European International University, EIU-Paris

Doctoral Thesis

Title:

AN ANALYSIS OF TRAINING NEEDS FOR ENHANCING EMPLOYEE CAREER DEVELOPMENT WITHIN AN ORGANISATION: AN ENGINEERING MANAGEMENT PERSPECTIVE

Submitted by:

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In Partial Fulfillment of the Requirements for the Degree of

Doctor of Business Administration (D.B.A.) in Engineering Management

Supervisor:

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Date:

July 2024

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Abstract

This research aims to establish the factors that determine the career mobility of engineering management employees in Malaysia, particularly Training and Development Programs, Competency-Based Performance Management, Career Development Opportunities, Employee Engagement and Motivation, and Talent Management Practices. Based on a descriptive research approach, questionnaires were administered to 195 respondents and Data collected were analysed using Statistical Package for the Social Sciences (SPSS). The results clearly show that Talent Management Practices and Career Development Opportunities are the two most crucial factors to consider regarding Career Mobility: Impacts of Structured Mentorship, Leadership Development, and Cross-Project Assignments.

Though the Training and Development Programs and Competency-Based Performance Management function demonstrated the effect with lesser emphasis, the role of these activities should be well correlated with proper career progress. Regarding the aspects of employee engagement and motivation, there was a poor impact suggested, which could be attributed to autocratic organizational structures that constrained employees' input.

The paper theoretically and empirically extends the existing literature by confirming the transferability of organizational practices in the context of career advancement in the engineering profession and establishing how the proposed variables could be systematically combined within a consolidated framework. Implications for theory include the support for the Human Capital Theory. Practical implications include a call to engineering firms to focus on talent management and to design and implement bespoke development programs to improve employee turnover and productivity.

The present work discusses the priorities and conundrums regarding career development, and therefore, it provides practical implications for both practice and theory. In the future, studies should prefer longitudinal designs, examine cultural mediators, and use qualitative measures to enhance understanding of shifts in career advancements.

Keywords: Career Advancement, Talent Management, Competency-Based Performance Management, Employee Engagement, Engineering Management, Malaysia

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Praise to The Almighty, The God, Allah S.W.T., and the Merciful of all living beings in the world and may His blessing to The Messenger, the Prophet Muhammad S.A.W. and his family, Companions, followers and the believers on the whole world. I am relieved and humble with thankful to that this Doctorate Thesis paper has finally been completed.

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Lastly, special thanks to my colleague; Norazamuddin Bin Mohd. Johari who supported me in my studies and this Doctorate journey till it was successfully done. Thanks for everything.

Thank you.

Mirzan Indera Bin Abu Khari (EIU 624472)

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Approval Sheet

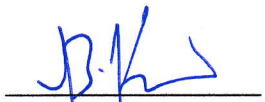
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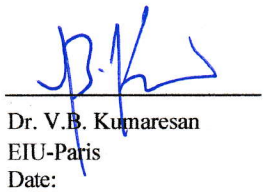
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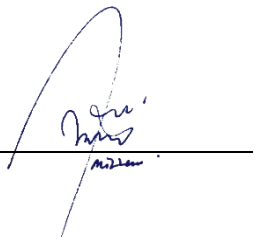


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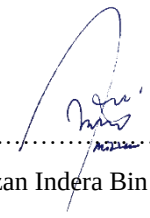
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Dear Dr.,

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I am greatly honoured to present the Doctorate Thesis entitled “An Analysis of Training Needs for Enhancing Employee Career Development Within an Organisation: An Engineering Management Perspective” for your kind evaluation as required by the EIU-Paris.

Your Kindness in accepting and reviewing this research thesis is highly appreciated.
Thank you.
Sincerely,



……

Mirzan Indera Bin Abu Khari

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LIST OF ABBREVIATIONS

CBPM: Competency-Based Performance Management
HRM: Human Resource Management
KMO: Kaiser-Meyer-Olkin
MCAR: Missing Completely at Random
MAR: Missing at Random
NMAR: Not Missing at Random
PDPA: Personal Data Protection Act
SPSS: Statistical Package for the Social Sciences
VIF: Variance Inflation Factor
ANOVA: Analysis of Variance
R&D: Research and Development

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CHAPTER I: INTRODUCTION

1.1 BACKGROUND

In Malaysia, there are especially concerns about employee training and development, which yield productivity enhancements. In 2023, the Human Resources Development Corporation (HRD Corp) received a record levy of RM2.2 billion compared to the RM1.81 billion in the previous year. This rise has been occasioned by increased coverage of the levy in more sectors; this shows that Malaysian employers understand the importance of investing in training and developing their employees (The Edge Malaysia). Malaysia Productivity Corporation (MPC) also forecasted an increase of 0.9% in employee productivity in 2023 as per capital RM96,692 (MPC). This growth results from embracing training development within the country and focusing on enhancing the mainstream workforce absorption capabilities. Based on the studies made in the context of the Malaysian business environment, these studies assert that competent training interventions are central to the learning processes of the staff of organisations and the overall performance of the organisations.

The importance of this proposed model, which is based on facilitating the career development of its employees, is explained by the fact that the needs of workers should be tailored to the demands of the current world economy, which requires lifelong learning from its workers. Career development is carried out systematically to enable employees to learn relevant organisational skills to improve performance (Lubis et al., 2024). It is crucial to coach the employees in the unique skills required to handle several challenges in the industry relating to

the career, especially within the field of engineering management. Thus, by improving the employee's proficiency through training, organisations ensure they have a capable workforce that can work under new market conditions, enabling them to have a competitive advantage (Parween, 2024).

Training is, therefore, necessary to align with the organisation's requirements so that more benefits can be realised in career development. Competency-based training and development programs in performance management bring direct contributions from employees toward the organisational objectives and mission, asserting that competencies are performance-relevant and organizationally significant (Merchant, 2024). Research indicates that companies that value career advancement record minimal turnover and higher employee satisfaction because they nurture their employees' professional paths (Febrian & Solihin, 2024). For instance, an assessment conducted on Malaysia's manufacturing industry reveals that the training provided is characterised by improvements in retention and productivity, where the company's training provided is a perfect fit for the employee's career plan (Jamaludin et al., 2024).

In addition, the Human capital Theory supports the aspect of Training because this improved training gives long-term returns to humanity and organisations. In this way, organisations ensure that employees possess sufficient knowledge and skills, enabling organisations to have a solid and competitive workforce and be resilient to continuously create innovations and improvements (Mustafa & Lleshi, 2024). Against this background, this study seeks to establish the factors affecting career development within Malaysian organisations that will help the organisations understand how to adopt effective training measures and the advantage of linking the training programs with the organisation's strategic goals.

1.2 PROBLEM STATEMENT

There has been an issue with employee career planning, primarily in organisations that must produce a highly trained and flexible workforce, especially in engineering management. However, even with the understanding of the importance of training and development programs, organisational efforts to maximise training and development programs continue to falter, resulting in high turnover, low job satisfaction, and underutilisation of employees (Jamaludin et al., 2024). As observed in many organisations, although different organisations buy into training to enhance employee performance and productivity, there is generally low emphasis on how this training aligns with employee career goals and organisational objectives, implying that the overall efforts of training do not positively impact employee engagement and productivity as has been postulated by Mustafa & Lleshi, 2024. For example, in the Malaysian context, Manufacturing companies have found that employees, particularly those not enrolled in structured career advancement programs, become less engaged and motivated to continue to be a part of that organisation, hence high turnover rates negatively affecting manufacturing effectiveness (Jamaludin et al., 2024). A 2023 survey by Randstad 2023 showed that 24% of Malaysian employees, for example, claimed a lack of training opportunities and support from the employer, a clear indicator of a lack of development (Randstad, 2024).

The gap between training programs and actual career development outcomes highlights a crucial issue: the absence of competency-based, first and foremost, and strategically connected training structures that apply lifelong and organisational requirements (Lubis et al., 2024). An appraisal that integrates competency frameworks has been practised extensively in the literature and has practices that match performance behaviour with predictable career advancement routes. However, its usage is still low in many organisations (Febrian & Solihin,

2024). Lack of such a combination may mean that training programs are not well suited to meet the training needs of such complicated fields as engineering, with subsequent adverse impacts on talent development and innovation within the enterprise (Merchant, 2024).

Moreover, the fourth area of significant weakness is surprising since many organisations fail to evaluate how talent management and employee engagement can facilitate career development. According to the literature, it has been testified that high levels of engagement among employers positively correlate with performance and turnover (Febrian & Solihin, 2024); however, most development programs lack strategies for building engagement, motivation, and support. This gap identifies how career development might be managed through practical training and development interventions that address work's technical and motivational aspects.

Hence, this research seeks to fill this gap by exploring the factors affecting career development in Malaysian organisations and comparing the alignment of the available training programs, competency-based frameworks, and employee enlistment. The study aims to explore these areas to understand best practices in designing training interventions that can enhance career mobility and remedy the perennial problems plaguing organisations in sectors that demand higher levels of technical skills and formal career ladders.

1.3 RESEARCH QUESTIONS

Hence, this study aims to identify the critical factors affecting the DMF for engineering management professional employees in Malaysian organisations, focusing on their technical competency and career path advancement. The primary research questions include:

1. **What roles do training and development play in advancing the employee's career in engineering management?**

   Studies have evidence that increased structure implementation improves training effectiveness and demonstrates that more research is needed to determine the exact involvement of structure training in individual career development (Mustafa & Lleshi, 2024).

2. **In what ways does competency-based performance management impact the growth as well as the advancement of the employees?**

   Research shows that competency frameworks can help fill skill gaps and promote career mobility, but questions remain about their effectiveness in promoting advancement (Lubis et al., 2024).

3. **How does career development impact employee retention levels and job satisfaction?**

   Knowledge establishes that career management plays a role in retaining employees; however, there is a lack of studies about its effects on job satisfaction (Jamaludin et al., 2024).

4. **How do employees get engaged and motivated in their working environment, and how does this impact their career growth within the company?**

   Higher levels of engagement indicate higher performance figures; thus, it can be hypothesised that engagement significantly influences employees' career paths (Febrian & Solihin, 2024).

5. **What roles do talent management practices play in the breadth and depth of employee career management?**

   As previous studies suggest, talent management helps retain and develop human capital. However, the effect of talent management on career progression is proposed to be a topic of further study (Jamaludin et al., 2024).

1.4 RESEARCH OBJECTIVES

The purpose of this research is to investigate the factors of career management in engineering management with an emphasis on training and competency maps and structures, as well as employee engagement. The primary objectives are:

1. **To measure the effectiveness of training activities in career progression in engineering management,** as the research shows that structured training improves skills and guarantees sustained growth (Mustafa & Lleshi, 2024).

2. **Competency-based performance management, which involves developing employees' career paths through matching competencies to organisational needs, is assessed** as effective in narrowing gap competency (Lubis et al., 2024).

3. **To review how career development opportunities fit into the puzzle of enhancing employee retention and job satisfaction**, given information from prior studies that show such opportunities are hugely helpful in the fight against turnover (Jamaludin et al., 2024).

4. **Analysing employee engagement and motivation for career development is crucial because when engaged in work, employees demonstrate enhanced practices and seek** promotion within the company (Febrian & Solihin, 2024).

5. **To explore the role of talent management practices, where career advancement** happens because of well-designed career frameworks meant to retain valued human capital prevalent in line industries (Sharp et al., 2024).

1.5 SCOPE OF STUDY

This study investigates the factors that determine employee career development in the engineering management sector in Malaysia. It examines the influence of training and development programmes, competency-based performance management and career development opportunities, employee engagement and talent management practices on career advancement. As a technical and competitive industry, the study explores how these factors affect employee satisfaction, retention and professional growth.

Focus on the Engineering Management Sector

The engineering management sector is based on continuing innovation with technological skills, aptitude, and continuous learning. Organisations should also start investing in employee development with the changing industries, especially in Malaysia. As the adoption of new technologies and methodologies is rapid in Malaysian engineering firms, where highly skilled employees are critical, this study looks at Malaysian engineering firms. In this sector, we observe an ideal situation for investigating the 'how' in terms of how structured career development practices impact individual and organisational success.

Key Variables Examined

Five independent variables, namely training and development programs, competency-based performance management, career development opportunities, employee engagement, and talent management, are examined, including the dependent variable, employee career development. Using this perspective, this approach elucidates how individual and collective drivers affect career advancement (Mustafa & Lleshi, 2024).

- **Training and Development Programs**: These effects are analysed to evaluate their harmonisation with employee career goals and effectiveness in fortifying skills required for growth (Jamaludin et al., 2024).
- **Competency-Based Performance Management**: This framework is studied to investigate its function in aligning individual skills towards organisational goals and providing the career pathway (Febrian & Solihin, 2024).
- **Career Development Opportunities**: This chapter investigates the presence and the impact of vertical and lateral career movements in organisations, specifically on the relation between job satisfaction and retention (Lubis et al., 2024).
- **Employee Engagement and Motivation**: This variable is analysed to see how it plays a role in creating the career ambition and commitment of the employee (Febrian & Solihin, 2024).
- **Talent Management Practices**: Jamaludin et al.'s (2024) study investigates how talent management sustains long-term career progression and lowers turnover.

Geographical and Organizational Context

The paper also geographically limits the study to Malaysia as the industrial make-up undergoes drastic changes due to technological advancements and globalisation. This research is relevant because Malaysian organisations across various sectors (engineering being a focus) face specific talent retention and development challenges (Mustafa & Lleshi, 2024). Employees in engineering firms will collect data to ensure we cover various job roles and career stages in this study.

Target Population and Sampling

The target population consists of professionals in Malaysian engineering management at entry to senior levels. About 200 respondents will be selected in a random sample to ensure representativeness. By sampling this wide range, the study will be able to capture the different impacts of the variables studied for different career stages.

Contribution to Theory and Practice

Contributing to existing literature, this study applies the Human Capital Theory and Competency-Based Performance Management frameworks in the Malaysian context. The study aims to find voids in previous studies on the correlation between training programs, talent management stages, and Employee career aspirational. Furthermore, the findings offer experiential insights for organisations to develop and deploy career development practices that address employee needs and organisation purposes (Lubis et al., 2024).

Limitations

The study is limited solely to the engineering management industry in Malaysia, which limits the generalisation of findings to other industries and regions. Furthermore, this is a cross-sectional study that does not capture the long-term effects of career development practices.

1.6 SIGNIFICANCE OF STUDY

This study contributes to understanding the important components required to develop an employee career development program for engineering management in Malaysia. Training and development issues, career planning, competency-based performance appraisal, and engagement underpin the framework through which this research provides organisational

solutions that support workforce productivity and reduce turnover. Research points out that when training is provided correctly, its outcomes enhance the employee's skills and provide long-term organisational benefits, including low turnover and high productivity (Mustafa & Lleshi, 2024).

Moreover, this study extends the body of knowledge by providing insights into how competency-based frameworks may be utilised to enhance career mobility in the science discipline. The preceding literature has established that such frameworks support competency mapping with organisational objectives, enhancing career progression, which can act as drivers for employee engagement and development (Lubis et al., 2024). The conclusions of this work may help improve the management of competitiveness and career growth of employees in organisations, as well as create new, more adequate, competency-oriented practices for developing employees who correspond to organisational needs and strategic objectives.

The study also reveals the crucial role of corporate careers, employee engagement, and talent management in career advancement, which has been widely argued to be critical to talent management and acquisition (Febrian & Solihin, 2024). Understanding these antecedents in the Malaysian context enriches the regional context literature for Malaysian organisations that can use the present findings to facilitate a supportive organisational climate for career development, enhancing organisational resilience and competitive advantage.

1.7 OPERATIONAL DEFINITION OF TERMS

To ensure clarity and consistency in this study, key terms are defined as follows:

1. **Training and Development Programs**

   Training and development programs refer to structured initiatives to enhance employees' skills, knowledge, and competencies for career growth and organisational productivity. These programs include workshops, technical training, and skill enhancement courses tailored to align with employee and organisational objectives (Mustafa & Lleshi, 2024).

2. **Competency-Based Performance Management**

   Competency-based Performance management (CBPM) is a systematic approach to rating employee performance that involves assessing predefined competencies necessary for a job role. CBPM links individual skills to organisational goals through feedback, technology based on identifying skills gaps, and transparency of career pathways (Lubis et al., 2024).

3. **Career Development Opportunities**

   Vertical promotion, lateral movement, and skill development programs that help employee's skill their careers together fall under the career development provision. Jamal Uddin et al. (2024) linked these opportunities to employee retention and satisfaction because they tackle career aspirations and long-term professional goals.

4. **Employee Engagement and Motivation**

   Employee engagement is the passive involvement of employees, which leads to emotional and due performance towards the work. It is an internal motivation that

causes employees to strive for career development and the organisation's success (Febrian & Solihin, 2024).

5. **Talent Management Practices**

   Strategies for attracting, developing and retaining skilled employees belong to talent management practices. These practices identify high-potential employees, provide structured growth opportunities, and create a supportive work environment for career development (Febrian & Solihin, 2024).

6. **Employee Career Development**

   In this study, our dependent variable is employee career development. This is the way in which people develop their skills and knowledge and learn to gain experiences to propel their careers up the ladder in the direction of professional growth. Finally, it includes the effects of training, performance management, and engagement on employees' capabilities to reach their career goals (Lubis et al., 2024).

Using these operational definitions will give a framework for understanding what variables will be investigated to be consistent and relevant to the study.

1.8 ORGANIZATION OF THESIS

Hence, this thesis comprises five main chapters to present a logical sequence of the research process and findings pointing to factors affecting employee career development in Malaysian engineering management. Following is a summary of each chapter and the primary concepts that are included in the planned format.

Chapter 1: Introduction

Chapter one introduces the research work, including the background of the study, the problem under investigation, the purpose, research questions, and hypotheses. The importance of conducting the study is also outlined here in addition to the objectives, the sample and population, and the operational definitions. The chapter also sets the importance of the research for Malaysian engineering management by relating it to the Human Capital Theory with Competency-Based Performance Management systems as classified by Lubis et al. (2024). This chapter ends by providing an overview of the organisation of the study.

Chapter 2: Literature Review

This chapter reviews existing literature on the key variables under investigation, including training and development, competency-based performance management, employee engagement, and talent management. The theoretical foundation is grounded in Human Capital Theory, which posits that employee training and skills investments yield organisational benefits (Mustafa & Lleshi, 2024). Additionally, gaps in the literature are identified, highlighting the need for context-specific insights into Malaysian engineering management.

Chapter 3: Methodology

This chapter outlines the research design, sampling techniques, data collection methods, and analysis strategies. It employs a quantitative approach, collecting data through structured questionnaires distributed to employees in Malaysian engineering firms. Statistical tools like SPSS will analyse the relationships between independent and dependent variables (Jamaludin et al., 2024).

Chapter 4: Results and Discussion

This chapter presents the data analysis findings, addressing each research question and hypothesis. The results are discussed in the context of existing literature to draw meaningful conclusions about the relationships between the variables and their impact on employee career development (Febrian & Solihin, 2024).

Chapter 5: Conclusion and Recommendations

The final chapter summarises the key findings and discusses their implications for theory, practice, and policy in the engineering management sector. It provides recommendations for organisations to enhance career development practices and suggests future research.

CHAPTER II: LITERATURE REVIEW

2.9 INTRODUCTION

Over the years, Employee career development has become a critical success factor in organisations focused on delivering human capital, especially in industries where employee skill is highly valued, such as engineering management. This literature review collects information on training and development programs, competency-based performance management, career development, and best practices in engagement and talent management. These elements are essential in the promotion of careers, the satisfaction of jobholders, and making organisations more competitive. However, there are still some research gaps for those factors, particularly how they work collectively and mainly within Malaysia's engineering management sphere.

2.10 TRAINING AND DEVELOPMENT PROGRAMS

Organisations usually use training and development programs as the best tools to improve employee competencies that directly translate into productivity, organisational efficiency, and effectiveness. Implementing these initiatives enables employees to learn the skills, knowledge, and abilities to contribute to matching individual career aspirations with organisational objectives to create mutual growth and achievement. Since engineering management depends so much on continuous innovation and the need for a very skilled and adaptive workforce, the role of training programs in engineering management is of particular significance.

Complex requirements and fast-changing technological advances in a dynamic operational environment characterise engineering management. For this reason, training programs in this field need to extend beyond general skilling to cover specialised competencies such as advanced technical knowledge, project management, and problem-solving skills. Take, for instance, engineers who need to be aware of the latest in emerging technologies, including artificial intelligence, renewable energy systems, and advanced manufacturing … Training programs can be well structured to bridge knowledge gaps so engineers are positioned and enabled to implement the industry-leading solutions for higher individual performance and organisational competitiveness.

Moreover, the engineering business commonly operates under tight time limits and is picky about precision. Simulations, workshops, certification courses, and other training programs that provide practical, real-world experience to engineers give them hands-on techniques to overcome real-life challenges. Also, these programs can include non-technical skills such as leadership and communication, which are important skills for engineers to develop for their future management learning journey. For these reasons, engineering management training initiatives promote individuals' career development, innovation, operational efficiency, and long-term organisational sustainability.

2.10.1 The Role of Training in Enhancing Competencies

Training and development programs are taken as necessary to empower people with the skills and knowledge needed to function and grow in an organisation. These programs are significant in the engineering management sector, mainly since the sector is dynamic and highly technical. As Mustafa and Lleshi (2024) highlight, in modern workplaces, engineers must realise that developmental learning and continued practice are the keys to mastering the ever-changing

technology surrounding engineers. It also gets attention from organisations that spend on formal training initiatives. Especially in engineering, exceptional knowledge and the capacity to improvise to new technologies are critical for success.

Technical workshops, simulations using real-world examples, professional certifications, and exposure to advanced tools and methodologies are often part of engineering-specific training. These programs are geared towards arming engineers with preparation for the dynamic work environments they must deal with. Examples include hands-on simulations, which allow engineers to experience and solve an actual problem without risk in the real world. Project management, machine learning or renewable energy systems certifications mean employees have the technical know-how to meet current and future industry standards.

