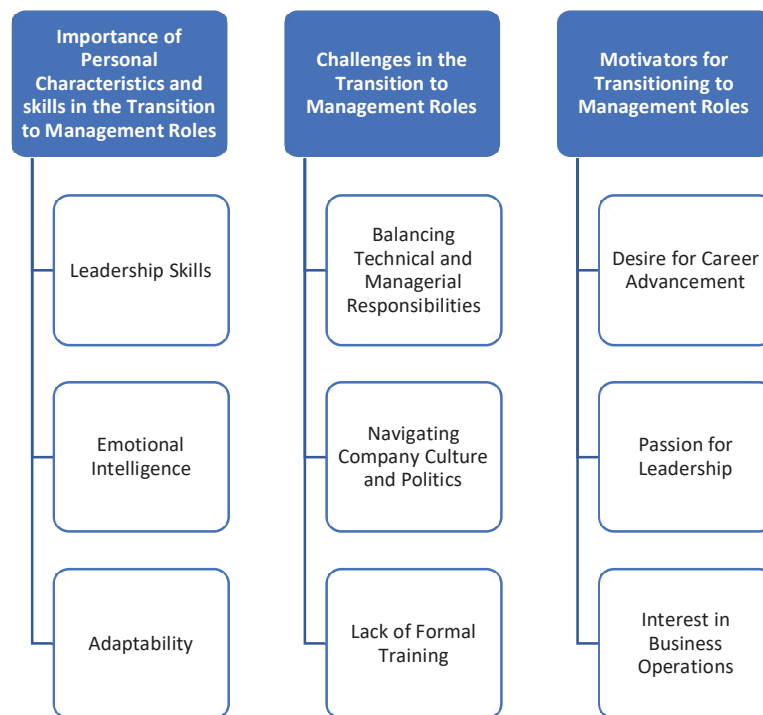


Figure 7. Final Thematic Map

The results of this study for the three main themes defined in the final thematic map, i.e., the importance of personal characteristics and skills in the transition to management roles, challenges in the transition to management roles, and motivators for transitioning to management roles, along with their corresponding sub-themes are further elaborated in the following subsections of this chapter.

Based on the thematic analysis of the interviews with engineers transitioning from engineering to management roles, several personal characteristics, skills, challenges, and motivators emerged. These themes are consistent with the theories of career choice, trait and factor, social-cognitive, and developmental self-concept.

5.1 Personal Characteristics and Skills in the Transition to Management Roles

During the interview, the participants were asked directly about the personality traits and skills that affected their transition from an engineering role to a

management role. Also, they were asked to describe when their characteristics and skills impacted their effectiveness as a manager.

Most participants highlighted vital personal characteristics and skills such as leadership, communication, problem-solving, ambition, self-awareness, confidence, and assertiveness. Financial and project management skills and problem-solving and decision-making abilities were also critical. Participants discussed the importance of developing strong leadership skills to successfully transition from an engineering role to a management role. This included motivating and inspiring team members, effectively communicating goals and expectations, and making difficult decisions when necessary. Six participants highlighted that a manager should be able to inspire, motivate, and guide their team towards achieving organizational goals. They should be able to set clear expectations, provide feedback, and delegate responsibilities effectively.

Four participants stated that leadership skills are essential for influencing and negotiating with others. Whether it's influencing stakeholders, negotiating contracts, or resolving conflicts, strong leadership skills help individuals navigate complex situations and achieve mutually beneficial outcomes. One of the participants indicated that *"I must make decisions that impact my team, organization, or community. I should be able to identify issues and develop creative solutions to address them. Also, I have a basic understanding of financial management to ensure that my team operates within budget constraints and achieves financial objectives"*.

Three participants pointed out building and managing a team; one participant said: *"As a leader, I am responsible for creating and managing my team to work together towards a shared vision. I collaborate effectively, build trust, and resolve conflicts. I always try to develop and maintain positive relationships with my team members, peers, and superiors"*.

While another one said: *"Managing people is hard, but I do my best to build a strong team, to understand my team, and lead them to the goal. I resolve conflicts*

between them and build trust".

