WOMEN ENGINEERS' SELF-EFFICACY AND CAREER PERSISTENCE: THE MEDIATING ROLES OF JOB CRAFTING AND SUBJECTIVE CAREER SUCCESS

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LIST OF ABBREVIATION

BEM	Board of Engineers Malaysia
CS	Career Satisfaction
DOSM	Department of Statistics Malaysia
IR4.0	Fourth Industrial Revolution
GDP	Gross Domestic Product
IEM	The Institution of Engineers, Malaysia
JC	Job Crafting
JD-R	Job Demands-Resources
MIDA	Malaysian Investment Development Authority
MPC	Malaysia Productivity Corporation
SCCT	Social Cognitive Career Theory
SCS	Subjective Career Success
SCT	Social Cognitive Theory
SE	Self-efficacy
SET	Science, Engineering and Technology
STEM	Science, Technology, Engineering and Mathematics
SWLB	Satisfaction with Work-life Balance
WLFP	Women Labour Force Participation

LIST OF APPENDICES

KERAJINAN KERJA DAN KEJAYAAN KERJAYA SUBJEKTIF SEBAGAI PENGANTARA ANTARA EFIKASI KENDIRI DAN KEGIGIHAN KERJAYA DALAM KALANGAN JURUTERA WANITA

ABSTRAK

Kejuruteraan adalah salah satu bidang yang dianggap didominasi oleh lelaki dan bukan bagi wanita. Oleh itu, kebanyakkan kajian bertumpukan kepada faktor-faktor yang menghalang kejayaan pelajar perempuan dalam bidang kejuruteraan dan kemajuan wanita dalam domain kerjaya kejuruteraan. Berdasarkan konsep agensi manusia, theori *social cognitive career* dan theori *job demands–resources*, tesis ini memberi tumpuan kepada dua faktor individu iaitu kerajinan kerja dan kejayaan kerjaya subjektif (kepuasan kerjaya dan kepuasan dengan keseimbangan kerja-kehidupan) sebagai pembolehubah yang penting untuk menerangkan kegigihan kerjaya jurutera wanita. Secara khusus, model pengantaraan bersiri dibangunkan untuk mengkaji peranan kerajinan kerja dan kejayaan kerjaya subjektif sebagai mekanisme menjelaskan hubungan di antara efikasi kendiri dan kegigihan kerjaya dalam kalangan jurutera wanita. Hipotesis dikaji dengan menggunakan kaedah statistik *partial least squares structural equation modelling* (PLS-SEM) dan bootstrapping. Dengan menggunakan teknik persampelan bertujuan, data dikumpul daripada sampel jurutera wanita yang bekerja di sektor pembuatan di Malaysia. Data daripada 156 sampel dianalisis dengan menggunakan PLS-SEM. Dapatan kajian menunjukkan bahawa kerajinan kerja dan kejayaan kerjaya subjektif (kepuasan kerjaya dan kepuasan dengan keseimbangan kerja-kehidupan) mempunyai hubungan pengantara yang siknifikan dengan efikasi kendiri dan kegigihan kerjaya. Kajian ini menyumbang kepada

penggunaan teori *social cognitive career* dan konsep theori *job demands-resources* dalam kalangan jurutera wanita. Kajian ini menyokong hubungan di antara efikasi kendiri sebagai sumber peribadi, kerajinan kerja sebagai tingkahlaku yang menjurus kepada tujuan, kejayaan kerjaya subjektif dan kegigihan kerjaya dalam kalangan jurutera wanita. Permintaan yang semakin meningkat untuk pekerja wanita dalam pelbagai domain kerjaya di sektor STEM, terutamanya dalam bidang kejuruteraan memerlukan pihak pengurusan organisasi memahami strategi yang digunakan oleh jurutera wanita yang masih bekerja dalam bidang kejuruteraan walaupun menghadapi pelbagai cabaran dalam persekitaran yang di dominasi oleh kaum lelaki. Hal ini demikian, dapatan kajian tersebut akan memberikan pengajaran kepada wanita lain dalam domain kerjaya kejuruteraan untuk menjadi pekerja yang proaktif dalam menyelia persekitaran kerja.

WOMEN ENGINEERS' SELF-EFFICACY AND CAREER PERSISTENCE: THE MEDIATING ROLES OF JOB CRAFTING AND SUBJECTIVE CAREER SUCCESS

ABSTRACT

Engineering is one of the fields considered male-dominated and a non-traditional profession for women. Hence, many studies have focused on barriers that prevent women's progress in engineering education and career domain. Little attention has been directed to those women engineers who persist despite the barriers. Guided by the human agency approach and drawing on social cognitive career theory and job demands-resources theory, this study focuses on two individual factors; job crafting behaviour and subjective career success (career satisfaction and satisfaction with work-life balance) as the influential variables explaining women engineers' career persistence. A serial multiple mediator model was developed to examine the roles of job crafting and subjective career success as the underlying mechanism linking self-efficacy to career persistence. The research hypotheses were assessed using partial least squares structural equation modelling (PLS-SEM) with bootstrapping. Using a purposive sampling technique, data were collected through a survey method from a sample of women engineers employed in manufacturing organisations in Malaysia. A total of 156 data were analysed using PLS-SEM. The results of the study indicate that job crafting and subjective career success (career satisfaction and satisfaction with work-life balance) fully mediate the effect of self-efficacy on career persistence. Overall, this study contributes to the utility of the social cognitive career theory and job demands-resources theory among a sample of women engineers. This study

provides support for self-efficacy as a personal resource that enables agentic behaviour through goal-directed behaviour, which in turn predicts satisfaction and women engineers' career persistence. The growing demand for diverse human capital in STEM fields, particularly in the engineering field justifies the need for understanding strategies used by those women engineers who persisted despite the challenges. Understanding why women stay as opposed to why they leave a career they have worked hard to enter will provide experiences to others in the field to be a proactive player navigating the work environment.