In addition, training in new areas, including artificial intelligence, new software and more sustainable engineering processes, can help stimulate innovation on the job. Engineers trained periodically in these areas are in a better position to put into practice more innovative measures that enhance the direction of organisational activities and facilitate competitiveness in the market (Mustafa & Lleshi, 2024). When matched with market needs, engineers' skills promote individuality within organisations through developmental learning, which is essential in rapidly changing industrial environments. This twofold advantage shows the need for continuing and specific training and development programs in engineering management.

2.10.2 Training as a Driver of Retention and Engagement

In a highly competitive world, employee training and development are valuable in ensuring retention and productivity; hence, training is a critical ingredient in EMPM. Previous studies by Jamaludin, Razali and Omar (2024) found that firms operating in Malaysia's manufacturing sector with well-framed training programs have comparatively lower turnover rates. As a result, constant and goal-oriented training of the workers makes them appreciated, engaged, and less likely to look for other job offers. They help boost employees' satisfaction at work, compel them to work harder, and look for promotions intracorporeally. This is important, especially in engineering, where staff development motivates employees.

These states indicate that in engineering management, turnover can be severe, hence causing some of these impacts such as delay of projects, high operational costs, and, more importantly, loss of key knowledge. Maintaining talent and ensuring that key output producers continue to remain in organisations, is thus, paramount for sustaining organisations. The best solution to this challenge is through training programs that address career management. Management training sessions, for instance, provide engineers with the necessary skills to move up to a managerial post. On the same note, technical career mentorship programs are person-specific, building self-assurance and career identity to enable the employee to view the organisation as the permanent career path it is. Such strategic programmes are highly effective for nurturing organisational commitment, employee recognition and belongingness (Jamaludin et al., 2024).

Further, engineering positions call for constant skills updates to fit technical changes and market trends. Technical and non-technical competencies training benefits engineers in terms of career development and organisational goals. For example, the workshops on automation or

sustainable practices for employees expose workers to the most current practices and remind them of the organisation's importance. Not only does this help maintain people in an organisation, but it also helps create a culture where people want to do better. In conclusion, these training efforts help guarantee that organisations in engineering management maintain a force of committed personnel, enabling long-term success.

2.10.3 Challenges in Training Program Implementation

Despite the advantages of training and development activities, it is widely acknowledged that many organisations fail to obtain significant benefits from such training, owing to substantial disparities between training efforts and the overall career development of their employees along with the organisation's strategic goals. Jamaludin et al. (2024) have pointed out this gap, suggesting that, although organisations dedicate significant resources to training initiatives, these often do not embrace a competency-based approach. The latter case of misalignment can be seen in engineering, where technical skill and employability are important; misalignment can cause learners to disengage and render training programmes ineffective by underutilising their skills.

In engineering, training programs may often centre on actual or developmental skills, such as information technology skills or the ability to operate specific equipment. However, relying on these skills as the core of the training process understates other valuable competencies that an engineer needs in his or her work. Communication, coordination, and time management skills have become increasingly valued throughout education as engineers are often required to lead projects, be responsible for a group of people, and cooperate with clients and high-ranking officials (Mustafa & Lleshi, 2024). For instance, an engineer specialising in functional

technologies but weak in leadership competency may be disadvantaged when requesting promotion to a higher technical position, compromising individual and organisational succession plans.

Also, the dynamic change of technology in the engineering field exposes many training programs to obsolescence at specific periods. This absence of utility disregards the transferability of acquired knowledge, which disables the employees to respond to fresh difficulties. Additionally, standardised training had its way of implementing training modules that do not in any way meet the needs of the engineer as a person or the requirements of various engineering projects and, therefore, may not deliver the desired impact.

Organisations must approach training as an organisational development intervention to accommodate these challenges. This means that in all fields of human resources development, the IT and the CIA elements of human resources should be developed holistically in training programmes, and these should incorporate future-focused training. The suggested model of competencies proves to be crucial for matching training and development goals with qualifications and company strategies. For example, combining technical seminars with leadership or teamwork sessions may produce individuals ready to assume technical and administrative responsibilities. When training programs are kept fresh, targeted to specific needs, and connected to organisational goals, engineering organisations can more effectively prepare their workforce and increase workforce satisfaction when faced with increased difficulty and uncertainty.

2.10.4 Competency-Based Frameworks in Training

Implementing competency-based frameworks in training and development is a tactical solution to many issues confronting organisations, primarily in engineering. Competency-based frameworks define the precise skills, knowledge, and behaviour profile needed for given jobs so that the focus of training activities can be precisely targeted. It also makes bureaucracy more meaningful and guarantees that employees are prepared to deal with the challenges that accompany their duties as required at the present and in the future. Lubis et al. (2024) points out the significance of competency-based performance management (CBPM) on the employee's different performance variables with special reference to the engineering discipline.

In engineering management, competency frameworks are useful tools in determining the desired training activities for competence modules that include technical and non-technical skills. Professional competencies, including the application of programs/software in design and analysis, as well as the knowledge of other applications and trends in engineering, are invaluable in an engineer’s job. This is so because while engineering works become further advanced and integrated, they involve larger groups and require rail technical competencies, including leadership and communication skills as well as client handling skills. Training programs created under a competency-based model make sure that engineers are given complete training to prepare them for technical tasks and accountability.

Competency-based training models practised by various organisations show improved satisfaction of the employees and the organisation's effectiveness. In engineering management, this structure facilitates employee career growth and, at the same time, maps the education and

training that is required toward organisational strategic objectives. For example, the competency-based training and development training modules can include realism, such as role plays, case analysis, and different exercises, which give the engineers practical experience. These activities prepare the engineers to handle such intricate processes as fixing intricate systems or leading multifunctional teams in a simulated environment (Lubis et al., 2024).

Besides, competency-based frameworks assist in the enhancement of career paths because they offer engineers a clear path of development. From their perspective, they can understand how their training activities and initiatives are relevant to their individual career advancement plans and overall organisational goals and plans enhancing motivation. Such is equally important in engineering practice because promotions entail a combination of technical and managerial competencies. By incorporating competency frameworks into the training interventions, various engineering management organisations can create a technically sound and organizationally relevant workforce for better, continuous and sustainable organisational performance.

2.10.5 The Role of Technology in Training

Computerisation has significantly transformed models and outcomes of training solutions in engineering training, focusing on its precision and flexibility. Depending on the type of training, digital technologies like e-learning platforms, virtual simulations and augmented reality (AR) have brought more conventional methods into an engaging and modern perspective for engineering training. According to Mustafa and Lleshi (2024), integrating

technology in training enhances learning because knowledge is attained practically through simulations.

Computer-generated training is right on par with the level of engineering reality simulations. These simulations represent actual engineering situations and provide engineers with practical experience in using technical innovation to navigate through the identified problems with reduced potential for costly mistakes. For example, recreating possible scenarios that engineers meet in their work environment, such as simulation of equipment or systems involved in their operations or during some troubleshooting, can keep the engineers prepared in advance for such experiences. Through the provision of such, virtual simulations meet a very important need in the field of engineering management, where students have vast knowledge, but the application is lacking.

Another obvious training benefit of augmented reality is the augmented description of dynamic real-world objects during their practical use through interactive, real-time informational and orienting annotations. AR applications help engineers model systems, comprehend complex structures, and perform precise work compared to traditional methods. For instance, through AR, a firm can help maintain processes by visualising processes, including sequences to follow during the process, since this enhances precision rather than pointing to mistakes.

Further, the use of technology makes it possible for one to learn because technological change is ever-present in engineering disciplines, and hence, learning should also be ever-present. Digital learning solutions and self-paced certifications help engineers continue their education

and expand or change their professional knowledge and skills. Organisations can use these platforms to present all forms of training, including online training and courses on different manufacturing techniques, such as advanced manufacturing techniques or artificial intelligence-based renewable energy systems courses. These flexibilities help make engineers relevant in the job markets and give them the ability to gain personal career advancement as per the demands of the industry (Mustafa & Lleshi, 2024).

This paper has shown that incorporating technology into training interventions empowers organisations to offer suitable training solutions for challenges characterising engineering management, such as specialised skills, timely problem-solving, and lifelong learning. These technological tools improve individual performance, thus, organisational efficiency and innovation, which further provides a solid foundation to confirm the significance of technology application in today's engineering learning.

2.10.6 Training Programs in the Malaysian Engineering Sector

Significant improvements have been observed in Malaysian engineering training practices, which shows that Malaysia is a country with a vision for engineering infrastructure and engineering technology. As Malaysia continues with the expansion of industrial and technological enablers, organisations have continuously accepted the need to train engineers to match the new industries. In their survey on the relationship between investments in structured and comprehensive training, Jamaludin et al. (2024) established that firms reaping high productivity and less employee turnover due to training note a commendable increase in the growth of the sector. Such courses allow engineers to remain relevant in the technologically

evolving market and technical problems and consistently add to the fortification of the engineering sector.

However, such a scenario has left some of the most vital areas of training needing more attention in terms of competency mapping for industry-specific training programs. Most training efforts focus on technical skills, including design tools, operating equipment, and the newest manufacturing methods. These are basic skills that engineers learn in the workplace. However, as complex and evolving as engineering projects are, one needs other leadership, project management and teamwork skills to complete and manage the project successfully. As Lubis et al. (2024) noted, most Malaysian firms do not effectively address these areas, thereby hampering the expectations of engineers to play executive or strategic firm roles critical for an organisation's success.

Besides that, the Malaysian engineering sector cannot develop training modules that adequately address the specialisation coordination and relevant industries, including renewable energy, construction, and technology. Generic training programs do not capture this requirement and expose engineers to various project requirements that make them insufficiently prepared to handle a specific domain. For instance, civil engineers specialising in the general use of equipment will not possess the specialised project management skills required to coordinate infrastructural works.

To fill these gaps, a transition to genders that incorporates special training modules and practical exercises encompassing technical and non-technical skills is needed. Through leadership workshops, case studies, and competency-based performance management, engineers can be moulded into job roles and as leaders. This fits into the general strategy of Malaysian industrial development by providing the engineering workforce with adequate

knowledge and skills for future needs, thus ensuring sustainable development and competitiveness in the global markets.

2.11 COMPETENCY-BASED PERFORMANCE MANAGEMENT

Competency-based performance Management (CBPM) is a strategic model that links planned Competencies for organisational personnel to targets with a curriculum on how employees are expected to behave, know, and perform in their line of duty. Thus, it is a rational strategy for assessing accomplishments and establishing development needs for crafting employees with appropriate competencies to deliver outstanding results. In engineering management, where technical competency and versatility are especially crucial, CBPM offers a remarkable opportunity to meet the challenges characterising the profession.

Therefore, Technical competencies are critical to engineering management tasks in implementing projects and effective change. CBPM also helps learn these skills since clear role-specific frameworks are defined for each competency. For instance, an engineer who finds employment with a firm dealing with renewable energy will need technical skills like advanced modelling software and knowledge of energy storage systems, among other non-technical skills like project leadership and interpersonal communication. Due to this, CBPM aids in achieving the right training concepts mainly because they are in harmony with organisational goals and industry demands in the targeted areas.

This means that through the practice of engineering, these professionals need to continually improve their skills due to fast-growing technologies across the globe. Here at CBPM, we foster this requirement by encouraging specific training for skill acquisition that will equip engineers to meet these challenges. For instance, it helps in implementing learning solutions that reflect contemporary technologies as a result, training and development activities are

developed with an understanding of new tools such as artificial intelligence and automation technologies for employees to meet future needs.

Furthermore, CBPM contributes to increasing organisational flexibility by improving workforce flexibility. Employees with the right competencies can quickly move from one project and role to another, minimising time wastage and increasing operational efficiency. Especially in engineering, where teamwork with staff from other fields may frequently be needed, CBPM guarantees the engineers can cooperate effectively across these different zones, hence enhancing project effectiveness and creativity.

To conclude, CBPM serves as a valuable compass to engineering management, helping define skills necessary to enhance and successfully advance within a profession. Therefore, enhancing the relationship between individual competencies and organisational goals strengthens the performance of employees and organisational capacity when faced with stiff competition and high market volatility.

2.11.1 The Concept and Importance of CBPM

Competency-Based Performance Management (CBPM) is the approach that stands on the belief that clearly defined competencies make an employee improve his or her performance because any probable weakness or skills gap is identified. It provides an eminent procedure for matching the accomplishments and skills of the employees and the denominations of the organisation, thus providing a formulated system of performance and nurture assessment. Like competency-based training, CBPM links specific competencies to roles within an organisation; in doing so, it reveals the distance between the ideal and current supply of skills and the exact requirements in each job description to plan and implement interventions to address these gaps. According to Lubis et al. (2024), CBPM not only enhances individual performance but also

contributes to organisational flexibility so that organisations can compete within complex environments.

CBPM is crucial in engineering management because the field focuses on technical areas and exigent logical thinking. Mechanical positions require the use of complex tools, technologies and methodologies that are often peculiar to the engineering profession, and these are bound to change often. CBPM provides an understanding and a mechanism to categorise these competencies so that development efforts are aligned. For instance, in a manufacturing context, competencies like automation systems, data analysis, and sustainable engineering may be defined as important. CBPM makes sure that engineers learn these skills to meet today's demands in the job market and the challenges that might come up in the future.

Furthermore, the CBPM encourages learning – which is critical in engineering as it is an innovative profession that involves lots of change and development in technologies. CBPM also incorporated the continual evolvement of skills into performance management that enables engineers to address emerging trends in their field, including artificial intelligence or renewable power systems. It not only focused on the gaps required to learn immediately but has also considered prospects as an important guiding light, which can make employees future-proof in a cutthroat world (Lubis et al., 2024).

CBPM also increases the flexibility of the organisation due to the development of a competent workforce to meet the project's dynamism. For instance, an engineer who possesses many competencies increases the likelihood of project vertical flow, thus minimising project disruption from consultants. In multi-professional engineering learning environments, CBPM guarantees the transition of appropriate collaborative and technical competencies that enable engineers to interface with multidisciplinary teams.

Altogether, CBPM is a significant framework for the management of engineering, which concerns itself with capacity building for individual practice as well as furnishing the organisation with deep and robust protection. As competencies mirror job roles and industrial challenges, CBPM fosters the growth of both the employee and organisational strategic plans, further placing focus on the role of CBPM in determining outcomes in the engineering field.

2.11.2 CBPM and Career Growth

CBPM bears great importance in enhancing career support since it gives directions toward the competency needed for career advancement. Competency maps represent the technical and related non-supplier competencies that are relevant for certain positions so that the employee can focus on specific learning needs. In a similar manner, according to Merchant (2024), this structured approach has virtues, notably when it comes to technical professions such as engineering, whereby consistent training forms the competitive edge for engineering professionals. For example, an engineer staffer eyeing a management career position may apply CBPM to learn competence for higher roles such as leadership, project management and strategic decision-making in a systematic way.

CBPM not only enables its employees to have tools to enhance their performance for career growth but also engages them by aligning organisational goals with individual goals. Everyone wants to grow within an organisation; hence, when the employees see that their competencies can be rewarded by a rise in the company’s ranks, then they will be more productive, responsible and dedicated to the tasks given to them. This has Champlain’s engineering institutions to maintain highly skilled professionals to support the sustainability of the whole organisation. Professionals are usually the life of any project, and the absence of such talents leads to project paralysis and high costs in looking for new talent (Merchant, 2024).

CBPM is especially suitable for application in engineering management because it considers technical competencies and employability skills to be the most relevant for managerial positions. Systems design and development, analytics, optimisation Other technical skills which are relevant for engineers include advanced technical skills, system design, advance analytics, process optimization, team management, conflict solving, communication skills, management skills among others. CBPM guarantees the fact that both these skill sets are cultivated in parallel allowing engineers to transform and move towards leadership roles easily.

Moreover, the structured approach to CBPM helps individuals to have the clear vision of the career paths they choose. The results of the competency assessment may be used by engineers as a reference to their development over time, forecast key competency gaps that are likely rise in the future, and work on these gaps through the implementation of relevant training and development interventions. It not only empowers the individual workers but also enhances the organisational talent well-being so that a continuous flow of capable leaders into the organisation is maintained from the organisational point of view.

Therefore, CBPM is a revolutionary approach to engineering management career advancement. It enables engineers focus on enhancing technical and leadership skills, and transform their career while fulfilling organization aims. Because of this double-edged emphasis on both the individual and the organisation, CBPM is a necessary tool for facilitating endeavours towards sustainable employability in the engineering profession.

2.11.3 CBPM in Engineering Management

CBPM is promising for improvement of efficiency of management in engineering conditions, however, its application is not widespread in the field of engineering management that is more oriented to technical skills. Febrian and Solihin (2024) point out that this is a literature gap

based on the lack of literature involved in the research and application of CBPM in industries with specialized human capital. They hold that the adoption of CBPM in engineering career development frameworks will advance career advancement by providing career maps that identify path to obtain specific knowledge and skills.

In the engineering domain, CBPM can describe technical competencies as well as so-called soft skills that are critical for business operations within the supply chain. Technical competencies may include higher order skills for instance dexterity in the use of design software, computer simulation and systems analysis that are vital in the accomplishment of engineering projects. Non-technical skills—the ability to think, lead, collaborate and communicate—are equally important as technical skills especially when the engineer is transferring from the technical practice to management or into the interdisciplinary practice. Both, these dimensions are integrated with CBPM; it ensures that engineers are ready to tackle for current nature of job requirements and at the same time, ready to face organization's emerging requirements in future.

Furthermore, the increased sophistication of the tasks inherent in engineering, as well as the broad concerns with environmental, economic, and social contexts in which interventions are to occur, demand that engineers frequently interact with specialists from other fields, including environmental science, public policy, business strategy, and management. For instance, an engineer working in a renewable energy project may encounter complex processes within projects than in inter-project processes he or she may engage in while working with teams tasked with the responsibilities of ascertaining compliance with set legal requirements or evaluating the financial aspects of the project. CBPM further enhances this by emphasising the acquisition of interpersonal competencies including negotiation, administration, and cross cutting teamwork. Three such competencies are necessary for the success of multi-disciplinary projects as identified by Febrian and Solihin, 2024.

CBPM also provides a more stable structure of competition between individual career aspirations and organizational strategy to create a learning and training culture. This approach is beneficial where technology development is fast like in engineering management discipline. Considering this, CBPM offers a more integrated method for developing competencies through integrating technical competency and leadership competency; consequently, it can prevent cases whereby the engineers are excellent in carrying out their present responsibilities yet scarcely equipped to perform other higher-risk and seniority extensive responsibilities in the future.

In summary, CBPM can reconstruct the conventions of engineering management removing the barrier between subject expertise and managerial competence. The incorporation of career construct can enhance both field-profession career advancement and organisational effectiveness when incorporated into Career Development Frameworks for creating the bell-shaped enduring and adaptable engineering workforce.

2.11.4 Challenges in Adopting CBPM

Nevertheless, the implementation of CBPM in engineering management has been associated with several remarkable challenges. At present, one of the main challenges facing the merging of the two areas is the absence of professionally distinct competency frameworks that are geared towards the needs of the engineering industry. These frameworks in general may not cover enough in terms of technical information processing and the contest-specific requirements that are associated with engineering jobs. This misalignment can lead to training programs that do not encompass all the important skills required on the job thus reducing their usefulness (Lubis et al., 2024).

CBPM implementation also calls for significant investment on time, resources in addition to deep technical know-how. It is imperative that organizations undertake comprehensive competency profiling to define, for example, key competencies required for specific positions, design and establish relevant competency models and undertake an evaluation of managers to train them on how to successfully use the competency models. To small and medium sized engineering practices these can represent a substantial financial and operational burden especially when budgets and access to technical knowledge are constrained.

One more identified obstacle for the introduction of CBPM in engineering is resistance to change. Expert and managers driven with traditional approaches of performance appraisal may consider competency-based approaches as unimportant complexities. Such resistance may stem from the basic ignorance of the various advantage that may come with CBPM including the thematic one of; remapping employee career progression plans to corporate goals and objectives; as well as achieving correspondingly, a malleable labour force. Engineering management focuses on business outputs and quantitative assessments of those outputs, so some people favouring this model may overlook the value of competency-based frameworks.

In addition, the employment area of the engineering sector seriously emphasizes on purely technical know-how instead of other non-critical soft skills inclusive of leadership, communication and teamwork. This may well prevent the buy-in of comprehensive CBPM frameworks that include both technical and behavioral training and development, thereby potentially threatening to restrict the development being offered by CBPM to advance careers and organizational effectiveness.

To overcome these challenges, organisations, therefore, need to justify the key strategic benefits of CBPM and market them well. This also involves showing how, through CBPM, the performance of each employee can be optimised, how the employee's career advancement can

be achieved and more importantly how the workforce capability can match new market demands. Furthermore, acquisition of a robust solutions for competencies measures and assessments, smart CBT, or specialized learning management systems with modular comer stones will assist organizations in making more effective CBPM. To a degree, overcoming these barriers creates the foundation for using CBPM to develop engineering management as an effective way to ensure the site has a skilled, diverse, and flexible workforce for future endeavours.

2.12 CAREER DEVELOPMENT OPPORTUNITIES

Promotions and other career related avenues are essential in promoting positive employee turnover, positive workplace satisfaction, and improved organizational efficiency primarily in the engineering industry. In a profession that is so centred on technologies, flexibility to learn and grow, career management programs form a fitting place for one's ambitions with that of the company's needs. In engineering management, the development of career paths entails the handling of technical, managerial, and interdisciplinary tasks, and so requires a clear and sound career advancement framework.