Communication is another vital skill that was pointed out by most of the participants. Participants indicated that a manager should be able to communicate effectively with their team members, peers, and superiors. They should be able to listen actively, articulate their thoughts clearly, and convey their message in a way that is easily understood.

Regarding emotional intelligence, participants also highlighted the importance of emotional intelligence in the transition to management roles. This included the ability to understand and manage one's own emotions, as well as effectively navigate the feelings of team members. They said it allows them to effectively understand, manage, and guide their own emotions and the emotions of those around them. They Pointed out that emotional intelligence enables managers to build positive and healthy relationships with their team members. By understanding and managing their emotions, managers can regulate their behavior and communicate effectively, creating a positive work environment. They can also empathize with their team members' emotions, understand their perspectives, and respond empathetically, fostering trust, respect, and collaboration. One participant claimed that *"By understanding and managing my team's emotions, I could regulate their behavior, communicate effectively, and create a positive work environment"*.

Another participant said *" I can inspire and motivate my team members with high emotional intelligence. I can understand their needs and provide appropriate support and guidance, which increases employee engagement and productivity"*. Furthermore, one participant, claimed, *"Managers with emotional intelligence are better equipped to handle conflicts constructively. They can manage their emotions and stay calm in tense situations, listen actively to understand different perspectives, and find solutions that meet the needs of all parties involved. So that I always stay calm, listen, and understand other points of view to see a solution"*.

In terms of Adaptability, participants emphasized the need for adaptability when transitioning to a management role. This included being able to quickly pivot

between technical and managerial responsibilities, as well as being able to adjust to the company's culture and politics. A manager should be able to adapt to changing circumstances and navigate through uncertainty. They should be able to adjust their plans and strategies as needed to achieve their goals. Some participants indicated that adaptability is essential for engineers transitioning into managerial roles. It enables them to manage people effectively, navigate interdepartmental dynamics, lead change, problem-solve, foster innovation, and continuously learn and develop as leaders. It helps engineers-turned-managers to effectively manage the complexities and challenges of a managerial role, leveraging their technical expertise while adapting to the new demands and expectations of their position. Specifically, one participant stated: *"Shifting the mindset from engineer to manager required me to focus more on managing and leading others; adapting allowed me to understand and appreciate the diversity within my team."* Another participant said: *"I need to adjust my communication style, delegation approach, and leadership techniques to suit the needs of our team".*

Some participants considered adaptability crucial in managing change effectively. Being adaptable allows managers to flexibly adjust their approach, anticipate challenges, and proactively work the transition process, leading to smoother implementation of changes. Managers may need to assess the impact of changes, communicate the rationale behind them, and address concerns or resistance from team members.

One participant mentioned, *'Adaptability also involves a willingness to learn and develop oneself. As an engineer-turned-manager, you will face new challenges and responsibilities, and it's important to learn and develop your managerial skills continuously. Adaptability allows you to seek feedback, learn from experiences, and adapt your leadership style as you grow as a manager'.*

5.2 Challenges in the Transition to Management Roles

To identify the challenges engineers faced during their transition to the managerial role; the participants were asked to mention some of the challenges they faced during the transition, how they overcame them, and a mistake made and what they learned from it. During the interview, most participants pointed out challenges such as managing people, planning tasks, organizing, and implementing, developing others, monitoring, and evaluating, balancing technical and managerial responsibilities, company culture and politics, and lack of training.

Participants identified balancing technical work with managerial responsibilities as a significant challenge in transitioning to management roles. This included managing a team while ensuring that technical work was completed on time and to a high standard. One participant said: *"Managing a team, time management, and delegation are my biggest challenges. Managing people can be challenging, primarily if you have not handled it before. It's essential to understand the strengths and weaknesses of each team member and find ways to motivate them to achieve their goals. Managing and resolving conflicts efficiently and finding solutions for everyone is hard"*. While other participants claimed: *"Engineers who are promoted to managerial positions may struggle to balance their technical expertise with the demands of managing people and projects"*.