CHAPTER 1

INTRODUCTION

1.0 Introduction

The unprecedented changes being brought on by the Fourth Industrial Revolution (IR4.0) (Schwab, 2017) have made engineering increasingly important in global economic advancement. The changes compel science, technology, engineering and mathematics (STEM) fields to adapt and grow in tandem with technological developments in automation and artificial intelligence. These rapid advances in technology necessitate a diverse pool of intellectual and innovative workforce, particularly in engineering (Fouad & Singh, 2011; Frehill, 2012; Martínez-León, Olmedo-Cifuentes & Ramón-Llorens, 2018) to be readily available. However, the engineering field suffers from the shortage of adequate workforce (Hewlett et al., 2008), mainly challenged by the underrepresentation of women participation (Buse, Bilimoria & Perelli, 2013; Smith & Gayles, 2018; Sassler, Glass, Levitte & Michelmore, 2017; Fouad, Chang, Wan & Singh, 2017; Fouad & Santana, 2017). As a result, the workforce's supply is not consistent with the rising demands for talents in the STEM fields, particularly in engineering (Corbett & Hill, 2015).

Accordingly, engineering is one of the most male-dominated STEM fields (Ayre, Mills & Gill, 2013; Smith & Gayles 2018; Gill et al., 2017) and often known as a non-traditional career for women (Ismail et al., 2017) because of the low representation of women engineers in the field (Sax et al., 2016). Gender disparity was found to occur both in who choose to enter and persist in STEM education and those who choose to persist in STEM occupations (Diekman, Weisgram & Belanger, 2015). Women are less likely to enrol into STEM majors, despite excelling at mathematics

and science subjects (Smith & Gayles, 2018). Those who chose to major in STEM programmes were found to opt-out or switch midway to other non-STEM programmes (Goy et al., 2017; Griffith, 2010; Hill, 2012; Beede et al., 2011). This phenomenon is often referred to as the 'leaky pipeline' (Blickenstaff, 2005; Diekman, Weisgram & Belanger, 2015; Glass et al., 2013) that describes the loss of women talent from STEM education pathway shrinking the pool of women talent entering the STEM occupations. Women's participation in the STEM fields is paramount, especially with the advances driven by the IR4.0. A diverse range of individuals fosters creativity and problem-solving skills (Hill et al., 2010; Corbett & Hill, 2015) that are vital in achieving customer-centric solutions (Waychal, Henderson & Collier, 2018) and productivity (Sax et al., 2016).

Following the brief discussion above, this chapter provides an overview of the study's background, problem statement, research objectives and questions, scope of the study and the significance of the study. The definition of key terms and organisation of the chapters are reported at the end of this chapter.

1.1 Background of the Study

Curtiss-Wright Airplane Company and General Electrics were the earliest to train and employ women for engineering work. As most men were away on service during World War II, a desperate need for human resources led these companies to acknowledge women as the potential human capital for technical jobs. Therefore, they took the opportunity by giving engineering lessons to women to take up jobs in the assembly plant (Bix, 2004). However, it was a short-lived initiative as men returning from post-war started to take-up their role in engineering again. As a result, women's role in engineering vanished and was seen as invading men's technical territory (Bix,

2004). Today the increasing demands for skilled talent in STEM fields (Engineering UK, 2020a; Cadaret, Hartung, Subich & Weigold, 2017; Diekman, Weisgram & Belanger, 2015) have necessitated many countries to improve girls' participation in STEM education and technical professions such as engineering (Gill, Ayre & Mills, 2017; Sax et al., 2016).

The number of female students graduating from engineering programmes is growing (Kahn & Ginther, 2015; Smith & Gayles, 2018), but it is not reflected in women's share in engineering employment. Women formed 21% (National Science Foundation, 2019) of engineering graduates in the USA in 2016 but only accounted for 12% of engineers in the workforce (US Bureau of Labor Statistics, 2015). Similarly, in the UK, 15% of graduates who completed their undergraduate degrees in engineering in 2016/2017 were women, and just 12% were employed in engineering jobs (Engineering UK, 2020b). Trailing UK is Australia which reported a modest proportion of 14% of women completing their undergraduate programme in engineering and related technologies in 2016 (Department of Industry, Science, Energy and Resources, Australia, n.d.). In the same year, it was found that only 12.4% of engineers were women (Kaspura, 2017).

In 2018, Malaysia reported that 49% of engineering graduates from public higher education institutions were women (Ministry of Higher Education, 2018). The proportion of Malaysian women graduates may appear considerably better than in other western countries. However, in 2019, only 8.2% of women were registered with the Board of Engineers Malaysia (BEM) as professional engineers, and 28.6% were registered as graduate engineers (Ministry of Women, Family and Community Development, 2018, 2019). The discrepancy between the number of women engineering graduates and the number of women employed in engineering occupations

is a pressing issue. Such discrepancy suggests that those graduates did not enter the engineering workplace or had left the field prematurely. As a result, this may prolong the underrepresentation and shortage of talent in the engineering field.