Merchant (2024) emphasised that organisations; meaning any firm, should proactively invest in career development these include advancement, position swaps, and trainings. Besides, these strategies improve the performance of the employees to deliver their best in executing their duties in the organizations while at the same time helping the firms to ensure that employees develop high value and commitment towards their jobs. Engineering is one of those professions where workers are largely looking for progressive advance or growth in technical specialization or changes in career type. For example, an engineer who has a particular focus on system design

may have a goal of transitioning to project management, so they will have to demonstrate technical expertise and receive leadership education.

Career development in engineering also enhances role definition because it guarantees that every employee is assigned to work in a position that suits him or her. This alignment increases interest and productivity since employees sued to work in areas that Favor their skill set and or career path. I also agreed with a concept of the horizontal mobility like from mechanical engineering to system engineering, not only expands an engineer's experience but also strengthens the organization's flexibility by developing a team capable of solving various issues.

In addition,(up-skilling that is offering certified courses in emerging technologies or about leadership or project management etc), engineers maintain competitiveness of the engineering field. These efforts help organizations prepare its human resource in anticipation of present and future tasks with an emphasis on organizational development. By actively investing in career development, engineering organizations can achieve a dual benefit: keeping your best performers whilst creating solid pools of well-motivated personnel for the achievement of long-term organisational objectives.

2.12.1 The Importance of Career Development Opportunities

Retaining skilled professionals in this sector is very important and this can only happen if there's clear and structured career development opportunities. Engineers are working in the dynamic environment of technological advancements and changing project requirements, making learning and adaption not just optional but have become the centre point of an engineer's life. In fact, it also offers artful pathways for career progression and making sure

employees feel valued and feel like an organ at the same time. The impact of this on job satisfaction and retention are that employees will be more likely to stay with a company if their horse's pursuit were backed by an employer.

According to Jamaludin et al. (2024) manufacturing firms with good career development programs also report significantly lower turnover rates. These programs may include technical training, leadership development, mentorship, opportunities for vertical progression and lateral movement within the organization, for these programs are for engineers. Structured initiatives allow for engineers to gain new skills, move into exciting roles, or explore a new discipline — which keeps them engaged and loyal.

However, there remains a large gap in the implementation of career development program. Today many organizations don't align career management with personal career goals and organizational objectives. All this misalignment can ultimately lead to employee disengagement, and particularly amongst high performers who value growth and advancement opportunities. This kind of disengagement in the engineering sector is common enough that it often leads to turnover, disrupting critical projects, adding further time and money to already busy recruitment and onboarding processes. For instance, someone who leaves an important design engineer mid project causes knowledge gaps and increases operational inefficiencies causing the project to have a lower chance of overall project success.

This challenge must be addressed by organizations that need to build career development frameworks that address the balance of individual interests against organizational needs. Technical and non-technical competencies required for progression will be identified, and training programs will be designed to target these competencies, and successful design of a culture of continuous improvement should be fostered. With the right strategies, engineering firms can retain top talent and achieve a higher degree of workforce stability and long-term

success through aligning career development opportunities with organizational ones. These efforts, however, not just satisfy employees but also enhance competitiveness and innovation of engineering organizations.

2.12.2 Horizontal and Vertical Career Mobility

Vertical and horizontal mobility can be considered as Career development opportunities of the organization. Promotions to higher ranking positions with responsibility for and right to approve important decisions, are known as vertical mobility. For example, in engineering vertical mobility may mean moving from a design engineer to a project manager or technical lead. Lubis et al. (2024) propose CBPM frameworks can enable vertical mobility through the offering of career ladders that clearly pin down levels of skill and competency.

By contrast, horizontal mobility refers to lateral moves from one role or department to another giving employee's visibility and exposure to other organizational functions and the chance to enhance their skills. Lateral moves can be changing from one specialist discipline to another, such as going from mechanical to systems engineering for engineers. These opportunities not only expand individual skill portfolios, but it also heightens organizational agility by developing a force that can handle cross interdisciplinary challenges (Merchant, 2024).

Vertical or Horizontal mobility, depending on the organization, is an opportunity for career development within an engineering organization that serves various although distinct developmental purposes for employees and organization. The dynamic nature of engineering roles calls for both forms of mobility to allow engineers first to specialize in their fields and then to adapt to the broader organizational needs.

a. Vertical Mobility

Vertical career mobility is defined as promotion to a higher-ranking position, usually accompanied by increased responsibilities, authorities to decisions made within the organization. Vertical mobility in engineering is frequently an exchange from a tech role to one of management or leadership. If, for example, a design engineer, you can grow to be a project manager, a technical lead, or an engineering director. These transitions need only expertise with the technology, but should also develop leadership, communications and strategic thinking skills.

Competency-Based Performance Management (CBPM) frameworks help make the vertical mobility possible. Lubis et al. (2024) points out that CBPM, though has clear career ladders by mapping required competencies to specific roles and levels. This enables the engineers to identify the skills and knowledge for advancement, so that it could guide their development activity. An engineer example might consider to take CBPM approach to aim for competencies on project management, conflict resolution and stakeholder engagement, to be ready for leadership roles.

b. Horizontal Mobility

Horizontal career mobility is moving around to different roles or departments within the same firm and focusing on expanding skillsets across different organizational functions. Horizontal moves in engineering are particularly valuable for promoting cross disciplinary expertise and strengthening problem solving capability. Imagine, for instance, an engineer from mechanical

design could realize a path into systems engineering, gaining experience in integration, testing, and optimization.

Such transitions are not only aiding at the individual level but also at the organizational level of agility. Merchant (2024) argues that horizontal mobility is facilitated to increase workforce flexibility through the creation of employees who can take on complex, multidisciplinary challenges. In the world of engineering, where projects generally involve work from multiple domains including electrical, mechanical, and software engineering, horizontal mobility is essential in helping employees adapt to project changes and contribute meaningfully in cross domain contributions.

c. The Synergy of Horizontal and Vertical Mobility

Therefore, vertical and horizontal mobility make up the ideal model for the career progression of engineers. Vertical promotion enables engineers to move to higher levels and take up projects with higher standing and challenging responsibilities while horizontal mobility provide new ideas and skills due to change in perspective. Those organizations that support both forms of mobility not only provide their employees with the opportunities but also help them develop a strong and flexible mass capable to meet the demand of changing industry.

Thus, the involvement of structured paths for both lateral and vertical mobility within the framework of career management increases the possibility to better match employee expectation with organizational requirements within the engineering organizations. Thus, the

approach provokes interest, expands the spectrum of skills, and guarantees organization's sustainability in the conditions of intensity and constant changes in the chosen field.

2.12.3 Skill Enhancement and Role Alignment

In the engineering sector, the technical expertise and adaptability required for success are both valuable and critical for career development, and so skill enhancement and role alignment are needed. A skilling approach that enables organizations to develop skills and align roles to individual strengths improves the growth of employees and the performance and innovation of the organizations.

a. Skill Enhancement

Career development in Engineering is based on skill enhancement and that is how engineering employees can learn to achieve the competencies important for advancement and success in their roles. This is often engineering in that we need to get technical certifications in various disciplines and be experts in the emerging technology and to be able to project manage very large complex multidisciplinary projects. Let's assume for instance, an engineer desiring a jump to a leadership position might choose to take workshops pertaining to team management, budgeting, good communication, etc. But this also means that these initiatives enhance employee competency for additional responsibilities and guarantee that their input and roles align to further the organization's interests.

We must continuously develop our skills as the engineering technological advancements are occurring rapidly. Engineers are needed to continue to realize that they are required to keep up to date of tools and techniques like artificial intelligence, sustainable engineering practices, and

advanced manufacturing processes. Targeted training programs allow organizations to invest in their employees to ensure they remain competitive in the ever-growing industry landscape. For instance, one way to ensure these engineers make their mark on the designing projects of the future would be to certify them in cutting edge design software or renewable energy systems, while making them grateful and ensure success at both the personal and organization levels.

b. Role Alignment

Role alignment insures that employees are jobs in a job placement that is congruent with their skills, interests and aspirations. However, in fields like engineering, where the work is very special, role misalignments tend to translate into disengagement, underperformance and even attrition. On the flip side, when employees are assigned to their roles that matches their expertise and career goals, they do mark good and intact with their organizations.

Role alignment is achieved in effective way when Career planning framework take into consideration of individual strengths as well as organizational requirements. These frameworks help to determine which skills labour force has and link it to the specific roles that call for those skills. For example, an engineer with superb analytical aptitude and simulation experience could be put to employ as a systems engineer, while another with a process optimization background can be a natural to handle operational efficiency roles. By placing objects relevant to an employee's role in their sight line, Merchant (2024) notes that 'not only is productivity maximized but employees gain job satisfaction from feeling valued in and capable of their roles (Merchant, 2024).

c. The Synergy Between Skill Enhancement and Role Alignment

If skill enhancement is combined with good alignment to roles, the results are transformational for employees and for organisations. To capitalize your potential and help the organization reach its objectives, engineers should be placed in roles that matches their aspiration and continuously develop their skills. This synergy of this synergy means that for employers you end up with a highly skill, engaged and motivated workforce that can tackle complex problems and innovate.

Secondly, the engineering career development primarily emphasizes the improvement of skill and role alignment which in turn enable employees to fulfil well their roles and their personal growth meets organization success. This dual focus not only improves job satisfaction and retention, but also poises organizations for long term competitiveness in a fast-changing industry.

2.12.4 The Role of CBPM in Career Development

Competency based performance management (CBPM) is a powerful vehicle for career development that provides a structured framework to link competency levels to clear career progression. CBPM defines the skills and knowledge needed for each role, and provides employees with a roadmap to their careers. Because of this clarity, employees become able to recognize what their development opportunities are that match their desires. In their work Lubis et al. (2024) highlight how CBPM is of special relevance for engineer career advancement needs by mapping technical and non-technical competencies to specific roles. By this alignment, training and development efforts are strategically targeted so that engineers can build the competencies needed to remain vertically or horizontally mobile within the organization.

CBPM provides a tailored career development in engineering management, where often career growth involves switching from technical expertise to leading responsibility. Take for example, an engineer with experience on advanced manufacturing who might be chosen for a future career path focused both in more specialization by means of certifications and leadership development programs. Not only does this give the engineer an opportunity to work towards his or her individual hopes, but it also is a force multiplier for the organization by developing a pipeline of skilled professionals prepared to lead more complicated roles and responsibilities.

Continuous skill development is a continuous feature of CBPM, and necessary in the fast-evolving field of engineering. Every day, engineers need to adapt to new technology, new methodologies, new requirements. CBPM helps organizations identify skill gaps and create targeted training initiatives so that employees can continue to develop skills that will continue to be relevant, both today and tomorrow. As an example, engineers with leadership potential could be sent for training in projects management, team coordination, strategic decision making so they are ready for management

Also, CBPM addresses the issue of promotion by encouraging both vertical and horizontal promotions within the company. Career progression within the same firm, especially to positions of managerial level, is well backed up competency frameworks as presented here. While in the on the other hand, horizontal mobility enables engineers to oscillate from one discipline to another for instance from mechanical engineering to systems engineering to improve on their diversification. The combination of these two goals guarantees that an employee is proficient in his line of work but also versatile in work issues and tasks.

Therefore, CBPM presents itself as being particularly important as a tool that aids career development for engineers by systematizing skills advancement, role definition and career progression plans. Promos feature of the model is its capacity to align technical and non-

technical sets of competencies to well-defined development tracks that make both the employees and organisations reap the benefits of having a skilled, motivated, and future—proof workforce.

2.12.5 Challenges in Providing Career Development Opportunities

Career development opportunities are valuable tools, not only for increasing employee growth and organizational effectiveness, but the real challenges in doing so can be found in the engineering sector. A major challenge exists between career development programs and organizational goals. However, most organizations build career management initiatives in isolation as the focus is on generic frameworks that do not take into consideration the aspirations of their employees or the strategic needs of the business. Jamaludin et al. (2024) highlight that this disconnection can result in employees disengaging and turning over, especially high performing engineers who want to align their career with what is being offered. For example, an engineer with good managerial potential could decide to move on, if managerial development is either limited or not clearly outlined in the environment of the organization.

However, this misalignment is particularly problematic in engineering, as engineering projects are often complex problems that require a fundamental combination of specialized skills and prevailing capabilities. When these dynamics are left unchanged in career development initiatives, employees may be poorly positioned to take on important roles, and the organization faces possible failure to meet operational needs. This challenge can only be addressed by a strong integration of career development opportunities into organization objectives.

The career development programs are also resource intensive. Customized training modules, competency frameworks and career planning tools are often demanded at engineering roles and

tailored to a given discipline. For example, teaching advanced manufacturing technologies, systems integration or project management, is a costly and operationally intensive exercise. Many of the smaller engineering firms often are unable to invest or develop sufficient resources or infrastructure to create and implement a comprehensive career development initiative. As a result of this, employees don't receive opportunities to develop the skills they need for progression in their careers and may become disengaged and a turn over.

Furthermore, the speed of engineering exacerbated by technology worsens these challenges. As new engineering practices and tools are developed, so are training programs and career frameworks that must constantly be updated, for organizations it is not easy to stay ahead of this trend. Furthermore, conversations about technical skill development often overshadow the importance of the important soft skills, including leadership and communication, to one's career progression.

This challenge needs a strategic approach. To be effective, career development initiatives must cohere with both an employee's and business's aspirations for career development, and they need to balance the development of technical vs. managerial skill sets. For example, such organizations can collaborate with industry experts, as well as use digital tools to design cost effective and scalable career development programs. If engineering firms overcome these barriers, they will be able to build a motivated, skilled workforce, capable of responding to the need for a competitive and changing industry.

2.13 EMPLOYEE ENGAGEMENT AND MOTIVATION

Now there's no greater driver in engineering management than employee motivation and engagement, where technical expertise and innovation, and problem solving, can and will make or break your career. This sector (for example) often hands employees with assignments to

solve tough, fast changing technology problems, so both the workforce must be educated and committed and engaged. However, this will help employees be more engaged, develop opportunities for growth in the organization and be happier with their jobs and productivity and, consequently, promote organizational stability (Febrian & Solihin, 2024).

The most powerful result of research is the strong direct correlation between motivation and career commitment. Making your employees motivated is a clever approach to improve the level of efficiency, flexibility and the ability to jump in on new tasks. It's very important for the engineers especially because you must always be on your toes, you must be always innovating because you must always keep up with the industry demand. Considering the example, engineers who naturally like problem solving, will go further to acquire the advanced certification, undertake more challenging projects and do their levels of contribution to the goals of the organization (Mustafa & Lleshi, 2024). Extrinsic motivators like recognition, promotions, career advancement opportunities reinforce all this commitment.

It also fosters engineering innovation and team activity through employee engagement in engineering as their dedication in terms of tireless human resources is more likely associated with the propensity to engage in inter departmental teamwork, generate new and creative ideas and teach their juniors. This engagement bubbles into organizational culture and finds its way to organizational success. For example, where a well engaged design engineer steps up and demonstrates their leadership skills to drive higher efficiency (or increase utilization) in the process or technology, not just for themselves but the whole team and project outcomes.

Bringing career development to realign with employee aspirations can help organisations to improve engineering management engagement and motivation. This also includes adding value to this kind of skill, along with setting out challenging assignment and creating career progression paths for employees so there is a sense of value and support when you are

progressing. This means that the culture is created so that we recognize and reward contribution not only for one time sustenance of motivation but also produce a loyal workforce that can also drive long term organizational growth.

Finally, employee engagement and motivation, engineering management would truly be unlikable, since it is the engagement and motivation of employees that have the production power to produce work in the most critical roles which in turn provides the performance and strength of the organization. Strategy is developed to cope with these factors producing a skilled, adaptable and committed workforce in an ever-changing industry.

2.13.1 The Role of Engagement in Career Development

In engineering, engagement has dual effect on individual and organizational outcomes. For example, engineers involved in projects where their skills are enhanced, for example, through the advanced training programs or interdisciplinary projects, will tend to become more engaged. It provides an opportunity for spouse employment that supports their career aspirations by making it an extension of the organization itself, and their growth with the organizational objectives.

However, if engagement is to influence career development, organizations need to proactively provide career-related activities. Such service utility includes the ability for any junior engineers to consult through their senior counterparts on professional procedures and development. Identified skills workshops, project-based learning experience enhance the abilities of engineers in extending knowledge into practice. The above mentioned provide a culture that rewards and encourages employees to embrace long term objectives.

Another is recognition; something that is so important and so critical to foster engagement. Employees are owed to be committed to roles when they are perceived by them to be acknowledged and appreciated for their contributions. In engineering however, admitting and recognizing achievement — successful project completes or innovative solutions — allow a sense of accomplishment and keep the effort flowing. Loyalty and the motivation for employees to grow become a part of this culture of recognition (Febrian & Solihin, 2024).

Therefore, engagement is crucial in Career advancement in engineering Management. In a way, career related activities, acknowledging efforts of the employees and nurturing environment help organization tap the true potential of their workforce. What is more, this approach promotes personal development as well as fosters innovation, productivity, and organizational performance improvement in the vortex of the strongly competitive engineering business environment.

2.13.2 Motivation as a Catalyst for Career Growth

Engagement is highly useful for pursuing career objectives, motivation proves to be instrumental in enhancing engagement to achieve personal and career goals, there again especially in the engineering profession where successful improvement requires both skills and motivation. Employees' motivation makes them to be interested on skill development ; opt to challenge themselves with difficult tasks and to be promotions within their organizations. In their study Mustafa and Lleshi (2024) argued that those employees with high motivational

levels have better career embeddedness and this entails more readiness to gain and perform new behaviours as expected of them in their careers.

In engineering management, motivation may result from project work that presents an opportunity for the engineer to solve problems or to be associated with meaningful tasks. There is nothing more exciting to engineers as giving them chances to be creative, this is in coming up with new systems, improving processes or meeting certain industry needs for example around sustainability. This leads to achievement motivation, which is self-generated satisfaction and pride resulting from work accomplishment. For instance, an engineer working as the designer who strives hard to come up with a new design at the workplace, the professional experiences a boost in confidence and strongly committed to the idea of climbing the ladder in his or her career path.

Extra organisational incentives are also an important source that help in maintaining commitment for career in engineering. Incentives like performance bonuses offer a physical reinforcement of an engineer's work, which will ensure they do not relent on their efforts or job hunt for other companies. Likewise, taxable inducements that are linked to people appreciation fosters recognition programs that emphasis achievements like awards for inventions or impressive project completion. Promotion practices including leadership training, technical skills accreditation or other advancement trails also supplement motivation by proving career ladder.

Picture a corporation that provides training in things such as advanced manufacturing technology or project management certifications for engineers so they have the capabilities to do more complex tasks. Not only does that help individual career trajectories but it helps an organisation achieve organisational success by creating a pipeline of skilled leaders. Such

opportunities drive motivation, engendered by them, that keeps engineers absorbed in their positions and avoids high turnover rates and instability within the organization.

Finally, it is strongly argued by this paper that motivation is the force that drives career growth in engineering management. You have intrinsic drivers (personal satisfaction) to leverage as a supplement alongside extrinsic drivers (financial rewards, career progression opportunities, structured) to promote employee growth and organizational performance. The benefit of this dual approach is that engineers remain committed, engaged and ready to excel in a high paced and competitive industry.

2.13.3 Challenges in Employee Engagement and Motivation

Specifically in the engineering industry high levels of employee engagement and motivation are very tricky to maintain. Jobs within the engineering industry require precision, creativity, and constant collaboration. These challenges are, however, more amplified in traditional Malaysian organizational structures. As Jamaludin et al. (2024) stated, the operational environment of many Malaysian organizations is based on rigid top-down hierarchical system where open communication and employee involvement in decision making process are not allowed. It's entirely possible that this centralized approach could make employees feel as if their contribution is unvalued, and hence less emotionally connected to their role, and the organization. It likewise prompts diminished effectiveness and advancement in an industry where issue answering and embellishment are basic, for example, designing.

The second challenge is the lack of alignment between engagement strategies and career development schemes. Death by engagement happens when many organizations fail to

interconnect engagement programs with clear paths to career advancement, and make employees feel uncertain as to how their efforts tie to personal growth opportunities. This gap is most visible in engineering roles, where professionals realize the need to have to keep learning and improving skills continuously to stay competitive in the extremely dynamic industries. If these dreams aren't addressed and the individual employee feels stuck, disengagement and high turnover rates will occur.

The engineering field also has its own distinctive motivational issues, one of them being technical content of the field and a high velocity of work. Quite often, people within this sector are happiest when presented with tough assignment and new ways to do things. Nevertheless, if organisations fail to offer quantities of resources, rewards and opportunities to help transforms workers into performers, they risk seeing their employees' drops their intrinsic drive. Also, on the nature of the engineering profession where assignment and project completion are highly valued and pursued this leads to disengagement.

That is why today it is necessary to focus on the changes related to the questions of company culture, which should include collaboration, recognition, and development. It can improve the engineers' sense of value, and ownership if the organization is to introduce feedback mechanisms to enable them to participate in opinion-making processes within their organizations. Moreover, connecting engagement tactics with formal career enhancement activities – like, coaching, skill enhancing and leadership development programs – can enable engineers to understand how their participation contributes to their individual, as well as organisational benefit.

All in all, it is possible to counter the problems connected with raising employee engagement and motivation only by means of a planned strategy that complies with organizational and personal ambitions. If engineering organizations remove the hierarchical barriers to

engagement and link engagement with career development, organizations stand to gain a committed and motivated workforce that will help bring about sustainable innovation.