The mindset shift is another challenge identified by more than one participant when they said that engineers might struggle with the mindset shift required to transition from a technical role to a managerial position, including the shift from focusing on individual tasks to managing and leading teams. Notably, one participant said: *"Engineers may struggle with the mindset shift required to transition from a technical to a managerial role, including focusing on individual tasks to managing and leading teams"*. At the same time, another participant said: *"When I was in the engineering position, I tended to focus on the short-term and technical details of a project, but now as a manager, I have a broader, long-term perspective and must consider the business impact of their decisions"*. Add more; one participant said:

"When I was in an engineering role, I used to focus on details and technical aspects of the project, but now in the lead role, I have to focus on the big picture and overall strategic goals".

More than one participant mentioned metrics and risk tolerance as challenges they faced during their transitions. They pointed out that engineer measures success based on technical metrics such as code quality and system performance. In contrast, managers measure success based on business metrics such as revenue, customer satisfaction, and return on investment. Engineers tend to be more risk-averse and prefer to avoid uncertainties, while managers must be comfortable with taking calculated risks and making decisions with incomplete information. Specifically, one participant stated: *"I was focused on avoiding errors or mistakes. At the same time, as a manager, I must balance risk and reward and make decisions that minimize risk while maximizing opportunities".*

Participants also noted that navigating the company's culture and politics was a significant challenge in transitioning to management roles. This included understanding the company's unwritten rules and power dynamics and building relationships with key stakeholders. Some participants mentioned that one of the significant challenges is leading a diverse team; in today's diverse workforce, managers must be adaptable to effectively lead teams with members from various backgrounds, cultures, and perspectives. So, it is a challenge when managers must effectively communicate and collaborate with diverse team members and create an inclusive work environment where everyone feels valued and included.

It is essential to comprehend the fundamental beliefs and values that shape decision-making processes within the company, as this can significantly impact garnering support for initiatives and establishing trust among team members and other stakeholders. Additionally, participants highlighted the importance of aligning with the company's values and mission while navigating its culture and politics. One participant indicated that: *"Managing a diverse team requires understanding and appreciating individual differences, fostering an inclusive environment where*

everyone feels heard and valued, and addressing any biases or discriminatory behaviors that may arise. Therefore, it is an ongoing process that requires adaptability, awareness, and effective communication to build relationships, gain influence, and create a positive and inclusive work environment".

Aligning with company values and mission is considered one of the challenges that our participants faced. They said you must align your values and missions with the organization to be an effective manager or leader. One participant said: *"Initially, I found comprehending and deciphering the company's values, missions, culture, and politics challenging. Company culture often includes implicit norms, deals, and expectations that may not be explicitly communicated. These unwritten rules can differ significantly across organizations and may not be readily apparent to those in new management roles"*. Furthermore, power dynamics within the company, such as cliques, hierarchies, and informal networks, can impact decision-making, resource allocation, and opportunities for career advancement. Navigating these unwritten rules and power dynamics can be difficult for managers striving to establish authority and make meaningful contributions.

Overall, navigating company culture and politics during the transition to management roles can be challenging due to the complex interplay of unwritten rules, power dynamics, relationship building, leading diverse teams, managing office politics, and aligning with company values. It requires a combination of interpersonal skills, emotional intelligence, strategic thinking, adaptability, and inclusivity, to successfully navigate these challenges and establish oneself as an effective leader within the organization.

Moreover, participants identified a lack of formal training as a challenge in the transition to management roles. Many felt they had not received adequate financial and human resource management training. Engineers are often promoted to managerial positions based on their technical expertise and performance without receiving sufficient training in the skills required for effective management. One participant claimed that: *"I moved to a manager position directly without any*

previous knowledge about the new role, I thought it would be easy, and I would adapt to the new place quickly until I found that I lack financial and project management skills".

Some participants added that engineers lacking formal management training might encounter difficulties transitioning to managerial roles. They may face challenges in team leadership, conflict resolution, decision-making, communication, and delegation. Adjusting to the more people-oriented and strategic responsibilities of a managerial position can be challenging for engineers who are accustomed to focusing primarily on technical tasks. Five participants indicated that: They struggled with aspects such as team leadership, conflict resolution, decision-making, communication, and delegation. And they need to learn it by themselves from different resources such as the internet and books.