Realising the importance of women's participation in the engineering field, many studies have devoted attention to understanding why very few enter and persist in the field, especially after all the hard work dedicated to gaining the necessary qualifications. The explanation for women's departure from engineering was often blamed on how women being marginalised, and the lack of support given to them at the engineering workplace. These reasons had adversely affected their commitment to the workplace and the profession. Based on gender stereotypes, it was posited that members of one group were perceived as more appropriate for the role than the other (Hatmaker, 2013; Faulkner, 2009). Bearing gender stereotypes in mind, women have been judged as less competent and not suitable for the profession. Such perception may have been rooted in the traditional engineering culture that was rigid with its masculine norms, resisting diversity (Bastalich, Franzway, Gill, Mills & Sharp, 2007; Faulkner, 2009). The notion of bias and sexism rooted in ill-informed judgements can be reduced with the increase of women representations in engineering organisations (Smith & Gayles, 2018).

Similar prevalence of male-oriented social constructs exists in other professions where women are marginally low in number. For instance, women solicitors experience gendered marginalisation within the legal profession (Pringles et al., 2017) through the lack of contextual support from the management, slow career progression and inequalities in pay, among others (Tomlinson et al., 2019). Kanter (1977) explains this phenomenon using the concept of tokenism to describe the numerical representation of women in non-traditional work setting such as

engineering, against the dominant group of men in the field. Specifically, Kanter asserts that women's negative work experiences are attributed by their low representation rather than differences in gender alone (Kanter, 1977).

Generally, many studies have been keen to explore various factors that negatively impede women's retention in engineering, but very few have investigated those women who stay despite the difficulties reported in the engineering work domain (Ayre et al., 2013; Buse, 2009; Plett et al., 2011). Buse and Bilimoria's (2014) study shows that women engineers' reasons to stay in the profession are not the opposite reasons for their departure. Those women who persist in engineering career were found to identify themselves strongly with engineering (Buse et al., 2013; Plett et al., 2011; Wasilewski, 2015), whereas those who exit from the field are more likely to blame the masculine culture of the field (Hewlett et al., 2008).

Investigating those women who remain committed to their engineering profession may provide a new body of knowledge and direction for understanding their behavioural processes in overcoming barriers (Fouad, Chang, Wan & Singh, 2017). The findings can be useful to others in contributing to changed attitudes within the profession (Ayre et al., 2013) and promoting greater representation of women in engineering, taking away the notion that women are unfit for technical professions. The following sections outline the barriers women experience in engineering, followed by the factors that facilitate persistence in the engineering workplace.

1.1.1 Perceived Barriers to Engineering Career

Women make up less than one-fifth of practising engineers in most countries. In the USA, women account for only 12% of engineers in the workforce (U.S. Bureau of Labor Statistics, 2015). Similarly, in the UK, only 12.4% of engineers were women (Kaspura, 2017). As such, attracting more women into engineering education and occupations has become a national interest in many countries. Research has explored factors that influence women experiences within the engineering profession to understand the reasons for women's underrepresentation in the engineering workplace. Hunt's (2016) study, based on 1993 and 2003 National Surveys of College Graduates, found there was a higher rate of women who exit from the engineering than science field. The findings also showed that the proportion of men in a field predicts the likelihood of women's exit from the particular field. In line with that, Hunt (2011), Preston (2006) and Glass et al. (2013) report that women are more likely to leave the engineering profession to move to other types of jobs. Specifically, women who have already entered the engineering workplace are more likely to leave the field (Fouad & Singh, 2011; Glass et al., 2013) at a higher rate than men.

In the case of engineering, men are perceived as the suitable gender to hold the job and as such women are often marginalised (Hatmaker, 2013) or expected to adapt to male-dominated environments (Smith & Gayleys, 2018). Moreover, lack of awareness and misconception of what the field is all about (Gill et al., 2017; Ismail et al., 2017) further aggravate the perception of engineering as a male-dominated and harsh environment for women engineers (Salas-Morera et al., 2019; Hewlett et al., 2008; Ismail, 2003). Others have explored women's communal traits (e.g., being nurturing and kind) as the determinant of their decision whether or not to enter the STEM fields (Diekman, Weisgram & Belanger, 2015; Boucher et al., 2017). STEM

fields are perceived as a competitive environment with limited opportunity to help or contribute to the community. This perception conflicts with women's expectation of helping others. Hence, such perception discourages women from choosing a career in STEM fields (Diekman, Steinberg, Brown, Belanger & Clark, 2017).

Several studies interpret women's unequal representation and marginalisation in science and engineering fields using feminist theory as a structural patriarchal underestimation of women's labour (e.g., Menezes, 2018; Smith & Gayles, 2018; Faulkner, 2007; Frehill, 2009; Franzway, Sharp, Mills & Gill, 2007). Feminists often place gendered experiences of women in engineering education and workplace environments as reasons to highlight injustices, inequality and oppression. These reasons provided substantial arguments in supporting the need for equality. To most women in engineering, they struggle to obtain informal support or excluded from social networks that can provide them access to information that pertains to opportunity for growth (Ismail, 2003; Menezes, 2018; Fouad et al., 2017; Buse & Bilimoria, 2014). For men, having those resources from the informal networking where information is shared between other male co-workers can contribute to potential developmental opportunities (Ismail, 2003), supporting men and not women for career advancement.

Having fewer women in the engineering field accentuates the sense of being socially isolated, which affects women's job satisfaction and engagement, leading to their decision to leave the field (Servon & Visser, 2011; Ahuja, 2002). Isolation in the engineering workplace makes engineering unwelcoming and socially non-inclusive for women (Yonemura & Wilson, 2016). Isolation can leave women without any opportunity for social interactions at the workplace. For some, isolation leads to assimilation (Dryburgh, 1999), a process of professionalisation which requires fitting

into the existing professional culture, internalisation of the professional identity and solidarity with others in the profession. However, Powell et al. (2009) argued that this process of assimilation to be detrimental as the adaptation strategy does not address women's issues in the male-dominated work environment and instead, it may encourage further hostility.