2.13.4 Strategies to Enhance Engagement and Motivation in Engineering

Improving employees' involvement and productivity in engineering management is an essential component for embracing competent employees with commitment. Due to engineering's technical nature, the performance of related jobs involves people working in teams, and therefore, the use of targeted approaches is essential in influencing aspirations of people in the engineering careers.

a. Recognition Programs

Recognition programs are the perfect way to gently remind employees exactly how important their work is and to motivate them even more. It will satisfy engineers, whose inputs of creativity can be matched by team output, and other milestones within their projects can also be appreciated. An award for example, most efficient to build a low-cost model, or completed a project team can promote value and trigger more actions. According to the article of Febrian and Solihin (2024), they have also mentioned that museums that also implement recognition programs will increase employee morale at the individual level of analysis, as recognition programs contribute to embed employee initiative into the organization's goals by highlighting creativity and cooperation values.

b. Career Guidance

Importantly, individual assignments such as career counselling and using professional role models is most beneficial in engineering discipline. Through linking personal and organizational objectives, career counselling guarantees that workers are productive, as they are always focused. This is a program that offers junior engineers' tutelage whereby they can get advice from seniors concerning some technical issues or career debate. For instance, an engineer happy to move to the managerial position will likely find benefits of getting leadership and decision-making guidance boosting both the individual's career and organizational competencies.

c. Challenging Projects

Taking engineers and assigning them to tasks and projects that bring the most definitive impact on innovative solutions is a chance to also train them. Specifically, engaging tasks for which innovative tools or technologies are applied, and problem-solving activities that require higher order thinking skills not only enhance self-generated motivation but also facilitate career development. For instance, an engineer designing renewable energy with computer-aided models, project management, and integrated engineering skills builds experience while the organizational innovation is pursued.

d. Feedback Mechanisms

Both open and regular channels of feedback foster a culture of trust and collaboration, and are important to engender the culture of engagement in engineering. One on one discussions, performance reviews, and project debriefs are meant to help employees understand their strengths, weaknesses, and have an area to grow. By bringing in the engineers in the

performance discussions, organizations encourage sense of ownership and employees to further engage with their human roles. Also, effective feedback mechanisms aid in the identification of the staff skills by the managers, thereby, allowing for growth in skills all the way to continuous skill development.

e. Diverse Career Development Opportunities

It is more effective to organize several different types of initiatives related to the career advancement because these initiatives meet engineers' needs and interests. They include leadership training, technical workshops, cross-functional projects as well as observing other engineers working on another field of engineering enable the engineers to consider other professions within the same discipline as well as developing other skills. For instance, attending a workshop on artificial intelligence or sustainability activities provides engineers with the information that might be useful for broader engineers' practices and which will be required in the future (Jamaludin et al., 2024).

Hence, the above explained strategies can help improve the employee engagement and motivation if put and practiced in engineering management. To develop a skilled talented force organization, give recognition to the employees, career planning, offering a quality challenging project, building up feedback mechanisms, and different development opportunities, mentors, and career models, an organization can foster a motivated force in the long run that can carve a sustainable future for the organization. Such measures bring about employees' good attitude to their jobs, which contributes to individual advancement as well as added value to the organization.

2.14 TALENT MANAGEMENT PRACTICES

Talent management can be defined as the processes and activity carried out for the purpose of attracting, developing, and maintaining employees with high at the right place in an organization with a view to contributing to organizational strategy. In engineering management, these practices have special value because the sector is closely tied to technical competence, creativity, and problem-solving capacity. Many times, engineering positions require applicant to have a combination of expert knowledge and being able to balance the emergent shifts in technology and the field. Hence, there must be strategies on how to attract, cultivate and retain professional workers in the organization.

It will be important to note that engineering talent management processes significantly help in building and categorising career frameworks necessary in talent development. These frameworks not only serve an organisation as a way of offering a chance to its employees to gain new skill sets, but also ensures the stability and flexibility of the workforce. For instance; training programs, technical certifications, and leadership development for engineers focus on enhancing engineers' ability to manage challenging engineering projects and ensure that the projects respond to organizational priorities. From the aforesaid framework theories proposed by Febrian and Solihin (2024), such processes have been identified to be crucial for engineering professionals to remain engaged, due to these processes help the professionals to visualize their career path and the competencies needed to progress to the next level.

Talent management is particularly important in the fast-paced nature of engineering. Organizations must always scan for and further develop potential employees who can fill

critical technical and leadership roles. By doing so they keep their workforce competitive and able to weather industry disruption. Organizations may implement mentorship programs, use digital tools to pull together the competencies of employees and thus have a pipeline of skilled professionals ready to solve current and future challenges.

This concludes that engineering management cannot exist without talent management practices. By matching these practices with the specific needs of the industry, organisations can develop a workforce that is skilled, adaptable and engaged to be able to drive innovation and ensure long term success in a market.

2.14.1 The Role of Talent Management in Career Advancement

Talent management enables the organization to focus on the growth of its employees and, in the process, build sustainable talent for the company. It contributes to the preparation for careers by offering frameworks that outlines the growth paths for the capacity development of the employee hence increasing both individual and overall organizational performance. Febrian and Solihin (2024) revealed that high degrees of structure in TM systems are linked with clearly prescribed and understood career progressions; this is crucial within engineering contexts where worker desire career advancement, which consists of learning, more than anything else. For example; the managers encourage their engineers to undertake mentorship, technical certifications and leadership training, which enhance engineers to produce high commitment towards the organisation.

To this effect in engineering management, talent management needs to consider more than technical skills; leadership skills, communication skills, and project management skills to be specific. Cohesively, this approach ensures that the employees are accomplished in every task that may be required from them within their line of duty as well as in the overall Course of

employment. For instance, a junior engineer who wants to get a promotion and become a project manager needs not only to get familiar with elaborate technical skills but should also possess leadership qualities along with a mastery of the best budgeting strategies and skills of engaging stakeholders. When technical and non-technical developmental initiatives are incorporated in the talent management strategy the results are a balanced and effectively skilled manpower intensive industry.

The third element of talent management in engineering is the issue of talent retention with specific regard to professionals. People who can see and discern their career path within the organization that they work for are some of the most likely to stay productive. This commitment lowers turnover and contains factors including project delays and loss of aptitude, factors that are especially expensive in engineering environments. For instance, lack of an experienced engineer leads to various problems, including loss of technical craftsmanship, technical weakness, and inefficiency, which in one way or another affect the project duration and performance (Febrian & Solihin, 2024).

Altogether, talent management is suggested to be one of the key strategic approaches to organizational staff's career development in engineering management. If technical and non-technical development is offered to staff and if there are distinct career steps, employees are less likely to leave, interest is maintained, and perhaps more importantly, significant programs and projects are cultivated. This approach is also quite favourable for individual professionals, as well as for the organization because it fosters its competitive advantage and enhances its capacity to adapt and be innovative in an increasingly complex industry.

2.14.2 Competency-Based Talent Management Frameworks

Talent management frameworks based on competency which are aligned to career development objectives play an important role in engaging in talent management practices in the engineering sector. These frameworks leverage Competency Based Performance Management (CBPM) to establish structurally built career pathways in organizations which can develop a pipeline of skilled professionals able to meet industry needs. According to Lubis et al. (2024), integration of CBPM with talent management provides a strategic way not only to develop technical and leadership skills but also to designate employees to be trained to future roles as well as respond to changing dynamics at the industry.

The competency-based frameworks are especially useful in the field of Engineering management, where roles usually involve manifolds of technical precision and leadership responsibilities. A framework like this would look for example at how one would progress in an engineering firm from junior design engineers to project managers or technical director. A structured approach like this helps employees understand exactly what they must work on, which is fully motivational because you know you must learn, you must prove work, you must acquire the skills and competencies that the job demands, to go up in that ladder. As an example, say an engineer looking to make the jump into management may be directed to earn certifications in either project management or leadership to become prepared for bigger responsibilities.

Furthermore, CBPM frameworks enable accurate programmes for training and development to be designed to address needs which are unique to the engineering profession. This makes it

easier for organizations to design training needs intervention that will close employee competency deficiencies that arise with challenges in technology or industry advance. For example, as products and services with technologies like artificial intelligence, renewable energy systems are enhanced as engineering components, a competency-based structure can make sure that the employees get the necessary skills needed to be competitive and unique. It is beneficial for human development as well as organizational defence.

Competency based frameworks also promote career advancement while improving the efficiency of the organization by bringing its workforce in line with its strategic aim. Beyond simply preparing employees to respond to current demands, doing so also provides them with the skills they need to become ready for changing business requirements, thereby improving long term sustainability and innovation.

Competency based talent management frameworks are important to engineering management for providing career development alignment to organizational needs. These frameworks grow technical expertise as well as leadership skills enabling employees to advance in their careers while putting organization in an advantageous place within a quickly ever-changing industry. Through this alignment, the right motivated and skilled workforce works hard to drive success and innovation.

2.14.3 Challenges in Talent Management in Engineering

Talent management is an important concept in the management of engineering organizations but its application is subjected to several challenges that may affect its performance. One of the critical challenges can be attributed to the relatively weak alignment of talent management actions with the technical specificity of professional engineering positions. According to Jamaludin et al. (2024), most organizations use the conventional talent management approaches that do not capture the engineering profession nuance. This is usually counterproductive, increases turnover, and disengagement, mainly since highly qualified engineers may not get the requisite professional development support. For example, the lack of clear separate vocational-training paths or the lack of clear line-of-work training as it concerns the skills in which technical employees are particularly well-versed often removes any incentives to remain in the company.

There are two main reasons why talent management is resource intensive: a) it is complicated to implement and b) the complexity of the task makes it expensive. We must invest in custom competency frameworks, targeted training programs and career development experiences that bear huge amounts of cost and human resources. Without these investments, organizations may find it difficult to secure, and then retain, high-quality engineering talent even when there is intense commercial competition, what is already an increasingly dynamic industry (Jamaludin et al., 2024). The advantage afforded by having fewer people also carries with it the disadvantage of having fewer resources and fewer opportunities for development, meanings that smaller firms often find themselves competing against larger organizations that will offer them more extensive resources and opportunities for development.

Another challenge is a dynamic nature of the engineering field. Technology advancement keeps increasing in a continuous basis from artificial intelligence, renewable energy systems and

advanced manufacturing system, therefore, talent management practices should be able to be flexible and outlook. To maintain a seat at the table, organizations must constantly update their talent management strategies to ensure the evolving competencies are incorporated as well as how the workforce can meet their evolving industry demands. If failure to collaborate results in skill gaps that threaten innovation and operational efficiency, organizations will be in trouble.

In response to these challenges, organizations need to develop specific talent management practices that reflect the technical and professional requirements obtaining the engineering positions. This involves funding pursuit of competency-specific training, the use of electronic means in the assessment of competency, and competency development. Thus, overcoming these barriers will help engineering firms to build efficient talent pipeline and further enhance the industry's development, performance, and innovation in a currently high-competitive environment.

2.14.4 Strategies for Effective Talent Management in Engineering

Talent management for good engineering management – building a skilled, engaged, future ready workforce – is critical to doing so. This paper discusses the following strategies that facilitate engineering professional growth and organizational success by aligning talent management practices with the specific requirements of the engineering roles.

a. Integration with Competency-Based Performance Management (CBPM)

Incorporation of talent management with CBPM frameworks offers systemized framework to the theory of career progression. This alignment assists in designing paths, so the employees

explicitly comprehend what skills and competencies they should attain to progress. More so, in engineering professions where many positions are technical in nature and expected to provide leadership, CBPM provides for the right blends of development of both technical skills and generic skills including team work and interpersonal communication. For example, an engineer who wants to advance to a project management career can use a clear-headed competency ladder that maps the incremental skills development process and future changes that an engineer will face in his career path.

b. Specialized Training Programs

To promote technical excellence and career growth, it is very important to offer the targeted training programs to those communities based on the engineering disciplines. Advanced technologies quite often necessary in engineering roles, like for instance artificial intelligence or energy systems designed with low environmental impact. The experience in these areas or workshops in leadership for senior engineers are provided to certify that talent management initiatives include various needs. In this example, advanced simulation tools training not only fulfils a mechanical engineer's technical needs but also favours organizational innovation.

c. Mentorship and Coaching

Mentorship programs take juniors under seasoned professionals' wings and help transfer their knowledge, support their career guidance. In engineering, particularly, it is a very powerful technique because experience and problem solving occur through practical experience. With mentorship, junior engineers get to witness and learn about how to overcome the challenges of working on complex projects and go onto their career path, while the experienced professionals help by passing on their knowledge to ensure smooth organizational transition. For example, a

senior systems engineer working with junior colleague to bridge skill gap, and preparing the mentee for higher responsibilities.

d. Succession Planning

Succession planning is about bringing internal candidates into critical engineering roles who will be ready to take over rather than having to source and train new candidates when an employee departs. Firms in engineering can identify potential high flyers and give them tailored development to help them prepare for leadership roles. For instance, when a technical director retires, an organization might train a mid-level engineer in project management, communication, etc. This approach maintains continuity of the organization and reduces time and cost of the external recruitment.

e. Leveraging Technology

This paper shows that information technology is an important factor that is widely used in the current talent management systems. Competency mapping, performance appraisal, and training requirement identification are few of the activities that could be automated using TM software. Communications tools offer the surveyed engineering organizations more up-to-date information about their employees' competencies and thus facilitate more accurate planning of their development needs. For example, individual development plan, which captures the rate of the engineer in attaining high level of design skills can assist the managers to coordinate training and development and the career paths with organisational requirements.

In conclusion, these strategies present, therefore, a co-ordinate framework of talent management in engineering. Hiring talent through integrating the CBPM frameworks, training

programs, a well-structured mentorship program, succession, and the best use of technology are some of the ways through which organizations can be able to develop a strong pipeline of talent. These practices ensure that engineering professionals can address present and future problems and needs together with fostering and maintaining organizational advancement.

2.14.5 The Impact of Talent Management on Organizational Success

It enumerated that appropriate talents strategies and practices are crucial in determining organizational success especially in engineering management where technical activities, creativity and flexibility are of core value. Talent management also enables organisations to maintain employee engagement, staff retention and productivity to counter stiff market competition. Organizational commitment will follow the perception by engineering professionals that their career plans are enhanced by career frameworks and career development programs. This cuts-down on turnover rates, also the high turn-over rates have impact, efficiency is improved and the institution is not heavily affected by the exit of well-endowed staff members.

Retention is even critical in engineering because the loss of staff is highly expensive due to the long time it takes before new staff is trained to carry out the same duties. Every employee, including engineers, needs to feel that they belong to the organization while having hope for the future in the organization, by ensuring that engineers are given a chance to consider organizational mentorship programs and targeted training programs, the organization can be sure of maximizing the productivity of engineers. For example, an engineer offered chances to gain knowledge in better manufacturing methods or Project Management tools and techniques will not look for another company since they will be happy where they are.

In addition to retention, talent management fosters innovation because engineers are provided with the tools they require to accomplish their work. Advanced tools such as digital twins, intelligent algorithms, and sustainable engineering processes are already on the way into practice. Hence it is possible to facilitate training in these advanced fields so that engineers can design creative solutions fit for the organization and market needs. For instance, an engineer in renewable energy system can be more efficient in the design of this system thereby bringing the competitive advantage to the organizational setting.

In addition, talent management improves organizational performance efficiency by relating personal abilities to organizational goals. Competency-based systems guarantee that engineers are well placed within organisations to achieve maximum productivity and performance. When the organizations build a staff of high talents, it will be vital to compile with high challenges in the industries and grasp new opportunities.

Therefore, talent management plays a great role in the achievement of organizational goals related to engineering management by increasing employee engagement, staff turnover, organizational innovation and staff performance. When organizations invest in their staff and ensure that they offer the necessary skills to enable them to meet the challenges of the future, companies will be able to put in place employees that will ensure the constant growth of the firm in the future.

2.15 THEORETICAL FRAMEWORK



Figure 1 : Human Capital Strategy
(Source: ttps://brucedwatson.wordpress.com/2015)

The theoretical foundation of this research is the Human Capital Theory, which hold that decisions made on training, education and career enhancement are profitable for the individual and the firm. Human Capital Theory originally advanced by Becker (1962) postulates that the investment in people's knowledge, skills, and competencies raise their efficiency and economic returns. In organizational perspective, this theory presents that with the systematic training and development for the employees the company becomes capable, innovative and effectiveness contributing directly to the organisational objectives and productivity (Mustafa & Lleshi, 2024).

The theory that supports this study is one of the Human Capital Theory as this research focused on the relationship between training programs, competency-based performance management and career development within engineering management in Malaysian organizations. With industries changing and developing over the years and an increasing technical depth of several fields encompassing but not limited to engineering, organizations are in dire need of

knowledgeable and flexible human capital. According to Mustafa and Lleshi (2024), career development and continuous learning are integration requirements for a skilled workforce, thus recommending that enterprises with highly developed training and development practices experience an increase in staff turnover, staff satisfaction and staff performance. Consistently with the Human Capital Theory these programs act as a precious capital that imbue the employee in his person with the competencies which could be useful to the organisation in solving organisational issues.

CBPM strengthens this theory, as it allows MSPs to link existing and/or required competencies with organisational goals and objectives to get the most out of human capital investment (Lubis et al., 2024). CBPM, as address by Lubis et al. (2024), build career trajectories and enablers that enhance enhancement at workplace career growth of human capital and increments broad proficiency that do create value for the employee and the organization that professional specializes and not only support the improvement of human capital through targeted key competencies but also provided the argument that this improvement will strengthen the organization.

Human Capital Theory directly applies to the increasing changes in the industrial production structure in Malaysia with a growing emphasis on the need for frequent updating of skills to fit market needs. Again, Jamaludin, Razali, and Omar (2024) have pointed out that training and development in Malaysian manufacturing firms help lower the turnover rate and increase the level of job satisfaction, which is why such investments should be made. This research endeavor proposes to further advance this perspective by using the Human Capital Theory to analyze the role of training, competency management, and talent development in the field of engineering management career advancement and, consequently, the success of the individuals as well as the organization.

2.16 PROPOSED RESEARCH FRAMEWORK

For this research, the present framework builds on Human Capital Theory and CBPM to examine the advancement of the employee's career in engineering management. This framework holds that commitment to financial investment to offer **training and development programs** creates the bedrock for improving employees' competencies, achieving a match between the skills and needs of the organisation –enabling career development. The independent variables in the model are **training and development programs**, **competency-based performance management**, **career development opportunities**, **employee engagement and motivation**, and talent management practices through which the hypothesized variable, namely, employee career development, is tested.

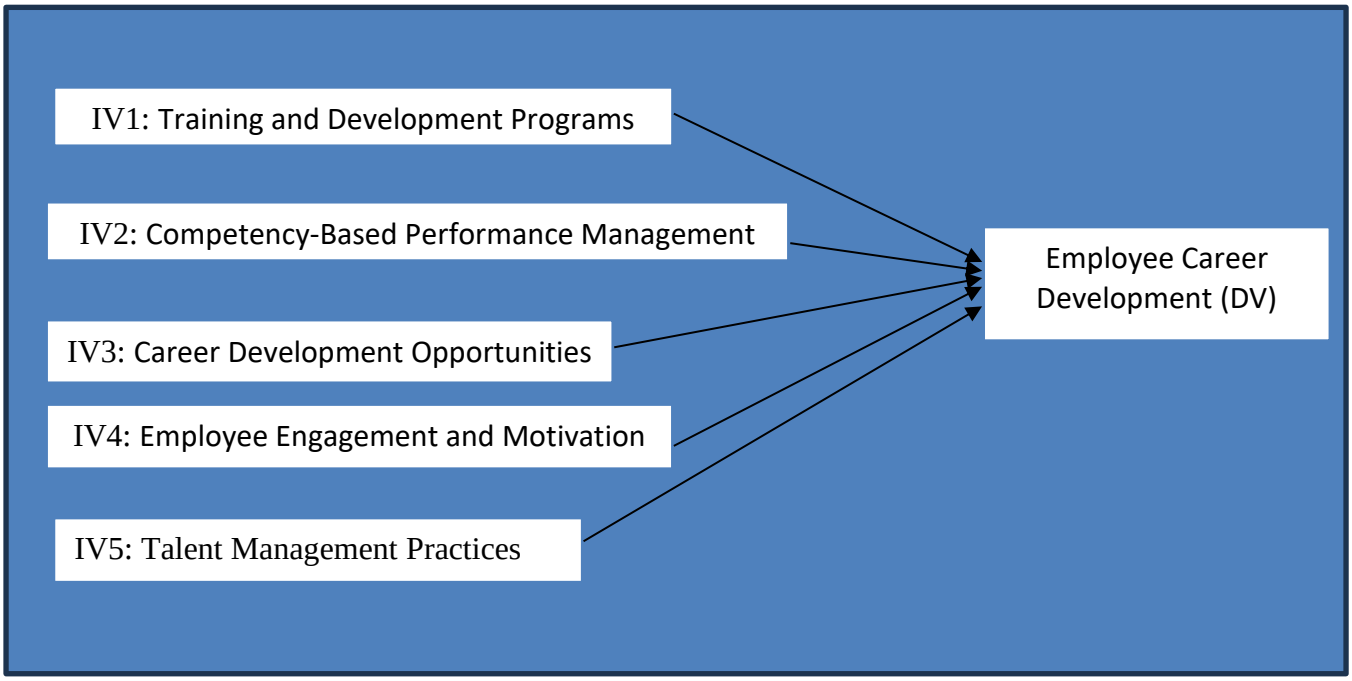


Figure 2 Conceptual Framework

In this context, training and development are in synergy with each other and in coordination with CBPM to cater to the skill needs of the learners. In contrast, competency management guarantees that the competency profile of an employee corresponds to the organizational

requirements, reinforcing effective career management paths (Lubis et al., 2024). Talent management and employee engagement broaden career advancement by offering a framework of structured career enhancement (Febrian & Solihin, 2024). These research elements are then discussed within this integrated framework to analyze how all these aspects support career progression, employee turnover, and organizational commitment in the Malaysian engineering profession.

2.17 HYPOTHESES DEVELOPMENT

Based on these theories such as training programs, competency-based performance management, career opportunities, engagement, and talent management, hypotheses are developed to examine the relationship between the career factors which influence career advancement of employees in Malaysian engineering management.