Furthermore, some participants emphasized that the absence of adequate management training for engineers can result in difficulties in comprehending and navigating the intricacies of organizational culture, politics, and dynamics. This can manifest in challenges related to building relationships with team members, effectively communicating with diverse stakeholders, and managing interpersonal conflicts that may arise in a managerial role.

5.3 Motivators for Transitioning to Management Roles

The engineers we met were motivated to transition into management roles for various reasons, including career advancement and salary increase, personal growth and desire to make a difference, recognition and challenge/excitement, and a passion for leadership. To identify the motivators affecting the transition to a managerial role, we asked our participants during the interview directly what motivated them to transmit to a managerial position and how they stayed motivated in their current role. We also asked them to describe when their motivators changed or evolved.

Different participants addressed the desire for career advancement as a primary

motivator for transitioning to management roles. Many felt that management roles provided more opportunities for career growth and development. Participants indicated that any engineer looking to expand his career opportunities and take on a new challenge might see a management role as an excellent way to achieve his career goals. One participant said: *"Management role offers me new opportunities to learn and develop and the potential for advancement within the company"*. While another participant said: *"Management roles often come with higher salaries and additional benefits, which motivated me to increase my income"*. Three participants mentioned that the desire to change is one of the motivators. Remarkably, one participant said: *"Jumping into a new role is a way to break out the routine and try something new, so I moved to a management role"*.

Regarding Passion for leadership, Participants also noted a passion for leadership as a motivator for transitioning to management roles. They enjoyed the challenge of motivating and inspiring team members and felt that they had a natural ability to lead. Engineers who strongly desire to lead and manage others may be drawn to a management role. They may enjoy the challenge of motivating and inspiring a team to achieve its goals. Some participants said they have leadership skills that helped them achieve a management role. One participant mentioned that: *"My boss nominated me to be a sales manager because I communicate well with the team and the customers. Also, I played the role of team leader many times"*.

In contrast, some engineers may be motivated to transition to a management role as a way to develop new skills, such as leadership, communication, and decision-making, delegation. They may see the role as an opportunity to grow both personally and professionally. One participant said: *"It is a good chance for me to develop new skills such as leadership, decision-making and communication skills"*.

Finally, participants identified an interest in business operations as a motivator for transitioning to management roles. They enjoyed learning about the financial and strategic aspects of the company and felt that management roles provided more exposure to these areas. One participant mentioned that: *"I see management roles*

as a way to contribute to my team member's professional development and growth. Also, it helps me to understand business strategies and company goals". Different participants considered their interest in business operations a motivator. They said they want to learn more about various activities and processes involved in running a business efficiently and effectively. Some engineers are interested in financial management activities, others in marketing and sales, and others in human resources.

Based on the thematical analysis, the engineers interviewed demonstrated a range of personal characteristics and skills, including effective communication, adaptability, emotional intelligence, strategic thinking, and leadership required for engineers who transitioned to management roles. However, the engineers interviewed faced several challenges during the transition process, including adapting to their new role and managing former colleagues, balancing technical and managerial responsibilities, and lacking training and support. Many also experienced resistance to change and pressure to perform. Despite these challenges, the engineers we spoke with were motivated to transition into management roles for various reasons, including career advancement and salary increase, personal growth and desire to make a difference, recognition and challenge/excitement, and a passion for leadership. These findings highlight the importance of developing strategies to support engineers in successfully transitioning to management roles, such as providing adequate training and support, addressing resistance to change, and recognizing the value of personal characteristics and skills in addition to technical expertise.

The thematic analysis of the interviews achieved an understanding of the factors influencing the transition from engineering to management roles. One central theme that emerged was the importance of personal characteristics, such as leadership skills, communication abilities, and adaptability, consistent with Bandura's Theory of Social-cognitive (Bandura 1997). Another theme was the challenges faced during the transition process, such as a lack of formal training in management and difficulty delegating tasks, which align with the Theory of Trait and Factor by

Parsons (2008). Additionally, the Theory of Career Choice by Holland (1997) helped to understand how individuals' interests and values impact their decision to transition into management roles.