Social barriers in terms of gender stereotypes (Buse et al., 2013; Smith & Gayles, 2018) persist in the engineering field. Men are considered members of a dominant gender group and deemed more appropriate for the job than women (Ely & Padavic, 2007). Women entering engineering workplace are likely to encounter preconceived negative assumptions about their technical abilities because of the stereotypical implicit bias that they are technically incompetent (Hatmaker, 2013; Powell, Bagilhole & Dainty, 2009; Faulkner, 2009). As a result, such environment produces self-doubt behaviour resulting in the lack of professional role confidence (Cech, Rubineau, Silbey & Seron, 2011; Kay & Shipman, 2014) that will further impede women's fit within the engineering field. For example, Hall, Schmader and Croft (2015) report that women engineers experience social identity threats led by negative conversations with male colleagues. The feeling of social identity threat is further heightened when the conversations with the male colleagues bring about women's feeling of incompetence and lack of acceptance.

Contextual factors such as the lack of opportunities for advancement, inhospitable workplace climates (Fouad et al., 2016; Yonemura & Wilson, 2016), unclear career paths (Hewlett et al., 2008) and dissatisfaction with pay and promotional opportunities have been found to influence higher exit rate among women engineers (Hunt, 2016). Fouad et al. (2017) applied a person-environment theoretical perspective using the theory of work adjustment (TWA) to understand women engineers' reasons

to leave the field. The findings of the study showed that women's decision whether to leave or remain in the engineering job depends on their occupational needs and whether the work environment matches those needs. As such, organisational support is one of the factors that is necessary to facilitate women's retention in STEM professions (Hewlett et al., 2008; Fouad et al., 2015). Also, Ayre et al. (2013) posit that work culture must recognise both women's and men's contributions based on their competence. Such culture and the respect of other members of the organisation will further shape women's sense of belonging in the engineering profession.

Gender role assumes women as a prime caretaker for domestic and child caring roles at home while men as the head of a family should provide financial support. With the rising number of dual-income families, women still need to care for the family and at the same time, progress in their profession. Family commitment is found to impede women's career progress and retention in engineering (Fouad et al., 2017; Kidd & Green, 2004; Hewlett, 2008; Hunt, 2016). Numerous studies have reported that the difficulties in the management of work and family roles had adversely affect women's commitment to the workplace and the profession (Bagilhole et al., 2007; Fouad & Singh, 2011; Servon & Vissers, 2011; Fouad et al., 2016; Hewlett et al., 2008).

In one survey involving 846 Spanish men and women engineers, work-family conflict was found to affect career satisfaction. A supportive organisational culture that facilitates work-life balance is found to reduce work-family conflicts (Martínez-León et al., 2018). However, the culture should foster genuine support to avoid the fear of family-friendly policies being perceived as the lack of work devotion and commitment. Cech and Blair-Loy (2014) point out that employees who have flexibility stigma tend to have a lower likelihood of intention to remain in the job and lower job

satisfaction. In the engineering workplace, women's dual roles are seen as a lack of commitment to the profession.

Contrary to these findings, Hunt (2016), Glass et al. (2013), Shinohara and Fujimoto (2016) found that family-related factors are either secondary or not significant in women's career outcomes. Similarly, Buse and Bilimoria (2014) provide evidence that the number of children has no direct impact on women engineers' work engagement and career commitment. Frehill's (2008) study involving three generational cohorts graduates' showed most women of the 1985-1992 cohort indicated time and family factors as the reason to leave the field. Meanwhile, the 2001-2005 cohort demonstrated the least concern over family-related factors. The inconsistency may have to do with women's attempt altering some aspects of their job to find a balance between work and non-work demands (Fouad et al., 2017; Buse et al., 2013).

Studies have shown women in male-dominated environments adapt and manage factors such as stereotypes in an effort to remain in their chosen profession (Hewlett et al., 2008; Buse et al., 2013; Menezes 2018; Fouad et al., 2016). One recent study by Seron, Silbey, Cech and Rubineau (2018) has shown that women engineering students' embraced the engineering culture and interpreted their experiences through two values central to the engineering culture; meritocracy and individualism. The students reject feminism and interpret their experiences of hardship in engineering as necessary in the course of becoming an excellent engineer. Evidently, those women who remained in their engineering career were found to identify themselves strongly with engineering (Buse et al., Plett et al., 2011; Wasilewski, 2015) while those who exited from the field were more likely to blame the masculine culture of the field (Hewlett et al., 2008).

1.1.2 Persistence Factors

While most studies have explained the barriers women experience in STEM education and career pursuits, recent studies have started to focus on examining those women who stay despite the barriers (Smith, Costello & Wilkinson, 2018). Exploring factors that promote employee's persistence in a field where the talent is scarce can help policymakers and organisations align structural influences to motivate individuals to succeed and persist in their career pursuit. Socio-cultural barriers and the absence of supporting organisational climate are often reported as the main reasons leading to various deterrent outcomes at the individual level (e.g., self-doubt behaviour, isolation, difficulties in managing work and family roles). These limitations have caused concerns among engineering stakeholders to be supportive by providing inclusive culture at the workplaces to recognise women's competence as much as men's.

Nonetheless, women engineers who remain working in the field are more likely to discuss how they adapted to the culture of engineering compared to those who left (Ayre et al., 2013; Buse, 2009; Buse et al., 2013; Fouad & Singh, 2011; Hewlett et al., 2008; Menezes, 2018). A study by Seron et al. (2018) report findings supporting the experiences of hardship in engineering are necessary to become an excellent engineer. The study's engineering students resist feminism because they perceived that feminists tend to fight for differential treatment. In their interpretation, it is the internalisation of embracing engineering as it is, makes one persist.