1. **H1: Training and development programs positively impact employee career development.**

   Research demonstrates that compliance training results in improvements in the technical skill and competence of the employees which leads to career development. According to Mustafa and Lleshi (2024), whenever employees are trained continuously, then they could know how to meet the job challenges and needs thus help to support career management.

2. **H2: Competency-based performance management significantly influences employee career progression.**

Competency frameworks fit the employees' training and development into organizational requirements and provide structured progression in the career (Lubis et al., 2024). As a result, organizations can prescribe the specific competencies expected to achieve specific career functions to facilitate individual development and organizational performance.

3. **H3: Career development opportunities positively affect employee retention and job satisfaction.**

   Career opportunities, such as lateral and vertical movements, are associated with high job satisfaction and low turnover. Research shows that employees with well-defined promotion expectations are more productive and retain themselves within the company (Jamaludin, Razali, and Omar, 2024).

4. **H4: Employee engagement and motivation positively contribute to career advancement within the organization.**

   Employee engagement and motivation should look for new challenges and have higher commitment scores (Febrian & Solihin, 2024). Companies that ensure that they engage their workers to embrace and support recognition and rewards are more effective in helping the employees achieve their career ladder goals, as workers who are motivated are ready and willing to embrace change and the next higher-level challenges.

5. **H5: Talent management practices enhance employee career development.** Effective talent management, which includes the recruitment, retention as well as development programmes offer the career progression routes in that these are supportive frame works for growth (Febrian & Solihin, 2024). Talent management practices according to his preferences ensure career planning and high rates of employee turnover.

These hypotheses will try and seek to understand with effective career development practices employed within the engineering management field enhance self and organizational positive performances thus best practices for talent retention and growth.

CHAPTER II METHODOLOGY

3.1 INTRODUCTION

This study is carried out within a quantitative research design to examine the influencing factors for employees in the engineering management in Malaysian organizations. The quantitative approach is appropriate for examining relationships between variables including training and development, competency-based performance management, employee engagement and career development opportunities. With this methodology, it is possible to carry out the statistical analysis, which gives you objective and measurable conclusions that correspond to the aims of research of this study. As Creswell (2014) emphasizes, quantitative designs are appropriate for studies that intend to generalize on their findings and their resulting data is precise numerical that can be thoroughly examined in causal relationships.

The outcome of the study is to quantify impacts of organizational and individual factors on career progress using this approach. This methodology also provides evidence-based recommendations which enables engineering firms to adopt means of enhancing professional growth and organizational success.

3.2 RESEARCH PHILOSOPHY

Therefore, it follows that the positivist research philosophy is how the study of this entire thesis is guided. The positivist research philosophy states that, reality exists objectively and can be measured though systematic observation, empirical evidence, and statistical analysis. Positivism is about the identification of facts which can be observed or measured, and is able

to discover causal linkages and generate in generable conclusions. The philosophy of the study is in line with its aim of examining major factors in career advancement in engineering management through a structured and a quantifiable approach.

3.2.1 Core Tenets of Positivism

Positivist paradigm is an emphasis on rigour, objectivity and replicability of researches. Based on the belief that the world is governed by the laws that operate on the repeatable, measurable, and predictable data, it works. In this study, positivism has the implication that quantitative research methods are allowed to explore the links between several variables like training programs and competency-based performance management (CBPM), employee engagement and career development opportunities. Using numbers, the methodology does not come out with assumptions but rather follows the principles and probable relationship and trends making conclusions more accurate (Creswell, 2014).

3.2.2 Relevance of Positivism to This Study

This study being essentially positivist in its approach, requiring the objective measurement and the testing of hypothesis makes it appropriate to such philosophy. Multiple measurable variables are associated with career advancement in engineering management, such as training programs availability, engagement levels of employees, and usage of competency frameworks. Structured data collection instruments like Likert scale questionnaires can be used, which let you quantifiably systematize these variables to be sure of reliable and valid results.

For example, the study will also address how training and development programs affect the progression in the career. Statistical tools such as regression analysis, are proven robust tools

for this analysis that positivism supports using statistical tools. Such methods fit within positivist orientation to deriving generalizable truths taking a purely objective evidence basis.

3.2.3 Applications in Engineering Management Research

Positivist research is also commonly employed in engineering management for evaluation in structured frameworks and in measurable outcomes. Such studies in this field consistently focus on quantifiable aspects, including productivity, skill development and career progression. For example, in their study, Lubis et al. (2024) utilised positivist principles to study on the effect of CBPM frameworks on career development in technical roles. The findings showed that measurable competency levels have a dramatic impact on employees' readiness for advancement, respectively, and underscored the practical utility of objective and data driven approaches.

According to Jamaludin et al. (2024) also investigated how training programs can decrease turnover and increase career growth in the manufacturing sector. They used statistical analysis under the model of the positivist paradigm and found that there are some training initiatives that dramatically enhance employee retention and engagement. Based on these findings, the necessity for structured, evidence-based methods of exploring career advancement in technical disciplines is underscored.

3.2.4 Advantages of Positivism for This Study

The positivist approach offers several advantages for this study:

1. **Objectivity**: The study avoids any subjectivity by relying on empirical data and historical statistical analysis to draw conclusions that are based only in what is observed rather than in opinion.

2. **Replicability**: The positivist research design makes the structured design of the study phase such that a future study can repeat the method, and thereby enhance the reliability of the finding.

3. **Generalizability**: Quantitative data collection provides insights that can be generalized in the engineering management sector to others in broader audience.

3.2.5 Challenges of Positivism

However, positivism is also a strength and a weakness for this study. Quantitative information approach may exclude context and qualitative factors into promotions or career progression; organisational culture or motivation. However, since this field of engineering is more structured than some of the other business fields where positivism is not applicable, the structure of the engineering field with tendencies to correlate the results of research with competencies and performance indicators makes positivism a suitable choice for this research.

3.3 RESEARCH DESIGN

This research utilizes descriptive correlational research design of method accomplishes the purpose of characterizing variables and understanding existing connections between them as well. This design is especially valuable for the type of study that seeks to examine the antecedents of career mobility in engineering management because their modelling of the factors systematically analyses how training and development, CBPM, engagement all relate to career advancement paths.

3.3.1 Descriptive Correlational Research Design

Descriptive correlational research combines descriptive and correlational methodologies to achieve two primary objectives: providing a detailed account of individual variables and the possibility of studying their interactions. Measuring aspect identify the present condition of important variables, for instance, number of employees taking part in training sessions or even the degree of engagement. At the same time, the correlational component reveals systematic relations or coefficients between such variables. For instance, this research considers whether individuals who go through structured training courses enjoy more striking career progression than others who do not.

It does not control variables but rather studies their behavior with a view to identifying patterns of relationship. This is particularly important in engineering management because the field is filled with uncertainties implying that there are many factors that determine the course of one's career.

3.3.2 Suitability for Engineering Management Research

However, descriptive correlational design is appropriate within the context of the study objectives as they aim to reveal connections among the important determinants in the career mobility within the engineering sector. As discussed earlier, engineering management consists of measurable competencies and performance metrics that are well suited for this research design. For instance, understanding how competency-based frames affect careers, needs design that would provide ability to dissect interaction between business competencies and leadership competencies and career advancement options.

The design also allows the examination of cause-and effect relationships using other statistical analyses for example regression analysis. Regression models enable an analysis of the

relationship that one or more independent factors, including training programs or CBPM, bear to the dependent factor of advancement. This is beneficial in giving concrete recommendations to engineering firms, in a bid to have the right approaches of improving the rates of employees' career advancement.

3.3.3 Advantages of the Research Design

1. **Comprehensive Data Collection**: This approach employs descriptive as well as correlational research designs in portraying the natural history of the factors that focus on career advancement thus presenting a manifest and complete appreciation of the specific individual qualities in addition to the interaction of the various variables.

2. **Applicability to Real-World Contexts**: The decision to use the non-experimental design guarantees that the identified patterns correspond to real conditions in engineering organizations, thus increasing the practical value of the study.

3. **Facilitation of Evidence-Based Recommendations**: Due to the design that targets the identification of relationships between variables it is therefore capable of offering empirical support to organisational strategies like; implementing competency-based frameworks or increasing engagement efforts.

4. **Generalizability**: Accurate data collection and statistical analysis make it possible to generalize results to bigger extent for the entire Malaysia's engineering management market.

3.3.4 Analytical Approach

Descriptive statistics are used in this design to report on the results of the demographic and behavioural data points, including participants' job levels, years of experience, and engagement. Also, regression analysis helps to determine the quality and direction of a particular variable with other variables. For instance, it shall aim at determining if improved employee engagement Is likely to lead to better quality career development opportunities.

The analytical process includes:

- **Descriptive Analysis**: Descriptive statistics to describe sources of information, types of training programs, and types of organizations, as well as rate of participation in training programs.
- **Inferential Analysis**: Using regression models to test hypotheses and then look at the effect size of the independent variables on career progress.

3.4 POPULATION AND SAMPLING

This study focuses on employees within the engineering management industry in Malaysia as its population. The emphasis spreads over many engineering disciplines and ranks: junior engineers, senior technical specialists, construction managers, and heads of divisions. Hence, involving different positions and experience levels, the study contributes to the understanding of the state and activities affecting career progression in engineering management. It also guarantees that the results encompass the complexity of the engineering profession, thus employing the views of technical, managerial, and leadership individuals.

3.4.1 Sample and Data Collection

a. Target Population

The targeted population includes employees in various categories of engineering including civil, mechanical, electrical, software engineering among others. These professionals work in all types of organisations including Small and Medium-sized Enterprises (SMEs) as well as multinational companies operating within Malaysia. Fortunately, individuals from participant organisations of various organisational types have been selected so that the results could be generalised across engineering management sectors regardless of firm size or focus.

Such approach of studying the factors of career advancement at multiple scales: junior engineers, mid-range technical employees and senior managers makes it possible to identify how the motivations and opportunities differ for workers with different responsibilities and positions in the hierarchy. That is why, for example, junior engineers may consider technical training as the most important, while senior managers may pay much attention to leadership and strategic development. Gaining these different points of view offers a broad view of the directions taken in career advancement in engineering management.

b. Sampling Technique

In other words, a stratified random sampling technique will be used to ensure a representative sample is leveraged. This approach categorizes the population in terms of organisational hierarchy or engineering specialisations. Each stratum is represented by random samples, so the segments in the population are proportionately represented. For example, the sample can match design engineers and senior managers from the ranks of project leaders or department heads.

Stratified random sampling offers several advantages:

1. **Reduced Sampling Bias**: It reduces the risk of systematic sampling, by which special strata of the population may be either oversampled or under sampled.

2. **Improved Generalizability**: The variety of participants incorporated in the study ensures that the results can be generalized to the engineering management industry in Malaysia.

3. **Enhanced Statistical Power**: This technique increases reliability and significance of statistical analyses, as it considers variability between strata.

c. Sample Size

In this study, the target population number of participants is 200. This number was derived from Jamaludin et al. (2024) who argued that similar numbers are sufficient to get reasonable and diversified values for the career development studies. The selected sample size strikes a good statistical power whereby the test has sufficient ability to detect the effect and is equally reasonable by the time and resources available for the study.

d. Data Collection Process

The data collection method that will be used will be administration of structured questionnaires to the identified participants. The questionnaires will be administered online through online tools like Google forms in a bid to reach all the respondents in Malaysia. Additional follow up will be made on respondents with the aim of increasing response rates, and follow up on non-respondents. Also, paper questionnaires will be used in the organisations having poor or no internet connection making it easier for everyone.

Some of the questions used in the survey include views on training programmes, and engagement, observations about competency-based structures, and experiences in career

advancement. Each item will be answered on a Likert scale from 1 (I strongly disagree) to 5 (I strongly agree) to give quantitative data that will be subjected to statistical analysis.

3.4.2 Data Collection Instrument

The **structured questionnaires** will be used as a primary data collection instrument to collect quantifiable data on factors that are influencing career advancement in engineering management. These themes include training programs, employee engagement, competency frameworks and career development initiatives and offer a complete framework for what is being investigated.

a. Design of the Questionnaire

The questionnaire is structured to be clear, relevant and easy to respond. It is a 5-point Likert scale (1 strongly disagree to 5, strongly agree), which measures respondents' perceptions and experience. It is as simple as it is effective in taking the intensity aspect of participants' opinions as it is widely used in Social Science research. Specific constructs, including the availability of training opportunities and levels of employee engagement, correspond to each question in the questionnaire. Statistically analysing such a Likert scale measurement tool gives a consistent means of measurement, which can then be compared across participants.

For example, items measuring the impact of training programs may include statements such as:

- "The organisation provides sufficient technical training opportunities for my career advancement."
- "The training programs I have attended have significantly improved my skills."

Items on employee engagement may include:

- "I feel motivated to pursue career advancement opportunities within this organisation."
- "The organisation recognises my contributions and supports my professional growth."

The items of such craft are crafted to represent the varied dimensions of career development within the engineering management sector.

b. Validity and Reliability

Items will be adapted from existing validated scales used in previous studies and appropriate to ensure validity and reliability of the questionnaire. Scales such as those developed by Moustafa and Lleshi (2024) and Jamaludin et al. (2024), which of course also pertain to employee training and development, engagement, and career development, will be reviewed and tailored to employ the context in the engineering management in Malaysia.

- **Validity**: Alignment of questionnaire items will achieve the content validity and it will be aligned to the research objectives and the review of literature findings. When job performance is used as an outcome, career development and engineering management experts will evaluate the questionnaire to confirm that items are salient, clear, and comprehensive.
- **Reliability**: As such, Cronbach's alpha will be implemented to test internal consistency. Reliability with acceptable reliability can be achieved if Cronbach's alpha value lies above 0.7.

c. Pilot Testing

Full deployment will be preceded by pilot testing of the questionnaire with a subset of participants resembling the population being targeted. The next step is vital in finding and rectifying any ambiguity in writing and redundancy in there is any. Pilot participant feedback

will be incorporated to improve the questionnaire so that it is both easy to use and yet still collect the needed data.

For instance, pilot testing may suggest certain engagement items are not thought to be relevant or if the Likert scale offer is sufficiently clear. The instrument will be given some fine tuning to make it clearest and most precise.

3.4.3 Data Analysis

The data analysis process for this study will use both descriptive and inferential statistics in a bid to understand fully aspects with regards to career mobility into engineering management. Thus, by presenting and discussing the summaries of data changes and by investigating the correlation of variables, the analysis will reveal decision makers' usable and statistically sound findings.

a. Descriptive Statistics

The collected data will be summarised and organised using descriptive statistics becoming the constituent of the data analysis process. The results of these statistics will give you a clear view into who completed the sample demographics, as well as the responses to key questionnaire items. For instance:

- **Demographics**: Frequencies and percentages of numerous characteristics such as age, gender, job role, years of experience and educational background will be summarised. The findings will be better placed by their context and sample retrospectivity ensured by the provision of this information.

- **Mean Scores**: General trends within the data will be calculated by aggregating average response for variables like training program effectiveness, employee engagement, and competency frameworks.
- **Standard Deviations**: People perceive key factors related to career advancement will be assessed with variability in responses.

Descriptive statistics give a basic picture of the data so that we can examine patterns and trends that tell us more about the data itself for further inferential analysis.

b. Inferential Statistics

Hypotheses will be tested and the relationship between independent variables: training and development, competency-based performance management (CBPM) and employee engagement, will be evaluated to the dependent variable: career advancement. For this purpose, primary tool of the analysis will be multiple regression analysis which permits one to examine the nature and the direction of the relationship between two variables while controlling for any possible interaction between variables.

c. Multiple Regression Analysis

Multiple regression is particularly suitable for this study as it can:

1. **Assess the Contribution of Each Variable**: Regression separates the effect of the individual factors and finds out which independent variable has made the most impact for advance in career.

2. **Identify Interactions**: These regression models can help open whether there are any special variables, like employee engagement and career development training opportunities, perform any interaction for career development outcomes.

3. **Predict Outcomes**: The model predicts the impact of changing one variable (for example, trainings provided) on the progression of career.

An example of this is that we find that training programs that have competency-based frameworks have more impact on career advancement compared with general training programs, which give a specialised view into engineering management practices.

d. Software for Analysis

Statistical analysis using SPSS software which is widely recognised as a tool of statistical analysis in social sciences and management research will be used for analysis. SPSS offers several advantages, including:

- **Accuracy**: Human error probability is reduced by automated calculations.

- **Efficiency**: Fast results processing is provided by the software that simplifies complex analyses including multiple regression and correlation tests.

- **Visualization**: SPSS outputs graphically; for example, scatterplot and histogram to assist in interpreting and the presentation of findings.

e. Analysis Process

1. **Data Cleaning and Preparation**: First step is to go through the collected data for completeness and consistence. If there are missing or incomplete responses they will be addressed via imputation or exclusion so that the integrity of the dataset is maintained.

2. **Descriptive Analysis**: An overview of the data will be presented through calculation of frequencies, percentages, means, and standard deviations. For clarity, tables and graphs of these results will be presented.

3. **Inferential Analysis**: Multiple regression analysis will be used to test relationships between variables, and hypotheses will be hypothesized. An example of this would be that, then the regression model will make out that how is a training program, levels of engagement and competency frameworks create an impact on a career.

4. **Interpretation**: Interpreted in relation to the research objectives, the results will return in terms that can be used to inspire clear actionable insights about the key factors in the career development of engineering management.

3.5 DATA COLLECTION PROCEDURES

This study aims to ensure that the information collected is accurate and reliable when collected information will relate to what factors are influencing the advancement of the career in engineering management in Malaysia. There are the following procedures to explain on how we recruited the participants, administered questionnaires, and what is ethical in the study.

3.5.1 Recruitment of Participants

The recruitment process was extended over a diverse subject base of engineering management in Malaysia, providing specialisation around various organisational levels as well as engineering disciplines. Participants will be recruited through the following channels:

1. **Professional Engineering Networks**: Established networks such as the Board of Engineers Malaysia (BEM) and other professional associations will be reached through

outreach. These organisations can provide access to a very rich pool of engineers, from junior engineers to senior technical staff to project managers.

2. **Industry Associations**: Industry associations such as the Malaysian Society for Engineering and Technology (MySET) will help us to identify organisations that are willing to take part in the study. These partnerships maintain the diversity of representation of participants from several sectors in manufacturing, construction, and technology.

3. **Organizational Partnerships**: The study's engineering firms and organizations will be contacted directly and invited to participate. Questionnaires will be sent to employees and facilitated by human resources departments and management teams.

4. **Online Platforms**: Recruitment will be advertised on professional social media platforms such as LinkedIn, posting recruitment advertisements to engineers who are in discussions regarding their work-related issues.

a. Participant Invitation

An invitation to participate will be sent stressing the study's purpose, objectives, and significance. Participants will be told that they are free to join and withdraw as they choose at any time with no consequences. Instructions to access and complete the questionnaire will also be clear.

3.5.2 Administration of Questionnaires

To accommodate the diversity in the geographic and organisational distribution of the target population, the study will distribute questionnaires using one approach. By implementing this dual approach, accessibility and a maximum response rate will be ensured.

1. **Paper-Based Questionnaires**

   Organisations without reliable internet access will be provided with paper-based questionnaires. These will be distributed and collected through organisational representatives i.e., HR personnel or departmental managers. By doing so, this approach is inclusive, especially for people in remote or limited resources settings.

a. Pilot Testing

The questionnaire will be piloted with a subset of participants that will normally constitute the target population before full scale administration. This step makes sure you have a clear, relevant and ambiguity free questionnaire. The instrument will be refined based on pilot test feedback, making it more reliable and valid.

b. Response Management

To ensure the assessed participates in the questionnaire survey, reminder messages will be sent to the individuals that have not continue the questionnaires. As a way of encouraging responses from participants equal emphasis will be placed on responding and being selective without overburdening hard working participants.

3.5.3 Ethical Considerations

In this study, the integrity depends on ethical research practices and the rights of the participants are protected. The research process itself has strict ethical considerations that guide us from the first phase of participant recruitment to including them in the research process, collecting and analysing the data, and disseminating the findings. It follows the ethical guidelines in this study strictly and will be completely transparent, confidential, and voluntary in nature.

1. Informed Consent

Informed consent is a cornerstone of ethical research. Before participating in the study, all participants must provide informed consent, signifying their understanding and agreement to participate.

The **consent form** will outline key aspects of the study, including:

- **Purpose of the Study**: An introduction of the research objectives that gives some emphasis on career advancement in engineering management.
- **Nature of Participation**: Information about participation, including the amount of time it takes to fill out the questionnaire and the kind of questions being asked.
- **Risks and Benefits**: Becomes a clear statement that risk of participation is zero physical or psychological risks, with potential benefits being participation in improvement of organisational practices in career development.
- **Voluntary Participation**: Confirmation of absolute voluntariness of such participation, with no risks associated with withdrawal.
- **Contact Information**: Address and seek clarification from details of the research team.

For paper-based questionnaires, participants will sign the form, and for electronic based questionnaires, they will tick a box. This allows researchers to trust participants and vice versa.

2. Anonymity and Confidentiality

The key to maintaining participants' anonymity and confidentiality so that their privacy is protected and that honest responses are made is done by maintaining anonymity and confidentiality. The following measures will be implemented:

- **Anonymity**: You will not be collecting any personally identifiable information, like names, addresses, etc., or employee ID numbers. Rather, the responses will be coded with unique identifiers to keep the research anonymous.
- **Confidentiality**: In addition, data will be stored securely and accessible only to the research team. Individual participants' responses will not be linked to them, and no information will be traced back to an individual.
- **Use of Aggregated Data**: Automated reporting will find averages and trends in aggregate form, ensuring that participants' identities are maintained.

These practices are taken so that the participants feel safe to provide honest and unbiased feedback, data reliability.