The interviews highlighted the role of chance opportunities, such as a chance to lead a project or fill in for a manager, in motivating individuals to pursue management roles. The Theory of Happenstance by Krumboltz (2013) was also relevant in understanding the motivators behind the transition. Finally, the Theory of Developmental Self-Concept by Super (1957) helped to explain the importance of career development and planning in the transition process.

Overall, the thematic analysis allowed for a comprehensive understanding of the factors influencing the transition from engineering to management roles, with support from various relevant theories.

After conducting the interviews and using thematic analysis to analyze the data, it became clear that several factors contributed to the transition from engineering to management roles.

Firstly, the Theory of Career Choice by John Holland (1997) is relevant, as many interviewees described their vocational interests and how they influenced their decision to pursue a management role. For example, those with a solid social orientation were drawn to the people-focused aspect of management. In contrast, those with a more investigative orientation valued the problem-solving and strategic aspects of the role. The study identified that personal characteristics such as communication skills and emotional intelligence are essential for career choice and job satisfaction. Holland's theory also emphasizes the importance of a good fit between one's personality and the work environment, which could impact an engineer's transition to a management role.

Secondly, the Theory of Trait and Factor by Frank Parsons (2008) is relevant, as many interviewees described their characteristics and how they impacted their transition to a management role. For example, those with strong leadership qualities

felt more confident and competent in their management role. At the same time, those who lacked strong communication skills found the transition challenging due to the increased level of social interaction required. According to Parsons' theory (2008) which emphasizes on the importance of matching an individual's skills and abilities with the job requirements. As our interviewees mentioned, specific skills such as leadership and project management may be more important in a management role than a technical one. This is relevant in the context of an engineer transitioning to a management role.

Thirdly, the Theory of Happenstance by John Krumboltz (2013) is relevant, as many interviewees described the role that chance events played in their transition to a management role. For example, some had unexpected opportunities arise due to staffing changes or company restructurings. In contrast, others had personal experiences outside of work that gave them the confidence to pursue a management role.

Fourthly, the Theory of Social-cognitive by Albert Bandura (1997) emphasizes the importance of self-efficacy and belief in one's ability to perform a task. This is relevant in the context of an engineer transitioning to a management role, as the individual may need to develop new skills and take on new responsibilities, which could impact their confidence and self-efficacy. Many interviewees described the importance of self-efficacy and its role in their transition to management. Those with high levels of self-efficacy believed they could succeed in the management role and were more likely to take on the required challenges and responsibilities.

Finally, the Theory of Developmental Self-Concept by Donald Super (1957) emphasizes the importance of personal growth and development throughout one's career. This is relevant in an engineer's transition to a management role, as the individual may need to develop new skills and adapt to new challenges to succeed in the new role. Many interviewees described their career aspirations and goals' impact on their transition to a management role. For example, those with a long-term career plan viewed the management role as a necessary step in their career

progression, while others saw it as an opportunity for personal and professional growth.

These theories provided a comprehensive understanding of the factors impacting the transition from engineering to management roles, including vocational interests, individual characteristics, chance events, self-efficacy, and career aspirations. By understanding these factors, individuals and organizations can better prepare for and support the transition to management, leading to more successful career development and overall job satisfaction.

6 Discussions

This study aimed to identify the personal characteristics, skills, challenges, and motivators that impact the transition from engineering roles to management roles and how they influence engineers' career development in this transition process. The central concepts were career development theories, which guided the analysis, and the method used was explanatory qualitative research, employing purposive sampling and thematic analysis.

The findings provide insights into the personal characteristics, skills, challenges, and motivators that influence the transition process. It identifies the specific personal traits and skills, such as effective communication, adaptability, emotional intelligence, strategic thinking, and leadership abilities, that impact the successful transition from engineering to management roles. The study also highlights the challenges faced during the transition, including adapting to new responsibilities, managing former colleagues, and acquiring new skills. By addressing these factors, the research offers a comprehensive understanding of the impact of personal characteristics, skills, challenges, and motivators on the transition process. Additionally, the findings shed light on how the identified factors influence engineers' career development during the transition from engineering to management roles. It emphasizes the importance of aligning personal characteristics with career choices and developing the necessary skills for successful management positions. By recognizing the challenges and understanding the motivators behind career transitions, individuals can effectively navigate their career development path. Additionally, the findings highlight the significance of external support and resources in facilitating career transitions and enhancing engineers' career development.