A number of studies have shown that self-efficacy has a strong influence on women engineers' career decisions (Duncan & Zeng, 2005; Buse et al., 2013, Singh et al., 2013; Lee & Flores, 2017). The self-efficacy belief enables women in the engineering workplace to initiate behaviours to seek challenging task, navigate tough technical problems and social interactions with supervisors and peers (Buse et al.,

2013). Women who persisted learn skills proactively, such as interpersonal skills, problem-solving and making things happen on top of their technical skills to strengthen their identity as a good engineer and to promote a sense of belonging to the profession. In a survey among Spanish engineers, suitability for the job was found to be more important than the level of income for women engineers' career satisfaction (Martínez-León et al., 2018). Thus, women perform better when their competencies are coherent with the demands of the engineering workplace.

According to the social identity theory (Hogg, 2006), a person's identification with the occupation is based on the self-concept derived from their cognitive interpretation of what defines group membership. Professional identity has been reported to influence women's retention in engineering occupations (Wasilewski, 2015; Buse et al., 2013; Plett et al., 2011). Buse and Bilimoria (2014) found one's real self and ideal self distinguishes women who stay or leave the engineering profession. Those who remained exhibits high personal vision that enables them to sustain unsatisfactory work environments with their solutions. As such, it promotes a sense of belongings (Ayre et al., 2013) where women feel they should be respected and valued for their skills and abilities.

Drawing from Holland's person-environment congruent theory, Donohue (2006, 2014) posits that individuals' vocational identity indicates the congruence between the individual and the profession. Also, cognitive dissonance theory (Festinger, 1957) explains that when inconsistency appears between one's cognition and behaviour, often individuals will attempt to change the dissonance, hence exiting from the environment to avoid disharmony. However, women engineers who enjoy the challenging work environment (Buse, 2009; Buse et al., 2013; Buse & Billimoria,

2014; Hewlett et al., 2008) and the job variety in engineering (Wasilewski, 2015) tend to persist.

Gill, Ayre and Mills (2017) report that women's commitment to the profession allows them to change work situations. Self-initiated proactive changes enable women to overcome barriers and stay in the profession. This is consistent with the findings in Fouad et al.'s (2016) study, which found that persistent women differ from those who left in terms of their career commitment. Individuals' self-directed strategies to manage workplace difficulties may explain the inconsistencies of why some women leave the profession while others are able to overcome the workplace challenges to sustain in the career that they have trained hard to enter (Fouad et al., 2017).

Employees' behavioural shift has a lot to do with the need for a self-managed career in today's uncertain and volatile economy. Concepts such as boundaryless career (Arthur & Rousseau, 1996) and protean career (Briscoe et al., 2006) start emerging in response to the changes in the traditional career path where lifetime employment in one organisation (Eby, Butts & Lockwood, 2003) has become less common. Individuals' self-directed career management has become more pertinent among employees now (Arthur & Rousseau, 1996). Therefore, it is vital to consider individuals' changing work behaviour to understand the factors that determine their career decisions.

Understanding predictors of persistence among women in STEM occupations is critical. Researchers are in general agreement about the numerous difficulties experienced by women in male-dominated work environments (Menezes, 2018; Smith & Gayles, 2018; Hatmaker, 2013; Buse & Bilimoria, 2014). Efforts to encourage women to participate in STEM occupations require a clearer understanding of their experiences, as their role can play a significant part in the economic growth of a

country (Schmillen et al. (2019). Globally, many countries are concerned about the rising demands for engineering workforce and the underrepresentation of women in the field (Kaspura, 2017; UK, 2020a). The government of Malaysia aims to increase the number of skilled talent in the manufacturing sector by attracting and developing future talent in the sector (Ministry of International Trade and Industry, 2018). Hence, knowing factors that promote persistence among women engineers may allow effective implementation of policies involving talent development in STEM fields. The following sections set the context for the issues pertaining to engineering talent in Malaysia.

1.1.3 Shortage of Engineers in Malaysia

Malaysia has reported a shortage of skilled workforce (Goy et al., 2017; TalentCorp, 2017; Jauhar & Yusoff, 2011), especially engineers (Hamid & Ahmad, 2017; Malaysia Productivity Corporation, 2019; Anvari et al., 2014; Kiang, Jauhar & Haron, 2014; Rahman, 2012; Islam et al., 2013), challenging the country's economic growth to achieve the 11th Malaysia Plan (11MP) (Prime Minister's Department, Malaysia, 2017a). The primary focus of 11MP is to capitalise on high technology and value-added industries with an emphasis on the development of a people-based economy and capital-based economy. Among the efforts set by the government of Malaysia during the 11MP is to increase the growth of productivity as the key driver in realising the country's aspiration of becoming an advanced nation. In 2019, Malaysia recorded labour productivity growth of 2.1% to RM93,973 from RM92,018 in 2018 (Malaysia Productivity Corporation, 2020). Compared to the 2.2% of productivity growth in 2018, the growth indicates a steady pattern from 2018 to 2019. However, the projected growth of 2.9% for 2019 (Malaysia Productivity Corporation,

2019) was not achieved. One of the most prominent and challenging issues was the shortage of high-skilled human capital.

Talent Corporation Malaysia Berhad and the Institute of Labour Market Information and Analysis (TalentCorp, 2020) report yearly Critical Occupation List (COL) to identify talent shortage faced by industries in Malaysia. Shortage of engineers has been consistently categorised as a critical occupation. Especially the manufacturing and construction sectors were hit the most with a talent shortage. The positions that appeared in the yearly report for four consecutive years from 2015 to 2018 were industrial and production engineers, mechanical engineers, and electrical and electronic engineers.