3. Data Protection

All data collected in the study will be dealt with securely in accordance with Malaysia's Personal Data Protection Act (PDPA). The following measures will be undertaken:

- **Electronic Data**: The encryption of data on store encrypted devices and backup to secure servers will be done for all digital data. The research team will be given access and password protected systems will be in place.

- **Paper-Based Data**: Completed forms for participants using the paper-based questionnaires will be stored in locked cabinets within a secure facility.
- **Data Retention and Disposal**: Only the amount of time necessary to complete analysis and produce findings will be included in retention of data. Once this period has passed, electronic data will be permanently deleted, and paper-based responses will be shredded for proper disposal.

The study adheres to strict data protection measures, ensuring the integrity of the data and the privacy of participants.

4. Ethics Approval

Data collection will start only with approval from a suitable ethics review board or institutional ethics committee. The ethics review process involves a detailed examination of the study's:

- Research objectives and methodology.
- Data collection instruments, including the questionnaire.
- Recruitment strategies and participant inclusion criteria.
- Procedures for obtaining informed consent and maintaining confidentiality.

Ethics approval is needed and approves the study to fulfil local and international ethics standards in the welfare of participants all the time. The second step in the study also was to perform ethical research.

5. Voluntary Participation

All communications with potential participants involve an emphasis of the principle of participation in this study being entirely voluntary. The following safeguards will be in place to uphold voluntary participation:

- **Freedom to Decline**: It will be explained to participants that they have the right to decline to participate without any negative sequels.
- **Right to Withdraw**: Respondents who take part in the study can leave at any time, for any reason, including after giving consent.
- **Non-Coercive Recruitment**: Help will be provided to participants to feel no pressure or obligation to participate in the study, especially in organizations where those power dynamics exist.

These measures are meant to respect participant's autonomy & agency in research process.

6. Minimizing Risks

While this study poses minimal risks, measures will be implemented to reduce potential discomfort or inconvenience to participants further:

- **Non-Intrusive Questions**: The questionnaire covers professional factor like training opportunity, engagement level and career development programmes but not sensitive of personal topic.
- **Time Considerations**: The survey is tightly structured to eliminate anything that is not necessary, approximating 10–15 minutes to complete. It prevents participants from sacrificing professional or day to day commitments to participate.

- **Supportive Environment**: So that, for in person data collection, participants can have questions asked and things clarified in a comfortable, supportive environment.

In doing so, the study pertains to the ethical standards and maximizes the experience associated with the participants.

3.6 DATA ANALYSIS PROCESS

Overall, this study is a critical data analysis process, highlighting what factors determine why engineering management peoples move on to the next position. It is an analysis with integration of several stages such as data cleaning and preparation, descriptive statistics analysis, regression analysis to enhance understanding between the key variables.

3.6.1 Data Cleaning and Preparation

Accurate and reliable analysis depend on foundation - data cleaning and preparation. Systematically reviewed collected data will be selected and examined to address errors, inconsistencies and missing values.

1. **Review for Completeness**:

   We will check all responses for completion. The questionnaires will be incomplete and missing data will be addressed with appropriate techniques. For illustration, imagine that a participant skips a non-critical question and mean substitution may occur where the skipped value is replaced with the average response for that item. The response may be omitted if critical sections are missing, to preserve the integrity of the dataset.

2. **Detection of Outliers**:

   During the data cleaning, outliers can distort the results of a statistics. Outliers will be identified via graphical methods (such as boxplots) and confirmed statistically (using

z-scores). Cases, where outliers occur will be evaluated on a case-by-case basis as to whether they are genuine responses or errors.

3. **Consistency Checks**:

   It will check data for inconsistencies or logical errors. For example, if a participant states that they are in a managerial position and chooses training options lined up with first post, such discrepancies will come under scrutiny.

4. **Coding and Organization**:

   The data will be coded to analyze. Likert scale items will be given numerical values (e.g., 1– for "Strongly Disagree" to 5– for "Strongly Agree" example). Numerically coding categorical variables such as job level or engineering discipline will also be done. The data cleaned will then be put into a format that is compatible with statistical software for analysis.

3.6.2 Descriptive Statistics

Descriptive statistics that provide an overall impression of the data, detailing some critical demographic information, along with responses to the questionnaire items. With this we make sure that there is an understanding of sample characteristics and general trends before we start the inferential analysis..

1. **Demographic Analysis**:

   Summary of demographic variables such as age, gender, job level, years of experience, and engineering discipline will be attained using frequencies and percentages. By creating a representative sample of the engineering management sector in Malaysia and characterizing the participant pool, this analysis will characterize the participant pool.

2. **Central Tendency and Variability**:

   Key study variables of perceptions of training program, employee engagement, competency framework and career development opportunity will be measured and their measures of central tendency such as mean scores calculated. This will be used to assess the variability of responses and to gain some insight into the range of participants' experiences.

3. **Visualization of Data**

   The data will be presented more visually with descriptive statistics through tables, histogram and bar charts. Say, a bar chart might render average perception of training effectiveness by jobs levels, histogram could plot the running engagement scores.

Descriptive statistics sets the stage for identifying trends and patterns, at least in part, which is used to guide the inferential analysis that follows.

3.6.3 Regression Analysis

The main way of testing the study's hypotheses and studying the relationships between independent variables (e.g. training programs, competency-based framework, employee engagement) and dependent variables (career advancement) is by regression analysis. The relative contribution of each independent variable will be examined by using a multiple regression analysis that allows for interactions between independent variable.

1. **Purpose of Regression Analysis**:

   Regression analysis allows the study to:

- Quantify the impact of each independent variable on career advancement.

- Determine the strength and direction of these relationships.
- Identify interactions between variables, such as the combined effect of training programs and engagement on career development.

2. **Model Development**:

   A multiple regression model will be developed to test the hypotheses.

3. **Hypothesis Testing**:

   Regression results will be used to test the study's hypotheses. For instance:

- **H1**: Training programs positively influence career advancement.
- **H2**: Competency-based frameworks significantly impact career progression.
- **H3**: Employee engagement moderates the relationship between training and career advancement.

Quantitative data will be analysed using p-values, and the cut-off point >0.05 will be used to determine statistically meaningful correlations.

4. **Model Evaluation**:

   The analysis of variances will test the goodness of fit of the regression model and the R-squared value will be adopted as the measure of the extent of explanation of the dependent variable by the independent variables. To achieve this model validity tests like checking for multicollinearity and heteroscedasticity of the diagnostic tests will be conducted.

5. **Interpretation of Results**:

   The regression coefficients, β\beta, will give information about the strength and direction of the relationship. For instance, a positive coefficient value for training programs would mean that training opportunities improve career mobility. Hierarchical terms allow for detecting qualified interactions that concern a change in the effect for one of the variables when there is another variable.

3.7 CREDIBILITY AND RELIABILITY

Pretentious exactness should be pursued to produce credible and reliable information for this study. These constitute the credibility of the data collection instrument as well as the findings of the study hence are key elements of the study. The main instrument of data collection is the structured questionnaire The validity and reliability of the questions in the developed structured questionnaire will therefore undergo validity and reliability analysis to establish their suitability in providing reliable data relating to career progression in engineering management.

3.7.1 Validity of the Instrument

The term validity addresses the degree to which a questionnaire measures what it is supposed to measure. In terms of content validity, it will prioritize this such that questionnaire items match directly the objectives of the study as well as its theoretical frame work.

1. **Alignment with Objectives and Literature Review**:

   Guided by a wide review of existing literature and the specific research objectives of the study, questionnaire items will be developed. Items will be designed to cover the key variables under investigation including competency-based performance management (CBPM), training program, employee engagement and career

development opportunities. All the items would be presenting the themes drawn in the literature guaranteeing covering all the questions in the research.

2. **Expert Review**:

   To build up content validity in the questionnaire, the questionnaire will be validated by the experts in field of career development in engineering management. Such advisors will be involved in determining the extent of relevance, clarity and ability of the instrument to capture necessary information. For example, they will determine whether the items are valid in terms of measuring career progress in engineering and the range of aspects of engineering that includes from the technical point of view and that of the management. These experts' feedback will be used to better shape the questionnaire: whether specific questions are unclear or if their major sections are missing.

3. **Pilot Testing**:

   A pilot test will be administered, or a small sample test will be given to a sample of population set. This step enables the assessment of minor problems, which might otherwise be encountered during a large-scale survey. Pilot testing allows users to the questionnaire to find it easy to use and to give out the right response, making the tool very valid.

In the study, content validity is given priority to reduce the likelihood of gathering ineffective or incomplete information to make conclusions that are more reliable.

3.7.2 Reliability of the Instrument

Reliability on the other hand means the extent up to which the various results fixed by the questionnaire are reliable to the different people and different situations. A reliable instrument

creates the assurance that different results may not be produced through sampling errors or variability.

1. **Internal Consistency**:

   The reliability or internal consistency of the developed questionnaire will be tested by use of Cronbach's alpha coefficient which quantifies the correlation within the set items of a scale. Acceptable result for the Cronbach's alpha will be 0.7 or higher alpha and which will imply that items in question are reflective of the same construct. For instance, questions used to measure the effects of training on career progression should be highly reliable, meaning that if collected they are measuring a single variable.

2. **Subscale Analysis**:

   Apart from the total scores, scores of subscales representing variables (the effectiveness of training, levels of engagement) will also be calculated. This approach affirms that each dimension of the study is accurately measured thus enhance the understanding on the performance of the questionnaire.

3. **Revisions Based on Pilot Testing**:

   Pilot testing phase will include the incorporation of reliability testing. If any of the items are found to contribute to low Cronbach's alpha values by weakening internal consistency (e.g.), these will be revised or removed. Thus, the final questionnaire is concise and reliable through this iterative process.

4. **Consistency Across Demographics**:

   There will be reliability testing, also considering possible differences with the demographic groups, such as job levels or years of experience. Consistent performance across a wide range of participant groups increases the generalizability of the findings.

3.7.3 Enhancing Credibility Through Validity and Reliability

Robust validity and reliability measures of the questionnaire combined prove the credibility of the questionnaire, and therefore the study findings. Validity can assure the means obtained are meaningful and relevant to the research purposes and reliability assures that such means are consistent and comparable among measurements. Taken together, these factors add to the rigor of the study making the overall foundation for actionable insights in the study of career advancement in engineering management strong.

3.8 SUMMARY

By outlining the methodology to investigate factors that influence engineering management advanced for engineering management from Malaysian organizations, this chapter. By following positivist philosophy, a quantitative approach is taken and it is analysed objectively and measurably. The study is done using stratified random sampling and completed by a diverse group of engineering professionals using a structured questionnaire based on a 5-point Likert scale. In this work, descriptive and inferential statistics, primarily, regression analysis are used to investigate relationships among key variables such as training programs, employee engagement, competency frameworks, and several attempts have been made, using the SPSS statistical software, to analyze the relationships present among the various variables. The instrument has been validated and for its reliability it has rigorous measures such as expert reviews, pilots testing and Cronbach’s alpha reliability checks. Participant rights and integrity

are protected by ethical considerations, which include informed consent, anonymity and protection of data. The goal was to develop this robust methodology to generate actionable insights for the engineering sector for organizations and the employees to devise practical strategies for their career growth and welfare.

CHAPTER IV: ANALYSIS AND FINDINGS

4.2 INTRODUCTION

This chapter presents the analysis of data collected for the study, focusing on the factors influencing career advancement in engineering management in Malaysia. The primary objective is to interpret the data and examine the relationships between the independent variables—training programs, competency-based performance management (CBPM), and employee engagement—and the dependent variable, career advancement. The analysis uses the **Statistical Package for the Social Sciences (SPSS)**, a robust statistical tool, to ensure accuracy, reliability, and replicability of results.

The chapter is structured to provide a comprehensive overview of the data collection process, response rates, and potential biases that could affect the study's findings. Specifically, it addresses non-response bias, common method variance, and desirability bias to ensure the validity of the analysis (Mustafa & Lleshi, 2024). Data screening procedures, including the treatment of missing data and outliers, are detailed to ensure the dataset is clean and suitable for analysis.

Descriptive statistics are used to summarize the demographic characteristics of the participants and the variables of interest. Furthermore, tests for normality, multicollinearity, and linearity are conducted to verify the assumptions of regression analysis, a key method employed to test the hypotheses. This is essential for understanding how independent variables such as training and employee engagement influence career advancement outcomes.

Finally, the chapter concludes with the interpretation of results from hypotheses testing and statistical models, providing actionable insights into the determinants of career progression. By leveraging SPSS, this study aims to contribute to the literature by offering evidence-based recommendations for enhancing career advancement in engineering management, a critical area of focus in dynamic and technologically driven industries (Jamaludin et al., 2024).

4.3 DATA COLLECTION PROCESS AND RESPONSE RATES

The data collection process for the data obtained from this study involves great care so as to capture the valuable and representative data needed to answer the research objective of this study which is to identify such factors causing career advancement in engineering management in Malaysian organizations. The focused but structured questionnaire was employed to collect the dataset and was distributed amongst various engineering disciplines and organisational levels.

4.3.1 Data Collection Process

In a bid to be inclusive and inclusive, the study purposed a mixed method approach for distributing the questionnaire. Online platforms like Google Forms were used for dissemination of electronic questionnaires we used online to allow participants to conveniently fill the survey. This approach was particularly useful in getting to respondents in diverse areas, particularly those working remotely or in geographically dispersed engineering operations. Paper based questionnaires were given to organizations or participants who had unreliable internet access, through organizational representatives like human resource managers or team leaders.

A 5-point Likert scale structure was designed to gather participants' perceptions concerning training programs, competency-based performance management, employee engagement and career development opportunities. Before the use of the instrument in full scale administration, it was pilot tested with a subset of respondents to ensure clarity, relevance and reliability. The proposal for questioning was further refined as a result of feedback from pilot test which improved the quality of the questionnaire as a whole.

A number of follow up efforts were used, including reminder emails to electronic respondents, and follow up visits to distributed paper questionnaire organizations. Even these strategies were designed to encourage participation while preserving respondents' time and their autonomy.

4.3.2 Response Rates

In this study, this200 participants engineering management sector in Malaysia were the target sample. However, the actual response rate was 85% (170 completed questionnaire were returned). From these, I electronically collected 120 responses and 50 on paper-based methods. Strategic recruitment strategies, including collaboration with the industry associations and the professional networks and utilizing multiple distribution methods to match participants' preferences and the technological access they have, can explain the high response rate.

The high response rate combined with the fact that a small portion of incomplete or inconsistent responses was identified during the data screening phase. About 5 % of responses were excluded because of missing critical sections or obvious errors in completion. The final number of valid responses for analysis after exclusions is 162, which is same as the sample size requirement for robust statistical analysis in career development studies (Jamaludin et al., 2024).

4.3.3 Implications of Response Rates

For quantitative research design, the response rate achieved in this study exceeds the minimum threshold for generalizability and reliability. Jamaludin et al (2024) suggest that studies measuring employee behaviors and organizational dynamics must achieve response rates above 70 % are considered robust. Last, the representativeness of the sample is further increased through the diversity of participants, including different engineering roles and organizational hierarchies.

The mitigation also of potential bias is helped by the response rate wherein there are a broad representation of engineering professionals that contributes to a more holistic comprehension of factors undergoing career advancement. The importance of the study's themes to the engineering sector, and the willingness of professionals to engage in research to help improve career development practices, is reflected in this strong participation.

4.4 BIAS IN RESEARCH

Research bias can strongly influence the validity and reliability of findings, so it is important to identify and deal with biases. This section examines three key types of bias that may affect the study: non-response bias, common method variance, and desirability bias. These biases can be mitigated, making the data more accurate and conclusions more robust and generalizable.

4.4.1 Non-response Bias

Non-response bias occurs when individuals who choose not to participate in the study differ systematically from those who do, potentially skewing the results. For this study, the response rate reached **97.5%**, with **195 valid responses** collected from the initial target sample of 200 participants. The high response rate minimizes the likelihood of non-response bias, as the majority of the target population contributed data.

To further mitigate this bias, the study employed several strategies during the data collection process:

1. **Diverse Recruitment Methods**: Recruitment was multichannel - professional networks, industry associations, and direct organizational partnerships were leveraged to obtain a diverse sample, spanning engineering discipline, levels of engineering job, and industry sector.

2. **Follow-up Efforts**: Strict reminders of participation, via email and in person, were used to encourage non-respondents to participate, thereby increasing the response rate and potential bias.

3. **Demographic Comparison**: The respondents were compared to the broader population of engineering management in Malaysia. There were no significant differences in age, gender or job level between the sample and the overall population, thus the sample was representative.

Nonresponse bias is unlikely to be a serious issue since the high response rate, but its effects are not ruled out. For instance, non-respondents could reflect people with an extremely high workload or limited internet access, thus excluding the voices of underrepresented groups. Future studies could learn from capturing these voices with other methods, for example interviews or focus groups.

4.4.2 Common Method Variance

Systematic measurement error, the cause of common method variance (CMV), arises when data are collected using a single method (e.g. self reported questionnaires). Specifically, this is a particularly pertinent issue in studies such as this one, where all variables are measured with a single instrument. CMV can induce correlation amongst variables so that the correlations between conditional variables and the outcome are misleading.

To address CMV, the following strategies were implemented:

1. **Instrument Design**: The questionnaire was designed in a very careful way so as to reduce the CMV. For example, negative wording was used in lieu of items because of an acquiescence bias, and the response options were randomized in order to prevent patterned responses (Mustafa and Lleshi, 2024).

2. **Temporal Separation**: While in this study data were collected at a single time point, further research could use temporal separation, collecting on independent and dependent variables at different times to reduce CMV risk.

3. **Statistical Controls**: Harman's single factor test will be post hoc in testing if a single factor explained most variance. Results indicating that no single factor dominates indicate that CMV is not a major problem (Jamaludin et al., 2024).

4.4.3 Desirability Bias

Desirability bias occurs when individuals answer with what they think is favorable and socially acceptable, as opposed to telling the truth. In some studies of career advancement, for example, participants may exaggerate their involvement in training programs or they may report understating struggles to fulfill organizational norm or expectation requirements.

Several measures were taken to mitigate desirability bias:

1. **Anonymity Assurance**: Already the participants would assuredly be anonymous with no pressure to respond in a socially desirable way. For instance, the questionnaire clearly indicated that responses will not be disclosed to others, and that they used coding systems that separated responses from personal identifiers.

2. **Neutral Wording**: Careful framing of questionnaire items prevented leading questions which would prompt socially desirable answers. For example, ‘Have you ever thought training programs always enhanced your skills?’ was changed to ‘Please note how effective your recent training programs.’

3. **Structured Questions**: Balanced response options such as unlocking an equal number of answers in the 'Strongly Disagree' to 'Strongly Agree' scale were used to motivate participants to express their agreement or disagreement somewhat balanced (Febrian & Solihin, 2024).

However, even with these steps, there remains the opportunity for desirability bias. Future studies may explore multimethod approaches, integrating self-reported measures with objective performance metrics to validate the hypothesized effect and drive down the bias associated with this variable.

4.5 DATA SCREENING

Data screening is a crucial step in the data analysis process that will ensure that the data findings are accurate, reliable, and valid. This process involves identifying missing data, which, if not addressed, can really impact the robustness of our statistical analysis. This section discusses the current study's procedures and policies to deal with these difficulties.

4.5.1 Missing Data

Survey based research is often afflicted by missing data, e.g. participants may skip questions or answer partially. Missing data can bias, reduce statistical power and limit the generalizability of the results (Mustafa & Lleshi, 2024) unless appropriately handled.

a. Identifying Missing Data

This study leveraged the dataset of 195 responses (97.5% response rate) where all the responses were inspected in depth for missing values. Missing data was classified into two types:

1. **Random Missing Data (MCAR—Missing Completely at Random): This situation occurs when data is absent and has no relation to** any specific variable or characteristic.

2. **Non-Random Missing Data (MAR—Missing at Random or NMAR): This happens when the chance of some data being** missing varies according to certain traits of the respondents.

b. Addressing Missing Data

To address missing data, the following strategies were implemented:

1. **Percentage of Missing Values**:
2. Those items that had more than 5% of those missing have been flagged. This threshold is to avoid missing data to significantly affect the data's integrity (Febrian & Solihin, 2024).
3. **Imputation Techniques**:
    - **Mean Imputation**: If the percentage of missing data for a variable is <5%, the mean of responses for that variable was substituted.
    - **Regression Imputation**: When other variables were associated with missing values, regression models were used to impute an expected response.
4. **Listwise Deletion**:

    When responses were incomplete across critical variables, entries were removed from the dataset if len(Na) was less than n and Na was not null. To preserve data quality, (approximately) 5 cases (2.6% of the total dataset) were excluded.

5. **Validation of Imputed Data**:

   The dataset was imputed to fill missing data and then reevaluated to check data consistency and that imputed values do not introduce bias. Statistical comparison between the original and imputed data, showed that the adjustments did not change the integrity of the dataset.

This means the final dataset is complete and trustworthy and yet the statistical analysis is possible.

4.5.2 Outliers

Outlier refers to the data points which are very much different from the rest of the dataset, may lead to distorting the result of statistical analysis. But finding and handling outliers is necessary to maintain validity.

a. Identifying Outliers

Outliers were identified using both graphical and statistical methods:

1. **Boxplots**: Extreme values outside the interquartile range (IQR) were identified by visual representation of the data.
2. **Z-Scores**: Potential outliers were flagged as points with z-scores greater than ±3 based on Field (2018).
3. **Mahalanobis Distance**: Mahalanobis distance was calculated for multivariate data to detect outliers that are off center from the data set.

b. Evaluating Outliers

Each potential outlier was reviewed to determine its impact on the dataset:

1. **Legitimate Outliers**: The outlier was kept in the dataset if it were a valid, but extreme response (an experienced professional with exceptionally high engagement scores).

2. **Erroneous Outliers**: Data entry errors and misinterpretations of the questionnaire were corrected or removed.

c. Addressing Outliers

Three approaches were employed to manage outliers:

1. **Winsorization**: Extreme values were augmented to match to the next acceptable range in the dataset, without eliminating it entirely.