Underscoring the importance of developing specific skills and characteristics for individuals considering a transition to management roles. Effective communication, adaptability, emotional intelligence, strategic thinking, and

leadership abilities are essential qualities that individuals should strive to cultivate. By understanding the demands of management roles, individuals can proactively work on acquiring these skills and enhancing their personal attributes. Additionally, being aware of the potential challenges, such as adapting to new responsibilities, managing former colleagues, and acquiring new skills, allows individuals to prepare and develop strategies to overcome these obstacles.

Organizations can leverage these findings to better support engineers during their transition to management roles. Organizations can help engineers acquire and enhance the necessary skills and competencies for successful management positions by offering targeted training programs and resources. Recognizing the significance of the identified personal characteristics and skills, organizations can tailor their selection and development processes to identify individuals who possess or show potential in these areas. Furthermore, understanding the motivators driving individuals to pursue management roles, such as career advancement, increased autonomy, and the desire for new challenges, enables organizations to create opportunities and career paths that align with these aspirations.

By aligning individual aspirations and organizational support, the likelihood of a smooth and successful transition to management roles can be increased. Providing mentorship programs, coaching, networking opportunities, and ongoing professional development initiatives can empower individuals to navigate the challenges and demands of their new roles effectively. Organizations that prioritize employee development during career transitions enhance career satisfaction and success, foster a positive work environment, and contribute to overall organizational performance.

The discussion of the study's results emphasizes the role of individual traits and external support in successful career transitions. It underscores the importance of self-awareness, seeking external support, and aligning personal characteristics with career choices. These insights have practical implications for both individuals and organizations, highlighting the significance of employee development and external

support in fostering successful career transitions. Moreover, the findings support the notion that engineers who successfully transitioned to management positions possessed strong leadership, communication, and stakeholder management skills, aligning with the idea that individuals are most fulfilled and successful in careers that suit their personality types.

The importance of external support in career transitions cannot be overstated. Seeking external support, such as mentorship, coaching, networking, and training, is crucial for acquiring the necessary skills and knowledge to excel in new roles. It also provides emotional support during the transition process.

These findings have practical implications for both individuals and organizations. For individuals, the study emphasizes the significance of self-awareness and understanding one's strengths, weaknesses, and personality type when making career choices. By aligning their career choices with their personal characteristics, individuals can enhance their chances of achieving career satisfaction and success. Additionally, seeking external support and training can aid in developing the skills and knowledge needed to excel in new roles.

The study highlights the importance of investing in employee development and providing external support during career transitions for organizations. By prioritizing employee development programs, organizations can ensure their employees are equipped with the necessary skills to thrive in new roles. Additionally, offering external support can ease the transition process and contribute to employees' overall success, improving organizational performance.

The findings of this study provide practical implications for both individuals and organizations involved in the transition from engineering roles to management positions. By recognizing the importance of specific skills and characteristics, understanding the challenges faced, and addressing the motivators behind career transitions, individuals can better prepare themselves for success. Organizations, in turn, can optimize their support mechanisms to facilitate smooth transitions,

improve employee engagement and retention, and ultimately drive organizational success.

In future research, there are several areas that can be explored; one potential avenue for future research is to conduct longitudinal studies to track the long-term impact of transitioning from engineering roles to management positions on engineers' career trajectories. These studies can provide insights into how the skills, challenges, and motivators identified during the transition process influence long-term career success and satisfaction.

Additionally, assessing the effectiveness of specific interventions or training programs designed to support engineers during their transition to management roles would be valuable. Experimental or quasi-experimental studies could be conducted to evaluate the impact of interventions such as leadership development programs, coaching or mentoring initiatives, or other career development interventions on engineers' career outcomes and satisfaction.

Furthermore, comparative studies across different industries or organizations could be conducted to explore potential differences in the factors influencing the career development of engineers in management roles. These studies would provide insights into industry-specific challenges, organizational culture variations, and unique support mechanisms that affect engineers' transition and career progression.