Malaysian Productivity Blueprint has identified nine manufacturing subsectors as the high potential drivers of productivity (Prime Minister's Department, Malaysia, 2017b). The electrical and electronics (E&E) industry is one of the nine subsectors that have raised concerns related to the shortage of industry-ready engineers (Malaysia Productivity Corporation, 2020). The shortage of engineering professionals in the manufacturing sector (Malaysia Productivity Corporation, 2019) can be detrimental to the performance of the industry and the sector as a whole, given that manufacturing is the second highest contributor to Malaysia's Gross Domestic Product (GDP). The sector contributed 22.4% to GDP in 2018 worth RM304.8 billion, making it the second-largest economic sector in terms of value. In terms of the sector's labour productivity, the manufacturing sector saw a growth of 1.7% to RM123,896 from RM121,841 in 2018 (Malaysia Productivity Corporation, 2018, 2020). As such, sufficient high-skilled talent is essential for the sector to attain the projected productivity of 3.9% by 2020.

The Malaysian Institute of Engineers (IEM) have echoed similar concerns citing the engineer to population ratio as the benchmark to gauge Malaysia's readiness becoming an advanced economy. According to Ir. Tan Yean Chin, the President of IEM, Malaysia needs to target a ratio of 1:100 from the current ratio of 1:150 in order to accelerate the country's transition plan into a developed nation (Tan, 2017). Due to fewer skilled talent in the labour market, the workforce shortage is exacerbated by inexperienced candidates taking up the available job openings. This, in turn, becomes another reason for the shortage of engineers due to the mismatched skills and demands (Malaysia Productivity Corporation, 2017), leading to increased turnover. Addressing this phenomenon, the Malaysian Education Blueprint 2013-2025 (MEB) was initiated, giving attention to the education system for sustainable industry-ready talent. Furthermore, the Malaysian Investment Development Authority (MIDA), Ministry of Education Malaysia and TalentCorp under the Industry-Academia Collaboration (IAC) have developed initiatives for industry-ready talent in terms of higher education curriculum development and industry attachments.

Brain drain is another area that needs attention, where highly skilled professionals leave the country seeking employment elsewhere outside Malaysia for better financial earnings and career prospects (Kiang, Jauhar & Haron, 2014; Rahman, 2012). One of the steps taken by the government to tackle brain drain is the Returning Expert Programme (REP). REP was developed in collaboration with TalentCorp to encourage Malaysian professionals living and working abroad to return, bringing their skillset to the advantage of Malaysia's economic prosperity. As of 2019, TalentCorp has reported about 5,366 REP approvals. Although the initiative shows positive outcomes, brain drain is still prevalent in Malaysia (Ramoo, Lee & Yu, 2017). Hence, policies should aim at preventing brain drain from happening in the first place.

Skill shortage can trigger a talent war (Jenkins, 2009), thereby aggravating the situation. Engineers are aware of the competitive advantage of the skills and experiences they own. As a result, job mobility or job-hopping (Rahman, 2012; Ganco, Ziedonis & Agarwal, 2015) to seek better opportunity or value that is congruent (Ren & Hamann, 2015) with their career aspiration has become a norm. However, dysfunctional separation, especially professional mobility can adversely cost organisations in terms of recruitment cost (Hom, Allen & Griffeth, 2019: Sherman, 1986; Allen et al., 2010) and possible knowledge transfer to the rival company (Png & Samila, 2013)

Recognising the need for sufficient engineers, the National Policy on Industry 4.0 aims to increase the number of high-skilled workers in the manufacturing sector from 18% to 35% by 2025 (Ministry of International Trade and Industry, 2018). In essence, the supply of industry-ready engineers is paramount to achieve consistent growth of the manufacturing sector and to accomplish the 11MP economic performance. The number of women graduates in the engineering programme is trailing closely behind male graduates. Hence, it is timely for the industry to look at the untapped pool of women talent.

1.1.4 Women Engineers in Malaysia

Between 2010 and 2019, the Malaysian women labour force participation (WLFP) rose from 46.8% to 55.6%. Meanwhile, male labour force participation (MLFP) increased marginally from 79.3% to 80.8% (DOSM, 2020). Although the WLFP rate has been steadily rising, signalling good progress compared to MLFP, women are still underrepresented in high-skilled jobs and the paid labour force compared to men. Education level is one of the factors among other demographic

variables that were found to influence WLFP (Akhtar, Masuda & Rana, 2020). In Malaysia and many other developed and developing countries, women have outnumbered men in higher education institutions (Wan, 2018; Goy et al., 2017). Evidently, in 2019 63% of the students enrolled for undergraduate level in Malaysian public universities were female (Ministry of Higher Education, 2019).

As indicated in Table 1.1, the number of female students' enrolment and the output in Malaysian public universities for the engineering field of study shows a marginal disparity between male and female students. Women achieving parity in engineering education is not translated into their participation in engineering occupations. In 2019, as presented in Table 1.2, only 8.2% of professional engineers registered with the BEM are women, in addition to 28% graduate engineers (Ministry of Women, Family and Community Development, 2019).

Table 1.1 *Number of Students' Enrolment and Output for Bachelor's Degree in Engineering by Gender in Malaysian Public Universities (2016-2019)*

	2016		**2017**		**2018**		**2019**	
	Male	Female	Male	Female	Male	Female	Male	Female
Enrolment	44,039	38,111	44,934	38,858	46,415	39,179	48,145	39,070
Output of Graduates	9,854	9,086	9,823	9,269	9,094	8,871	10,171	9,835

Source: Higher Education Statistics (2016, 2017, 2018 & 2019), Ministry of Higher Education, Malaysia

Table 1.1 shows the increasing trend of female students' enrolment into engineering programmes in Malaysian public universities. It is also noticeable that the number of male and female students graduating from the engineering programme shows a steady pattern between 2016 and 2019, reflecting that gender disparity is not a substantial concern for women's representation in engineering education. It is an

indication that women in Malaysia are given equal rights for education in whichever field of study they are academically qualified. This has to do with the Malaysian government's efforts under the 11MP in realising the crucial roles of women both in the family settings and in the labour market (Prime Minister's Department, Malaysia, 2017a).