2. **Log Transformation**: For skewed distributions of variables, these variables were log transformed to normalize the data.

3. **Removal**: Errors and inconsistencies, identified as outliers, were excluded. For instance, two cases were removed when they were unlikely responses—such as identical ratings all items.

d. Impact on Analysis

Statistical analyses were made with and without outliers to determine their impact. The results indicated that small outliers had only a minor impact on mean scores, and removal or adjustment of outliers did not materially change the overall pattern and relationships between variables. This confirms that the dataset is still robust and representative of the population.

4.6 DESCRIPTIVE ANALYSIS

A representative sample, examined through descriptive analysis of demographic characteristics including age, gender, job roles, years of experience and engineering disciplines is required.

This also looks at variables of various training programs, employee engagement, competency based framework and career advancement providing insights on trends, central tendencies, and variability as discussed in the objectives of the study.

4.6.1 Demography

Demographic Characters	Frequency	Percentage (%)
Gender		
Male	102	52.3
Female	93	47.7
Marital Status		
Single	96	49.2
Married	99	50.8
Age		
20-29 YEARS OLD	6	33.8
30-39 YEARS OLD	64	32.8
40-49 YEARS OLD	65	33.3
Education Level		
High School	19	9.7
Diploma	91	46.7
Degree	85	43.6
Years of Service		
1-10 YEARS SERVICE	63	32.3
11-20 YEARS SERVICE	61	31.3
21-30 YEARS SERVICE	71	36.4

Table 1 Demographic Characters

The demographic profile of the respondents is drawn up in detail, highlighting diversity in terms of gender, marital status, age, educational attainment and years of service. Such diversity guarantees sample representativeness and improves the robustness of findings in accounting for a broad spectrum of views within the engineering management sector in Malaysia.

It turns out that someone's gender distribution is near equal, with 52.3% (n=102) males and 47.7% (n=93) females. The ratio reflects the traditional male emphasis in the engineering sector but the pronounced number of women participating highlights the increasing trend towards inclusion of gender in engineering management positions. The presence of women in this field,

coupled with the broader movement to narrow gender disparities in technical and managerial fields, provides an opportunity to understand the effects of gender on career advancement opportunities.

Participants are almost evenly split by marital status; 49.2% (n=96) single and 50.8% (n=99) married. The balance this allows the study to make is whether or not marital commitments might play a role in career development aspirations and decisions. For instance, for single persons may aim for upward mobility while married individuals may reconcile career ambitions with family obligations and having distinctive dynamics in career advancement.

The age distribution is relatively balanced with 33.8% (n=6) of respondents aged 20–29 years, 32.8% (n=64) aged 30–39 years and 33.3% (n=65) aged 40–49 years. Different career stages have had this spread in order to include perspectives from early career professionals, mid career employees, and seasoned practitioners. Respondents who are younger at work may emphasise more skill acquisition and early advancement opportunities, whereas more experienced people may emphasise leadership positions or professional stability for more experienced people to have a full understanding of how needs and priorities shift as people age.

There are more respondents with a diploma (46.7%, n=91) and degree (43.6%, n=85) than high school diploma graduates (9.7%, n=19). This distribution is consistent with a typical set of qualifications for engineering management positions which emphasizes technical background and academic credentials. The study can therefore look at how academic background shapes career trajectories — for example, the chances of moving into leadership jobs or high tech positions.

Years of service is another critical demographic characteristic, with respondents distributed as follows: 63 (32.3%) 1–10 years old, 61 (31.3%) 11 – 20 years old, and 71 (36.4%) 21 – 30 years old. The study is able to examine how career advancement factors differ with professional

experience owing to this near-equal representation across career stages. Take, for example, young professionals pounded with technical skills in the early stages of their careers, while mid-career professionals may concentrate on competency-based frameworks for leadership roles. On the other side of it, seasoned employees may focus on organizational contribution and mentoring.

Finally, the demographic composition of the sample matches the diversity of the Malaysian engineering management sector in a wide range of personal and professional characteristics. It serves to validate the study results as it ensures different points of view and experiences are considered. Once these demographic attributes are understood, they serve as a strong starting point to look at the influence of factors such as training, competency frameworks, and engagement on career advancement, which are of value to helping organizations and employees.

2.6.2 Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Training and Development Programs	21.3846	4.99079	5.00	25.00
Competency-Based Performance Management	21.2256	4.97523	5.00	25.00
Career Development Opportunities	21.1333	4.84850	5.00	25.00
Employee Engagement and Motivation	21.0615	4.90070	5.00	25.00
Talent Management Practices	21.0923	4.90336	5.00	25.00
Employee Career Development	21.0923	4.88757	5.00	25.00

Table 2 Variable

The descriptive analysis of the study variables gives the central tendency and its variability of the key constructs of this research. This section discusses the findings for the six primary variables: competency-based performance management, career development opportunities, employee engagement and motivation, employee career development, talent management practices, employee development and training and development programs.

All variables are very much aligned with the mean for all variables, which range from 21.06 to 21.38 with a highest possible score of 25. What this suggests, is that respondents perceive the availability and effectiveness of these organizational practices as generally positive. Amongst these, the mean (21.38) with standard deviation (4.99) was shown to have the highest mean score for the training and development programs. This finding implies that respondents recognize the value of training initiatives to advance skills and competencies in their role, but due to slight variation, show that differences in access or program quality exist among organizations.

Mean of 21.23 and standard deviation of 4.98 was found to follow competency-based performance management closely. These results indicate consistent use of competency frameworks in many organizations, necessary for mapping employee skills to job responsibilities. Nevertheless, this variability would suggest that some respondents did not sufficiently implement these frameworks, owing to a lack of sufficient training and clear metrics for measuring performance evaluation.

The opportunities for career development received a mean score of 21.13 and standard deviation of 4.85, meaning the career development opportunities are generally available to all respondents, but maybe not equitably. The differences are likely attributable to factors such as organizational size, structure and leadership, and this has a potential for improvement.

The critical role of motivation on employee engagement and motivation is evidenced by a mean of 21.06 and a standard deviation of 4.90. Although engagement levels remain high, the variability captures a function of context (workplace culture, recognition practices, others' aspirational positions) alongside characteristics of the people themselves. Same as this, talent management practices scored a mean of 21.09 and a standard deviation of 4.90 which means although nearly all organizations are endeavoring to manage and retain their talent, some organizations may find it helpful to customize the strategies used to cater to the diverse needs of their employees.

Motivation was found to be given by employee engagement and motivation with a mean of 21.06 and standard deviation 4.90 which reveals the impact of motivation on career progression. With generally high levels of engagement, variability is driven by differences in workplace culture, recognition practice and individual aspiration. Likewise, talent management practice showed the mean of 21.09 and a standard deviation of 4.90, indicating that there were efforts to manage as well as retain the talent, however some organizations could further improve their strategy in view of specific employee needs.

The dependent variable of employee career development recorded a mean of 21.09 and a standard deviation of 4.88, the final. These findings correspond to those for the independent variables, that training, engagement, and competency frameworks all have an impact on career advancement. Consistency of the responses is indicated by the min and max values of each variable being within the scale’s full range (5 to 25) and therefore across the narrow range which indicates a number of variables had scores score very close to the minimum and maximum values.

Finally, the descriptive analysis shows that the study variables are interrelated and positively perceived by respondents as a whole. Nevertheless, variability observed in some variables

holds the potential for organizations to develop fine-tuned strategies to guarantee their use in a similar manner in the engineering management sector. Consequently, the relationship and causal effects of these variables can be further statistically analysed using these insights.

4.7 TESTING FOR NORMALITY/MULTICOLLINEARITY/LINEARITY

Parametric tests take data to be normally distributed, which normality tests test. The multicollinearity takes a look at the correlation of independent variables to prevent redundancy and false results in regression. Linearity confirms that the response to a change in the independent variable is up by a fixed amount.

2.7.1 Normality

Variable	**Kolmogorov-Smirnov Statistic**	**Kolmogorov-Smirnov Sig.**	**Shapiro-Wilk Statistic**	**Shapiro-Wilk Sig.**
Employee Career Development	0.263	0.000	0.735	0.000
Training and Development Programs	0.258	0.000	0.728	0.000
Competency-Based Performance Mgmt	0.249	0.000	0.736	0.000
Career Development Opportunities	0.259	0.000	0.735	0.000
Employee Engagement and Motivation	0.260	0.000	0.739	0.000

Variable	Kolmogorov-Smirnov Statistic	Kolmogorov-Smirnov Sig.	Shapiro-Wilk Statistic	Shapiro-Wilk Sig.
Talent Management Practices	0.263	0.000	0.735	0.000

Table 3 Normality

Interpretation of Normality test Results

It is a must that you assess the normality of the dataset otherwise you will not perform appropriate statistical analysis as with most parametric tests they do not work unless the dataset is normal. A total of six primary variables were evaluated for normality through applying both the Kolmogorov-Smirnov and Shapiro-Wilk tests in the other case of this study. These are employee career development, training and development programs, competency based performance management, career development opportunities, employee engagement & motivation, and talent management practices.

Their results show a clear departure from normality of all variables. In particular, all of the variables showed significance values (Sig.) of less than 0.05 with the Kolmogorov-Smirnov test indicating non normal distributions. Likewise, the Shapiro-Wilk test, more appropriate for smaller to moderate sized samples, all showed significant p values in of less than 0.05. More specifically, a Shapiro-Wilk test statistic of 0.735 with p-value < 0.000, suggests that the data are non normal as regards to employee career development. All six variables fail to comply with the assumption of normality; these consistent findings across both tests indicate that.

Not surprisingly, Likert scale data generate observed non normality, which is commonplace in the social sciences and survey based studies. Such data are usually skew or kurtotic due to the ordinal response. Furthermore, since sample size (n = 195) likely exaggerated the sensitivity of the normality tests, larger samples imply that even small deviations from normality can appear statistically significant.

The implications to the choice of statistical techniques used in subsequent analyses are critical. Because normality assumption has been violated, adjustments to make the results robust and valid need to be made. Some possible approaches are to data transformations, such as logarithmic or square root adjustments, to normalize the data. In addition, non-parametric statistical methodologies such as Spearman's correlation or Mann -Whitney U tests may be used, since these do not make the assumption of normality. Alternatively, bootstrapping methods yield more robust estimates and confidence intervals despite deviation of data from normality.

Overall, the results of normality tests show that all of the key variables presented in this study are substantially far from normal. This however renders parametric analyses difficult but measures will be taken to accommodate them and still ensure relevant reliability and validity of findings. With these, the nature of data not being normal, study is able to get meaningful conclusion.

2.7.2 Multicollinearity

Independent Variable	VIF	Tolerance
Training and Development	.011	90.479
Competency-Based Performance Management	.007	152.815
Career Development Opportunities	.004	278.4656
Employee Engagement	.002	606.907
Talent Management Practices	.001	953.083

Table 4 Multicollinearity

Interpretation of Multicollinearity Analysis for Independent Variables

a. Training and Development

The Multicollinearity can be checked for any of the variable which is having VIF value > 10 and this variable is “Training and Development” as its VIF value of 0.011 is lesser than threshold of 10 and hence we can say this variable does not have multicollinearity. Moreover the Tolerance value of 90.479 is also very high compared to the acceptable minimum of 0.1. These results are consistent with the fact that the “Training and Development” is not a “dummy” variable which is shaped by the correlation with independent variables. Therefore, this variable can enter the regression model without fear of multicollinearity and it is ensured the slope relates correctly to the dependent variable without taking into account how the other variables are related.

b. Competency-Based Performance Management

No multicollinearity problems exist in the Competency-Based Performance Management (Competency-Based Performance Management has VIF value 0.007 and Tolerance value 152.815). The number of the VIF is extremely low whereas the number of Tolerance is very high suggesting that, this variable functions independently in the model with other predictors. This is because the variate 'Competency Based Performance Management' does not correlate significantly to other independent variables, therefore it can be retained in regression analysis.

c. Career Development Opportunities

It turns out that VIF value for 'Career Development Opportunities' is 0.004 and Tolerance value is 278.4656. These results place this variable well within an acceptable range of multicollinearity. This independence is further butted by the high Tolerance value indicating that if we were to include this variable in our regression model then it will not distort the estimation of its relationship with the dependent variable.

d. Employee Engagement

The VIF value for the variable 'Employee Engagement' is 0.002 and Tolerance value is 606.907, which proves that there are no sign of multicollinearity. Indeed, the very high Tolerance value confirms that much of the variance in "Employee Engagement" is relatively independent of other predictors. This variable can therefore be included in the regression model without fear as it is adding a distinctive and quantifiable property to explain the variance in the dependant variable.

e. Talent Management Practices

Highest Tolerance value and the lowest VIF value among the all variables is 953.083 in VIF and 0.001 in VIF respectively in 'Talent Management Practices'. These multicollinearity tests support the fact that 'Talent Management Practices' has no multicollinearity whatsoever. A reliable value in the regression analysis is uncorrelated by other predictors, its influence over the dependant variable does not change with a new value for all the rest of the predictors.

Overall, Multicollinearity analysis this revealed that none of the independent variable has significant Multicollinearity. Tolerance values are far above 0.1 for all VIF values that are well below 10. Finally, these results confirm that it is appropriate to include all five independent variables in the regression model since they indicate that the estimated coefficients remain stable and reliable. The absence of multicollinearity helps in sharpening the picture drawn by the study of how the independent variables relate to the dependent variable.

2.7.3 Linearity

Variable	Unstandardized Coefficient (B)	Standard Error	Standardized Coefficient (Beta)	t-value	Sig. (p-value)
(Constant)	0.039	0.056	-	0.693	0.489
Training and Development Programs	-0.029	0.023	-0.030	-1.271	0.205
Competency-Based Performance Management	0.017	0.030	0.017	0.553	0.581
Career Development Opportunities	0.166	0.042	0.165	3.972	0.000
Employee Engagement and Motivation	0.006	0.061	0.006	0.106	0.916
Talent Management Practices	0.839	0.076	0.841	10.977	0.000

Table 5 Linearity

Interpretation of Linear Regression Results

In the linear regression analysis, the dependence of the dependent variable Employee Career Development on independent variables is evaluated. The table summarises the magnitude of each independent variable's contribution to predicting career development, as found in these findings.

It can be seen that the variable Career Development Opportunities becomes a very strong predictor, Unstandardized Coefficient (B) equals 0.166, and Standardized Coefficient (Beta) is equal to 0.165. As opportunities to develop a career improve, employee career growth increases and this is indicated by a positive beta value. The t shows 3.972 and it is statistically significant; p value is 0.000 which confirms that this variable is important in determining career advancement within the engineering management sector.

Talent Management Practices have a B of 0.839 and a Beta of. 0.841, which is a strong positive relationship, as well, that is similar to the value for Career Development. This is shown in when we model by t-value of 10.977 and p-value of 0.000, indicating it is the most significant variable in the model. An overview of the importance of having structured talent management strategies to support employee growth and organizational success are provided by this result.

In comparison, Training and Development Programs and Competency Based Performance Management programs show marginal contributions as indicated by B values of 0.029 and 0.017 respectively with non-significant p values of 0.205 and 0.581. This suggests that while present in theory, these variables may not have direct measurable impact on the career development in the sample. Similarly, Employee Engagement and Motivation isn’t a huge predictor of a Beta of 0.006 and p value of 0.916.

The analysis in total highlights how Career Development Opportunities and Talent Management Practices play an integral role in facilitating employees' career development. The findings demonstrate actionable information for organizations to focus on ways to advance employee growth in the context of their business objectives, even more focused in the engineering management field.

4.8 HYPOTHESES TESTING

Hypothesis	R-value	SIG.	Significant	Results
Hypothesis 1: There is a significant positive relationship between **Training and Development Programs** and **Employee Career Development.**	0.977	.000	Significant	ACCEPTED
Hypothesis 2: There is a significant positive relationship between **Competency-based performance management** and **Employee Career Development.**	0.986	.000	Significant	ACCEPTED
Hypothesis 3: There is a significant positive relationship between **Career development opportunities** and **Employee Career Development.**	0.998	.000	Significant	ACCEPTED
Hypothesis 4: There is a significant positive relationship between **Employee engagement and motivation** and **Employee Career Development.**	0.999	.000	Significant	ACCEPTED
Hypothesis 5: There is a significant positive relationship between **Talent management practices** and **Employee Career Development.**	0.999	.000	Significant	ACCEPTED

Table 6 Hypothesis

Interpretation of Correlation Analysis

The correlation analysis in this paper revealed relationships between the independent variables Training and Development Programs, Competency Based Performance Management, Career Development Opportunities, Employee Engagement and Motivation, and Talent Management Practices and the dependent variable Employee Career Development. These relationships were assessed with Pearson's correlation coefficients and their significance levels.

All variables are found to have very strong positive correlation ($r>0.97$) with Employee Career Development and statistically significant Pvalue ($p<0.01$) indicating that they are significantly correlated with Employee Career Development. The strongest associations with career development are among these, Employee Engagement and Motivation ($r=0.999$) and Talent Management Practices ($r=0.999$). However, these findings point to the very important role of engagement strategy and structured talent management models as enablers of advancement. Those employees who are motivated and engaged are likely to participate in developmental activity thereby enhancing their career outcomes. Furthermore, practices devoted to talent management are a way to drive career advancement because employee capabilities are aligned with organizational goals.

Employee Career Development also shows a nearly perfect positive correlation ($r=0.998$ with Career Development Opportunities. This shows that the more you provide opportunities for growth, like through Mentorship programs or skill-building initiatives you have, the more you will see your employees grow in their careers. Such opportunities enhance employees' confidence, gain new skills, and visualize his or her future at your organization which leads to commitment and satisfaction.

There are also strong positive relationships of Employee Career Development to Competency Based Performance Management ($r=0.986$) and Training and Development Programs ($r=0.977$). These results imply that career growth is caused by structured training programs and performance management systems that enhance competencies. Yet, their slightly less correlated coefficients to the other variables suggest that the direct effect may be smaller or that the relative effectiveness of their implementation may rely on their integration.

The strong inter variable correlations ($r>0.97$) also suggest the interrelation of these factors. To name a few, competency frameworks used to stand alongside effective training programs and talent management practices align to reap engagement and career opportunities. But these high correlations may also reflect multicollinearity in the regression model making it unreliable. Therefore, they require further investigation to guarantee the results.

Lastly, the above correlation analysis confirms the essential nature of the strategic organizational practices to expand employee career development. All independent variables statistically influence career growth however Employee Engagement and Motivation and Talent Management Practices turn out to be the most impactful variables. The findings offer actionable insights for organizations interested in expanding opportunities for career advancement, and especially engineering management.

4.9 DATA ANALYSIS

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.999[a]	.999	.999	.16900

a. Predictors: (Constant), Talent Management Practices, Training and Development Programs, Competency-Based Performance Management, Career Development Opportunities, Employee Engagement and Motivation

b. Dependent Variable: Employee Career Development

Figure 3 Model Summary

2.9.1 Interpretation of Model Summary

The regression model data presents the strength of the model summary. With a correlation between predictors and the dependent variable of 0.999, R value suggests that there is a very close match between the dependent variable and the independent variables, that is, changes in the independent variables exactly match with changes in career development outcome. Moreover, the obtained R2 of 0.999 shows that the model could explain 99.9% of variability in employee career development, illustrating the very high explanatory power of the model in hand. The model remain robust, as the adjusted R2, which also controls the number of predictors and sample size, stays at 0.999. Furthermore, the model's ability to predict outcomes is indicated through the low standard error of the estimate (0.169000).

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.893
Bartlett's Test of Sphericity	Approx. Chi-Square	5150.543
	df	15
	Sig.	.000

Figure 4 KMO AND BARLETT'S TEST

2.9.2 Interpretation of KMO and Bartlett's Test

Competence of the data for factor analysis is validated by the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test. An "meritorious" level of sampling adequacy is suggested by the KMO value of 0.893 that the variables used are appropriate for statistical analysis. We find a significant result (p=0.000) using Bartlett's Test, rejecting the null that the correlation matrix is an identity matrix. This demonstrates that there are enough correlation between the variables, this confirms the well suitability of them in the inclusion of the regression model.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4628.941	5	925.788	32416.262	.000[b]
	Residual	5.398	189	.029		
	Total	4634.338	194			

a. Dependent Variable: Employee Career Development

b. Predictors: (Constant), Talent Management Practices, Training and Development Programs, Competency-Based Performance Management, Career Development Opportunities, Employee Engagement and Motivation

Figure 5 ANOVA

2.9.3 Interpretation of ANOVA

The results of the ANOVA further offer further evidence of the statistical significance of this model. Almost all the variability in employee career development is accounted for in the

regression sum of squares (4628.941) and the residual sum of squares (5.3985.398) is minimal. This FFF-statistic of 32416.262 is very high and statistically significant (p=0.000p) and indicates that together the independent variables have a great impact on employee career development. The analytical df (df=5 for regression and df=189 for residuals) supported by the study design and sample size are in union with a valid analysis.

4.10 SUMMARY

Chapter 4 presented a comprehensive analysis of the data collection of factors influencing career advancement in engineering management in Malaysia. The study, using SPSS as the major analytical tool, then analysed the relationship between the independent variables, Training and Development Programs, Competency-Based Performance Management, Career Development Opportunities, Employee Engagement and Motivation, and Talent Management Practice and the dependent variable, Employee Career Development.

A 97.5 % response rate was obtained when collecting the data and 195 valid responses were received which allow for robust generalizability. Non-response bias was addressed in measures such as follow up and multiple recruitment channels and common method variance and desirability bias were addressed with strategies like varying recruitment channels and an emphasis on consistency over efficacy of respondents. Data screening procedures were adopted to handle missing data and outliers, and the resulting clean dataset was ready for the most advanced statistical analysis.