The role of external support, such as mentorship, coaching, networking, and training, could be further investigated in future studies. It would be valuable to understand the specific types and qualities of external support that are most beneficial for engineers during their transition and how they contribute to overall career development and satisfaction.

By exploring these research avenues, a deeper understanding of the factors influencing the career development of engineers during the transition to management roles can be achieved, leading to more effective support mechanisms and practices in facilitating successful career transitions. This knowledge can

ultimately contribute to developing tailored interventions, training programs, and organizational policies that enhance engineers' career success and satisfaction during their transition to management roles.

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Appendix 1 – The Questionnaire

Part I (Demographic Questions)

- Level of Education
- Job Title
- Engineering Sector

Part II (Open Ended)

Personal characteristics:

- Can you tell me about your background and how it has influenced your career path?
- How do you think your personality traits have affected your transition from an engineering role to a management role?
- Can you describe a time when your personal characteristics impacted your effectiveness as a manager?

Skills:

- What skills are most important for engineers transitioning into management roles?
- Can you tell me about when you had to develop a new skill to succeed in a management role?
- How do you think your technical expertise has helped or hindered your transition into a management role?

Challenges:

- What were some of the biggest challenges you faced when transitioning from an engineering role to a management role?
- How did you overcome those challenges?
- Can you describe a time when you made a mistake as a manager? What did you learn from it?

Motivators:

- What motivated you to transition from an engineering role to a management role?
- How do you stay motivated in your current role?
- Can you describe when your motivators changed or evolved during your career development?

Appendix 2 – Informed Consent Statement

MBA Research: Factors affecting engineer's transition process toward management roles.

Researchers: Tariq Abu Naseer, taab20@student.bth.se

Ghassan Jaradat, ghja20@student.bth.se

Dear Interviewee,

This statement is to confirm the following regarding the research as stated above.

1. The main purpose of this research is to find the factors affecting engineers in their transition toward management roles.
2. This study follows a mixed-based approach as guided and open-ended questions will be incorporated into interviews. Basic information about the Interviewees won't be required, but essential timeframes may be required. A short study background will be given, and all interviews will be recorded for correct typing later if an interviewee feels that the tape recorder be switched off at any stage. The interviewer will do so.
3. The interviews will vary in length, but an estimated time of 20 mins is to be set out.
4. Interviewees may stop their participation in the study at any time or ask for a break if any discomfort or uncertainty is felt.
5. Participation is entirely voluntary.
6. Complete anonymity, privacy and confidentiality are ensured by the interviewer. If any information is wished to be kept private and not published, the researchers will adhere to this.
7. Questions could be made available beforehand for insight to be gained on the questions that will be asked.
8. All the data collected in the interview will be used for the research, safely secured under the research period, and then disposed of.

I agree that I have read and understand the above information and consent for my data to be used in this study.

Name:

Signature:

Date:

Appendix 3 – Initial Codes

Question Topics	Associated codes
Personal Characteristics	<ul style="list-style-type: none"> ● Leadership qualities ● Communication skills ● Adaptability ● Emotional intelligence ● Self-awareness ● Decision-making skills ● Time management skills ● Problem-solving skills ● Ambition ● Emotional intelligence ● confidence
Skills	<ul style="list-style-type: none"> ● Project management ● Strategic planning ● Budgeting and financial management ● People management ● Conflict resolution ● Performance evaluation ● Financial management ● Team management ● Decision making ● Time management ● Delegation

	<ul style="list-style-type: none"> ● Leadership skill
Challenges	<ul style="list-style-type: none"> ● Lack of experience ● Difficulty delegating tasks ● Balancing technical and managerial responsibilities ● Resistance from team members ● Cultural differences within the organization ● Managing conflicts with superiors ● Adapting to a new role ● Lack of training and support ● Resistance to change
Motivators	<ul style="list-style-type: none"> ● A desire for career advancement ● Interest in management and leadership ● Personal fulfilment and satisfaction ● Financial rewards ● Recognition and status within the organization ● Sense of responsibility to contribute to the success of the company. ● Personal growth ● Desire to make a difference ● Challenge and excitement