With the rapid advances in the technological-based economy, the need for women professionals in the STEM fields becomes more crucial than before. Although the number of women pursuing engineering education has increased, the shortage of adequate talent in the field remains a concern (Ismail, Zulkifli & Hamzah, 2017; Hamid & Ahmad, 2017; Malaysia Productivity Corporation, 2019; Anvari et al., 2014; Kiang, Jauhar & Haron, 2014; Rahman, 2012; Islam et al., 2013). Table 1.2 presents the total number of registered persons with BEM. BEM is a statutory body formed in 23rd August 1972, and it is constituted under the Registration of Engineers Act 1967, which overlooks the registration of engineers in Malaysia.

Table 1.2 *Number of Registered Members of BEM by the Type of Registration and by Gender for the years 2014 and 2019*

Type of membership	2014			2019		
	Male	Female	Female % of total	Male	Female	Female % of total
Professional Engineer	15,534	823	5%	19,332	1,721	8.2%
Graduate Engineer	60,226	17,690	22.7%	94,686	37,939	28.6%

Source: Statistics on Women, Family and Community (2014, 2019), Ministry of Women, Family and Community Development

Table 1.2 shows that the professional engineer membership among women has grown by 52% to 1,721 in 2019 from 823 in 2014. The number of women graduate engineers has also grown by 53% to 37,939 in 2019 from 17,690 in 2014. Although the growth reflects the number of Malaysian women taking up engineering as a profession, the number of women professional engineers are seriously low compared to men. The growth in the number of women engineering graduates is not reflected in their participation in engineering occupations (Ismail, Zulkifli & Hamzah, 2017; Goy et al., 2017; Johari, 2013). Notably, 70% of science, engineering and technology women graduates are not working in the related field (Ministry of Women, Family, and Community Development, Malaysia, 2010).

Furthermore, the fee incurred for an undergraduate engineering programme in Malaysia is substantially lower compared to a similar programme in private higher education institutions. The government of Malaysia is committed to ensuring education is accessible to every qualified Malaysian. As such, the tuition fee is highly subsidies by the government. For instance, in some Malaysian public universities, such as in Universiti Sains Malaysia, engineering students pay approximately RM1,560 in tuition fee per semester (Universiti Sains Malaysia, 2020). In contrast, private higher education institutions charge between RM45,000 and RM170,000 for the 4-year engineering programme (Wan, 2017). World Bank (2020a) reported that Malaysia spent 4.5% of the GDP on education in 2018. Of that, one-fifth of the expenditure (21%) was allocated for tertiary education (World Bank, 2020b). The government funding need to be translated with graduates entering the workplace, contributing back to the economy.

In one recent report by World Bank Group entitled ‘Breaking Barriers: Toward Better Economic Opportunities for Women in Malaysia’, Schmillen et al. (2019)

highlight that if all the economic barriers are removed for women, Malaysia's income per capital could grow by 26.2%. That translates into an average annual income gain of RM9,400. In the same report, the authors have emphasised the shrinking demographic of the working-age share of the population that requires the participation of untapped women human capital in the workforce contributing to socio-economic development.

Balamuralithara, Foon and Azman (2015) have reported that women who are already in the workforce tend to leave after some time. One of the key reasons for Malaysian women exiting from the workforce was to raise a family because of the lack of alternatives for childcare (TalentCorp & ACCA, 2013; Abdullah et al., 2013). Research has also found family commitment is the major hindrance for women progressing in their career (Schmillen et al. 2019; Indra & Tanusia, 2013; Ismail, 2003; Ismail & Ibrahim, 2008; Ismail, Zulkifli & Hamzah, 2017; Hamid & Ahmad, 2017; Madihie & Siman, 2016). Women's commitment to the family is found to negatively influence their performance (Ismali, 2003) and is perceived as their lack of commitment to the profession (Watts, 2009).

A comparative study between women engineers in Japan and Malaysia (Balamuralithara, Foon & Azman, 2015) reveals that women engineers in both countries tend to leave the engineering field after they have children. Ismail and Ibrahim (2008) report similar findings among female executives in an oil and gas company in Malaysia that women's responsibilities in the family domain and the commitment to the family are the most significant barriers perceived by the executive women in the study. These sorts of experiences make women work harder, proving their competence and earning an equal reward as men (Koshal et al., 1998; Ismail & Ibrahim 2007). Indeed, Kanter (1977) has posited that women underrepresentation in

a male-dominated work environment may lead to visibility phenomena to perform harder. In 2014, a survey conducted by IEM reported that although the common challenges encountered by women engineers are work-life balance, it is the lack of women in senior roles and the workplace culture that influence women engineers' job satisfaction and intention to stay (Zoe, 2015). Others have reported the negative perception that engineering is more suited for men than women (Abdullah et al., 2013; Ismail et al., 2018) to hinder women from participating in technical jobs.

Following the discussion above, Ismail and Jajri (2012), Saadin, Ramli, Johari and Harin (2016), Othman and Othman (2015) argued women's turnover intention and dissatisfaction are partly due to discriminatory practices in terms of the wage gap and pregnancy stereotype (Rahman, 2012). However, in recent studies, discrimination is no longer pertinent to the Malaysian engineering scene (Madihie & Siman, 2016; Ling, Ahmad & Abas, 2017). Senior professional engineers interviewed by IEM for its monthly bulletin have emphasised that promotion is based on performance (Zoe, 2015).