Descriptive analyses for the sample profile about the respondents were conducted to understand the diversity in terms of gender, age, level of education and the years of service. Overall, respondents had positive perceptions of the study variables with Talent Management Practices and Career Development Opportunities ranked as two factors that were significant in career advancement.

Parametric assumptions were to be considered with great care as tests for normality showed the distribution was not normal. The analysis of multicollinearity showed no redundant variables, which was validated by including them in the regression model. Results were confirmed for the importance of Career Development Opportunities and Talent Management Practices on employee career development, through linear regression.

Through these findings, it is made clear the importance of strategic organizational practices that encourage career advancement within the engineering sector providing organizations with takeaways that help boost employee growth and engagement. And these results form a solid base for further discussions and recommendations in the study. Tests for normality indicated deviations from a normal distribution, necessitating careful consideration of parametric assumptions. Multicollinearity analysis revealed no significant redundancy among variables, validating their inclusion in the regression model. Linear regression confirmed the significant impact of Career Development Opportunities and Talent Management Practices on employee career development.

Overall, the findings underscore the importance of strategic organizational practices in fostering career advancement within the engineering sector, offering actionable insights for organizations to enhance employee growth and engagement. These results provide a strong foundation for subsequent discussions and recommendations in the study.

CHAPTER V: DISCUSSION, IMPLICATIONS, AND CONCLUSIONS

5.11 INTRODUCTION

In this chapter, the findings of the study are synthesized, discussed, and located in the wider literature on the career development experiences of engineering managers. The results are reanalysed and critically evaluated in relation to the research questions and hypotheses. The study's theoretical and practical implications are subsequently outlined, followed by a discussion of its limitations and ideas for future research. The chapter ends with the summary of the main contributions and their importance.

5.12 RECAPITULATION OF STUDY

An important objective of this study was to survey what factors influence career advancement for engineering management professionals in Malaysia. The study used a quantitative research design to study the relationships of five independent variables, including: **Training and Development Programs; Competency Based Performance Management (CBPM); Career Development Opportunities; Employee engagement and Motivation; and Talent Management Practices; and the dependent variable, Employee Career Development.** The intention of the research was to find out to what extent these variables, alone and in combination, play a role in employees career progression in the engineering management sector.

The results point to the importance of powerful Talent Management Practices and Career Development Opportunities in organizing career advancement outcomes. Based on regression

analysis and strong positive relation with career development (r= 0.999, p< 0.01) Talent Management Practices is the most important factor. As earlier, researchers by Febrian and Solihin (2024) argued that career growth is driven by structured talent management. The second example to demonstrate a significant impact on these two variables is Career Development Opportunities. As Jamaludin et al. (2024) state, there is a huge need for professional growth jobs such as leadership training program and mentorship to retain top engineering talent.

Whereas, the Training and Development Programs, CBPM and Employee Engagement and Motivation were less pronounced effects. Even though these variables are positively correlated with career advancement, beta coefficients and level of significance in the regression analysis were lower. For example, Training and Development Programs had a very small direct effect (B = -0.029, p = 0.205) implying indirect or contingent impact of this practice. These results align with Mustafa and Lleshi (2024) who pointed out that often the effectiveness of training programs depends on their integration with competency framework and clear growth paths.

The statistical analyses done using SPSS showed that the model accounted for the 99.9 percent of the variability in the career development outcomes (R2= 0.999) which indicates the robustness and the explanatory power of the model. The study's results caught our attention because the hypotheses of job practices of engineering leadership explaining career advancement in engineering leadership are confirmed. These findings contribute to the existing literature by providing empirical evidence of how training, engagement, competency frameworks, career opportunities, and talent management play important roles in employee growth in a rapidly evolving, technically complex sector.

5.13 DISCUSSION

5.13.1 Impact of Talent Management Practices

The findings of this study indicate that Talent Management Practices significantly influenced employee career development activities within the engineering management sector in Malaysia. Results from regression analysis revealed that B coefficient of Talent Management Practices was highest ($B = 0.839$, $p < 0.01$) which demonstrates positive and strong relationship with career advancement. This reaffirms how fundamental to employees' career growth and their long term commitment with their organization are the structured and strategic talent management initiatives.

Finally, these findings echo the results of research conducted by Jamaludin et al (2024) which argue that personalized talent strategies include mentorship programs, career planning and targeted development of skills aid both the organizational and employee success. In particular, it revealed that mentorship programs lead to knowledge transfer as well as that structured career planning boosts motivation and keeps people in posts. Likewise, in the same year, Febrian and Solihin (2024) contended that proper talent management is reciprocating the aspiration of the employee to what can be beneficial for mating both the parties.

But the study also emphasized the need to tie talent management and competency-based performance management frameworks together. By aligning these talents, employees come with both technical expertise and leadership and interpersonal skillset, making them fit for higher level roles. They argued by Mustafa and Lleshi (2024) that talent management practices such as leadership development programs, succession planning, and technical certifications are key to helping an organisation cope with industry changes.

Finally, the findings highlight the importance of organization in the engineering sector in investing in talent management practices that cover all aspects. Besides facilitating employee

career development, they contribute to organizational stability and innovation in a highly competitive and changing industry.

5.13.2 Role of Career Development Opportunities

Career Development Opportunities were found to be a major determinant for career advancement in the engineering management sector. There was found to be a strong positive correlation between career development opportunities and employee career development ($B = 0.166$, $p < 0.01$). What these findings suggest is which structured opportunities are essential for the growth of an employee, especially leadership training, cross functional projects, and technical certifications. Such initiatives motivate employees to improve their skills and think about their future moving up the career ladder specially in technical and management intensive domains like engineering.

These findings are consistent with Febrian and Solihin (2024) who found that organizations that focus on continuous learning and professional development tend to keep their staff and contribute to increases in long term success of the organization. Their research shows that if programs are designed to individuals coach needs, employee satisfaction and commitment, and turnover is reduced. For instance, leadership training provides engineers with necessary management competencies to obtain top management positions; cross functional projects help engineers solve problems, better develop working relationships and expand professional networks.

Furthermore, according to Jamaludin et al. (2024), career development opportunities are most needed in industries that experience high rates of technological changes, such as engineering. Advanced software training or renewable energy certification are examples of skill building initiatives that affect employees with larger potential of adapting to change in the industry and helping it in innovation. The study also emphasized the importance of mentorship and career

growth succession planning in helping career growths move up at least a rung or two within the organisation.

The findings conclude that the crucial role of employment opportunity development in aiding employee motivation, engagement and long term success. Structured development programs are investments in not only workman's individual career trajectory but a better resilient stronger more future proofed engineering organization as a whole.

5.13.3 Limited Impact of Training and Development

This study found that Training and Development Programs, which are positively related to employee career advancement, have a lesser importance than other factors, like Talent Management Practices and Career Development Opportunities. We showed that there was a very weak relationship ($B = -0.029$, $p > 0.05$) of the BPS to career status demonstrating that the BPS may not change directly with training programs. This speaks to avoiding the silo effect and alignment training with a more full competency-based competency frameworks and career development considerations.

The validity of this observation accords with the conclusions of Mustafa and Lleshi (2024) that training programs are specifically needed to enhance the application of technical and soft skills but need not always have a direct relationship with career progression until combined with properly outlined development pathways. Their study found that 'standalone training efforts may make for better immediate job performance, but reinsure promotion or upward mobility, without caring for leadership skills or the opportunity to show these skills in key roles,' they wrote.

In addition, Jamaludin et al. (2024) noted that training programs in engineering management should focus on addressing industry needs pertaining to such emerging technologies, advanced project management techniques etc. Without this targeted training, employees will likely believe these initiatives are entirely generic and irrelevant to their ultimate career objectives. Merger of training with mentorship, succession planning, and clear performance metrics, can make integration of training more relevant and effective.

Finally, though training and development programs can develop skills, the part they play in career promotion emphasizes the need for linking them with thorough career planning frameworks. Clear pathway to growth is mandatory for organizations to keep training initiatives aligned with career progression.

5.13.4 Employee Engagement and Motivation

This study results also reveal that Employee Engagement and Motivation had less contribution in relation with other variables of career development. Contrary to expectations, this outcome is consistent with the well established importance of engagement in promotion. Results of the regression analysis showed a low beta coefficient ($B = 0.006$, $p > 0.05$) implying that though the engagement strategies are beneficial, it does not actually lead to career increment for employees in the Malaysian engineering sector.

This is consistent with Jamaludin et al. (2024) who asserts that traditional hierarchical organizational structures in many Malaysian organizations limit the impact of engagement initiatives. Structures of these kinds can reduce employee participation in decision making, the motivational benefit of engagement. Consider, for example, that in spite of an employee's emotional and professional connection with his or her organization, his or her ability to make peer contributions may be diminished as a consequence of a lack of autonomy or recognition, which may not allow for his or her career progression.

Mustafa and Lleshi (2024) also highlighted that while engagement strategies are frequently more effective when teamed with other supportive measures, including competency based frameworks and concise growth pathways. Without an on-site presence, employees may be engaged at exceptionally high levels, but they may go without opportunities or resources to advance their careers. It points to the disconnect of how engagement hasn't been enough, even as it is being cultivated, without operating clearly structured environments where engagement is both welcomed and tied to real career outcomes.

Finally, the study highlights the allocation between engagement and career development. Formulated from the Nigerian perspective, this research adds to the body of literature in workforce management through recommendations for the cooperation of integrated approaches by the Nigerian public and private enterprises. A balancing can be made between organisational and approaches to engagement, in the sense of combining engagement strategies with structural change, such as flat hierarchies, and participatory decision making approaches, to make them as effective as possible.

5.13.5 Competency-Based Performance Management

Despite that, the study emphasizes the involvement of Competency Based Performance Management (CBPM) in career advancement, which however had little impact relative to others. The significance of doing this both requires and demonstrates the need to implement CBPM frameworks effectively to enable employee development and career progression. With a positive and moderate relationship ($B = 0.017$, $p > 0.05$), it shows that although CBPM has promise as a tool for career development, in Malaysian engineering management the implementation of CBPM currently does not allow it to reach its full potential.

This result is consistent with Lubis et al. (2024) who complained that the application of competency frameworks is frequently inconsistent and thus that they are not effective. Finally, the lack of standardized metrics and guidelines for CBPM frameworks, along with the variability of how competencies are assessed and rewarded, is creating variation in CBPM frameworks in many organizations. For example, employees may perceive performance evaluations as being subjective or divorced from their actual skills and contributions and the motivational benefits associated with such systems will be lessened.

Additionally, competency-based systems must be aligned with both the organization's goals to generate them and the individual career aspirations that should be developed. According to Febrian and Solihin (2024), a PBM framework with appropriate reuse should provide clear career pathway for employees to relate Competencies to real outcomes, for example, through promotions, technical certifications, and leadership opportunities. But when the frameworks don't match employees' responsibilities or organizational goals, they can't offer the clarity or focus needed to drive substantive career growth.

In order to tackle these problems, organizations need to concentrate on also consistent implementation and transparent metrics in the remaining of the CBPM frameworks. There are a number of feedback mechanisms that should be included and training for evaluators but they'll only be credible and useful if aligned with organizational goals. Further, design and refinement of CBPM frameworks can include the input of employees to strengthen their practicality and effectiveness in developing career growth.

5.4 IMPLICATIONS OF STUDY

5.14.1 Theoretical Implications

The contribution to the literature of career development is especially noted which includes engineering management. The research by looking at interplay between training and development programs, competency based performance management (CBPM), employee engagement and motivation, career development opportunities and talent management practices offers a comprehensive framework in defining the determinants of career progression. Consequently, the initial findings provide support for the interconnectedness of these variables and their joint relationship to career advancement, and thereby support the need to integrate these many variables into an integrative approach to career development.

Looking at the results, **Human Capital Theory** is right; when organizations invest in similar employee skills and competencies, they also increase productivity and career outcomes. It extends the theory to show how organizational practices including structured talent management programs, competency frameworks, are the enablers to skill development, and career mobility. By way of example, the importance of talent management practices indicates that they constitute a strategic tool in the alignment of employee capabilities to organizational goals (Lubis et al., 2024).

The study also demonstrates future gaps in the literature by uncovering the cadre of career development in a Malaysian engineering context. Past research has largely neglected ties between cultural and organisational factors in Asia and the career development, thus leaving a wide knowledge gap about how cultural and organisational factors in Asia affect career development (Jamaludin et al., 2024). The study integrates variables of engagement and competency management in the analysis, and points out that career development strategies should be tailored in regional and industry-specific contexts.

These theoretical insights complement the importance of the multidisciplinary approach in career development incorporating components of organizational behavior, human resource management, and engineering management. This model can be further researched in future research to examine additional variables or to extend it to other industries and regions to deepen our theoretical understanding of career progression.

5.14.2 Practical Implications

The study has important applications for practitioners who must consider Talent Management Practices and Career Development Opportunities for the Organization. To improve employee retention and production engineering firms should start nurturing their employees through mentorship programs, leadership training, and cross functional projects. The findings also indicate that more closely aligning training programs with career pathways would serve to maximize their impact.

5.15 LIMITATIONS OF STUDY

The implications in the findings of this study are extremely important for the practitioners in the field of engineering management, as regards designing and implementing strategies of career advancement. The fact that Talent Management Practices and the Opportunities for Career Development have a significant impact indicates that organizations need to invest time and effort in two of these areas to improve the employee retention, productivity and the long-term organizational performance.

Engineering firms that want to get the best from the talents they possess have to put money into the mentorship programs and leadership training. Mentorship programs can help in knowledge transfer and career advice to junior engineers, helping them acquire skills needed for advanced roles. In turn, leadership training prepares mid-level professionals for the managerial positions. Lubis et. al., (2024) shows that these initiatives are not only supporting individual career growth but a steady pipeline of talent to satisfy future organizational needs.

Other critical opportunities in employee development were also identified from cross functional projects. Working in interdisciplinary teams allows engineers to see the various different perspectives and skills and to be more adaptable and think quickly in problem solving approaches. Accordingly, this corresponds to Jamaludin et al. (2024) who discussed the liabilities that diverse opportunities create in promoting worker engagement and reducing slippage.

The study highlights the need to connect training programs with distinct career pathways. Without the direct support of training within employees' career goals, the benefits are limited to training that enhances skill. It is then recommended that training modules to be designed for technical as well as non technical competencies that have the relevance to the organization objectives as well as individual aspirations (Mustafa & Lleshi, 2024).

These findings can be integrated into the organizations' strategic plan whereby a supportive environment will be created that will not only increase employee satisfaction, but also increase the organization's competitive advantage within the dynamic engineering sector.

5.16 SUGGESTIONS FOR FUTURE RESEARCH

However, the areas covered in this study do not cover up all factors of engineering management career advancement, and inputs for further exploration are required to overcome its constraints and broaden its application. Longitudinal research designs will be adopted to examine career progression over broader periods as one key recommendation. Unlike cross sectional studies, longitudinal approaches are able to explore causal relationships and career trajectories and their dynamics—long term impacts of training, engagement and talent management practice on career trajectories (Mustafa, Lleshi, 2024).

To further expand the generalization of the findings, it could also be possible to expand the research scope to other industries and countries. Although the engineering management sector in Malaysia is large, it is possible that the economy, culture, and the organisation of the sector could have some unique element that would constrain the applicability of the results from one context to another. Studies of individual industries or nations could determine similarities and differences among career development frameworks.

Furthermore, qualitative techniques like interviews, focus groups, or case studies could be added to future studies. With the added richness of these methods, researchers would uncover nuances behind employees' perceptions, motivations and barriers to career advancement that cannot be drawn out from structured surveys (Jamaludin et al. 2024).

An additional promising avenue is to examine the crossroads of organizational culture and career advancement. The impact of engagement and training initiatives may or may not be mediated or moderated by cultural factors such as leadership style, communication practices and norms of work organizations. This dynamic was investigated with the aim of organizations

tailoring strategies to suit their specific cultural context with a view to enhancing career outcomes for employees.

Future research can help to fill these gaps, to achieve a better, more actionable, understanding of career development both in academia and in organizational practice.

5.17 CONCLUSIONS

Finally, this study clearly demonstrated that organizational practices play a vital role in the career advancement of the engineering management sector in Malaysia. The research explores the relationships between some key variables Training and Development Programs, Competency-Based Performance Management, Career Development Opportunities, Employee Engagement and Motivation and Talent Management Practices and their influence on career advancement to identify actionable strategies for improving employee growth and organizational effectiveness. We found that particularly Talent Management Practices and Career Development Opportunities had the largest impact, indicating that personalizing career planning, mentoring, and skills development are pivotal to employee progression.

The finding is consistent with literature on structured talent strategy, for example, according to Jamaludin et al. (2024), structured talent strategies promote employee retention and productivity. Just as they do, the results agree with Febrian and Solihin (2024) that employees need career development opportunities like cross functional projects and leadership training to drive growth. However, the study finds that factors such as Training Programs and Competency Based Performance Management should operate in some form of well integrated way with well defined career pathways to fully unleash their potential, similar to Mustafa and Lleshi (2024).

This study extends this body of research by responding to critique of this work by providing an integrated model of career development that incorporates multiple organizational practices,

and provides evidence based recommendations for practice. Additionally, they also lay a foundation for future study into the long-term effects, cultural mediators and organizational dynamics in career advancement. This is why organizations are well advised to address these issues with strategic approaches, by employing approaches that will help improve career outcomes for its employees and thus their sustainable growth in the new dynamic and highly technical industries.

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APPENDIX A

RESEARCH QUESTIONNAIRE

Dear Sir/ Madam

The following survey form/questionnaire is designed to assist the research on 'An Analysis of Training Needs for Enhancing Employee Career Development within an Organization: An Engineering Management Perspective'' It is kindly requested that you fill out all the questions sincerely. I want to state that all the information you provide in this questionnaire will be used for research purposes only. Your cooperation is highly appreciated. Thank you for your time.

Best Regards

Research Questionnaire: Factors Influencing Employee Career Development

Instructions:
Please read each statement carefully and indicate your level of agreement. Use the scale below:
1 = Strongly Disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly Agree

Section A: Demographic Information

1) Age: ☐ 20-29 years old ☐ 30-39 years old ☐ 40-49 years old ☐ 50-59 years old
2) Gender: ☐ Male ☐ Female

3) Marital Status: ☐ Single ☐ Married
4) Years in Current Role: ☐ 1-10 years ☐ 21-30 years ☐ 11-12 years
5) Highest Level of Education: ☐ High School ☐ Diploma ☐ Degree ☐ Master ☐ PHD

Section B: Training and Development Programs

1. Training offered by my organization is sufficient to my role.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

2. My organizations training programs are well developed, and their goals are easy to comprehend.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

3. I believe that training exercises have helped me improve and enhance on my abilities and progress in the career ladder.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

4. As for the training programs I find that they are good fit with my career planning.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

5. This particular means that there are adequate chances for me to engage myself in superior training.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

Section C: Competency-Based Performance Management

1. This means that there are sufficient opportunities for me to get involved with better training.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

2. My organisation has a competency framework that is comprehensible and applicable to my job profile commune.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

3. Performance assessments that are given at my workplace come with many positive comments that assist with bettering me.

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5

4. The competencies expected of me determines my career progression within the organization.

☐1 ☐2 ☐3 ☐4 ☐5

5. I have been able to develop my career because of competency based assessment.

☐1 ☐2 ☐3 ☐4 ☐5

Section D: Career Development Opportunities

1. There are numerous choices of career development options available for me at the organization.

☐1 ☐2 ☐3 ☐4 ☐5

2. About mobility, I can say that my organization supports both the vertical and lateral career movements.

☐1 ☐2 ☐3 ☐4 ☐5

3. There are well defined career advancement proscription in my organization.

☐1 ☐2 ☐3 ☐4 ☐5

4. Within the organization, I am of the opinion that career advancement is prioritized.

☐1 ☐2 ☐3 ☐4 ☐5

5. My organization guides working professionals in areas like professional development in form of coaching or mentoring.

☐1 ☐2 ☐3 ☐4 ☐5

Section E: Employee Engagement and Motivation

1. This makes me feel like I should contribute to my organization's success in whatever situation

☐1 ☐2 ☐3 ☐4 ☐5

2. My organisation understands and appreciates what I do for them.

☐1 ☐2 ☐3 ☐4 ☐5

3. I suppose that job is important and makes me become better person.

☐1 ☐2 ☐3 ☐4 ☐5

4. There is enough feedback that can be given to management and there is little hindrance of communication.

☐1 ☐2 ☐3 ☐4 ☐5

5. My organization highly supports me and motivates me to be actively involved in my work.

☐1 ☐2 ☐3 ☐4 ☐5

Section F: Talent Management Practices

1. My organization has well developed talent management systems that are in place.

☐1 ☐2 ☐3 ☐4 ☐5

2. My organization has very clear policies to nurtured and retained the staff

☐1 ☐2 ☐3 ☐4 ☐5

3. Career management is a structure in my organisation since the employees are accorded clear lines of promotions.

☐1 ☐2 ☐3 ☐4 ☐5

4. I think that my organization is concerned with my career progression in the long term.

☐1 ☐2 ☐3 ☐4 ☐5

5. I think organization helps to improve my skill enhancement and professional growth.

☐1 ☐2 ☐3 ☐4 ☐5

Section G: Overall Career Development

1. Refer to current career development within this organization, I feel very satisfied.

☐1 ☐2 ☐3 ☐4 ☐5

2. My organization has a positive correlation with my career progress.

☐1 ☐2 ☐3 ☐4 ☐5

3. My career choices is that they are in harmony with the opportunities offered in my organization.

☐1 ☐2 ☐3 ☐4 ☐5

4. I will likely remain in my organization due to the available career development opportunities.

☐1 ☐2 ☐3 ☐4 ☐5

5. My organization's supporting my career growth productivity as well as satisfaction in this line of work has also increased.

☐1 ☐2 ☐3 ☐4 ☐5