In addition, the notion of women being denied a leadership role based on gender is no longer the situation in Malaysia. The TalentCorp and ACCA (2013) survey has shown that 60% of working women in Malaysia agreed that they have an equal opportunity to men in career progression. As such, it is time to grasp that women need to equip themselves and develop competencies (Rahman, 2015; Ismail & Jajri, 2012) to advance and progress in their career choice. Also, in a case study examined by Rahim, Mohamed, Amrin and Mohammad (2019) among Malaysian women professionals in SET (science, engineering and technology), the participants demonstrated strong determination to grow and task persistence despite the obstacles they experience. These findings are consistent with other studies conducted among

women engineers outside Malaysia (e.g. Ayre et al., 2013; Buse et al., 2013; Menezes, 2018), supporting the argument that women are capable of navigating workplace issues with self-initiated changes.

The BEM members' registration between 2007 and 2017 demonstrates an increasing trend in female engineers' registration (see Appendix A). In 2007, there were 840 new registered female engineers, and the number increased to 3,064 in 2016. Although the data is not a representation of all engineers in Malaysia as not all practising engineers have registered with BEM, the data indicate that Malaysian women are taking up engineering as a profession. Hence, it is timely to examine those who are interested in entering and remaining in the engineering career despite the perceived obstacles and barriers in the male-dominated environment. Their behavioural interventions in the engineering workplace may explain important factors for informed recruitment and retention efforts.

1.2 Problem Statement

The rapid advances in a technological-based economy warrant a diverse pool of intellectual and innovative human capital, particularly in engineering (Fouad & Singh, 2011; Frehill, 2012; Martínez-León et al., 2018). A diverse workforce can bring different ideas and styles of thinking that are essential to thrive in a solution-based industry such as engineering. In this respect, engineers are the enablers of productivity growth (Kaspura, 2017), capitalising on ideas and turn them into innovative solutions. Globally, many countries are concerned over the rising demands for engineering talents, and the situation is further challenged by the underrepresentation of women's participation in the field. Although the number of female students graduating from engineering education is growing, women make up less than one-fifth of practising

engineers in most countries. Such discrepancy indicates that those graduates either do not enter the engineering workplace or have left the field prematurely.

Mitigating women's underrepresentation in engineering was often directed at two major areas. The first addresses students' recruitment and retention in engineering education (Male, Gardner, Figueroa & Bennett, 2018; Goy et al., 2017; Marra, Rodgers, Shen & Bogue, 2009). While the second focuses on the shortcomings and barriers to women's retention in the engineering occupations (Fouad et al., 2017; Cadaret et al., 2017; Cech & Blair-Loy, 2014; Frehill, 2012; Bagilhole et al., 2007; Hewlett, 2008; Hall, Schmader & Croft 2015; Yonemura & Wilson, 2016; Bastalich et al., 2007). The explanation for women's departure from engineering occupations is consistently subjected to socio-cultural barriers, lack of organisational support and individual factors that adversely affect women's commitment to the profession and the workplace.

A considerable amount of research has provided an understanding of the challenges and experiences women encounter in the male-dominated work environment. However, less is known about what enables them to remain. A growing body of literature has examined those women engineers who stay on despite the perceived barriers in the engineering field (Fernando, Cohen & Duberley, 2018; Fouad et al., 2016; Panatik et al., 2017; Menezes, 2018; Buse & Bilimoria, 2014; Wasilewski, 2015; Ayre et al., 2013; Buse et al., 2013). Of these, research has explored the interactions between individuals and the social context under which women engineers were more likely to experience satisfaction and persistence, mostly in the form of contextual supports as the key determinants to women career experiences (Fernando, Cohen & Duberley, 2018; Fouad et al., 2017; Martínez-León et al., 2018).

Fouad et al. (2017) highlight the need for studies to investigate successful strategies employed by women engineers who persisted in the engineering profession. Indeed, studies have reported those women engineers who persist have appeared to demonstrate confidence in fulfilling engineering tasks, ability in managing multiple life roles and ability in coping with the organisational culture as ways to overcome obstacles (Ayre et al., 2013; Buse et al., 2013; Fouad et al., 2016; Wasilewski, 2015; Menezes, 2018; Rahim et al., 2019). Those who stay are more likely to discuss ways they have adapted to engineering culture compared to those who left, who appeared to blame their departure on the culture. These types of individual's beliefs and behaviours are consistent with Bandura's (1986) concept of human agency that is related to self-efficacy beliefs.

Highly efficacious individuals tend to cope with workplace adversity successfully by activating self-regulated proactive behaviours overcoming challenging environments or experiences (Bandura, 1977; Tims et al., 2014). Studies have shown that those who persist in their engineering occupations engage in proactive behaviours in an effort to find solutions to workplace difficulties and demands (Menezes, 2018; Buse & Bilimoria, 2014). However, despite the importance of these factors, there are very few quantitative studies of the underlying influences of self-initiated behaviour between self-efficacy and the decision to persist.

According to the job demands-resources (JD-R) theory (Bakker & Demerouti, 2014), an individual with a higher level of self-efficacy uses it as a personal resource to proactively make changes to their jobs to balance job demands and job resources. One specific form of proactive behaviour is job crafting. This bottom-up approach is useful in an environment where there is a misfit between an individual's needs and what the job offers (Lu, Wang, Lu, Du & Bakker, 2014; Tims & Bakker, 2010). As