Global Business and Management Research: An International Journal
Vol. 9, No. 4 (2017)

Insights on Engineering as a Non-Traditional Career Field for Women

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Abstract

Purpose: This study examines insights about engineering as a non-traditional career field for women.

Design/methodology/approach: This conceptual paper adopted in-depth literature review approach from past studies conducted worldwide. A total of 75 sources of literature based on international contexts are used in the analysis that include journal articles, books, book chapters, and website documents. The analysis is based on the social role theory. To conduct the literature reviews, we used keywords such as women engineers, engineering as a non-traditional career, as well as women in science, technology, engineering, and mathematics (STEM). Constant comparative analysis was used to establish some thematic insights about engineering as a non-traditional career for women.

Findings: The results show that there are strong literature evidences that women are underrepresented in the engineering profession despite the fact that women are making inroads in it. The thematic insights derived from this analysis are: women can build a successful career in engineering, engineering field provides good salary for women, women engineers face tough competition with men engineers, consistent gender bias and stereotype threats faced by women engineers, women over forty years old are not appropriate to work in engineering as men in the same age, women engineers are bound with family commitment, and women engineers subjected to harassment as well as glass ceiling effect at workplace.

Practical implications: Further research is suggested to test and validate quantitatively and qualitatively the themes generated from this analysis based on specific sample of women engineers

such as mechanical engineers or computer engineers. Upon validation, it is recommended that organisations to adopt various gender-friendly initiatives for women to unleash their talents and potentials as engineers.
Originality/value: The paper contributes to literature on the significant insights about engineering as a non-traditional career field for women, which is rarely discussed in business and management literature. The insights are valuable for other inspiring women to know and organizations to appreciate what takes to be a successful woman professional in the non-traditional career of engineering.

Keywords: Women engineers, non-traditional career, women in science technology, engineering, and mathematics (STEM).

Introduction

In this twenty first century, women face challenges in career development due to competitive factors in the labour market. In the past, fewer occupational choices were available to women due to factors such as stereotypical thoughts, sexism, discrimination, and limited education accessible to women (Domenico & Jones, 2007). Before the late 1800s, a woman's ability to even enrol in a university was limited, especially if she wanted to study sciences. For example, in the advanced country of the United States, the University of Missouri began enrolling female students in its college of education in 1867 to study teaching, but they were not allowed to enrol in all academic programs until 1871 (Society of Women Engineers or SWE, 2016). However, women currently are not only playing the nurturing roles in the societal development but they also have been part of the active players in industrial and economic development worldwide.

In Malaysia, for instance, the involvement of women in the labour force is still low despite its steady increase from 2010 to 2015 (Figure 1). One of the factors contributing to this development is the improvement of women in tertiary education; however, the rate of increase of women in certain sectors is not as expected. Women's labour force participation rate was up by 0.5% reaching 54.1% in 2015 compared to 53.6% in 2014 (Malaysian Statistics on Women, Family and Community, 2016). According to the Ninth Malaysia Plan (2006), women have contributed nearly half of the Malaysia labour force and their contribution continued in the Eleventh Malaysia Plan (2015) with the new target is to achieve 59% participation of women in the labour force in 2020. Therefore, to achieve the target, paid employment of women increasingly has moved from primarily traditional female-oriented jobs to more non-traditional, and previously male-oriented careers (Domenico & Jones, 2007), including the field of engineering.

Engineering has been known as a non-traditional career field for women because fewer women have involved in the field. According to an international website called EduAdvisor.my (2017), engineering is all about using mathematics and science to solve problems. Thus, by applying scientific, economic and mathematical knowledge, engineers work to design, build, maintain and improve all sorts of physical things, including structures, machines, electronic devices, systems and processes. Even though women have achieved parity in life sciences in many countries, they still trail men in engineering. While the representation of women in engineering has improved in recent years worldwide, misconceptions about engineering, lack of encouragement and other factors still act as barriers preventing more women to pursue a career in this non-traditional career.

Zywno et al. (1999) and Burke (2007) listed factors that tend to divert women away from engineering as a career, which are streaming or the Leaky Pipe Syndrome where women are diverted from math and science courses early in their high schools, perception of engineering is thought to be extremely difficult, and the myth that women are poor at mathematics. Other factors are exposure where women do not have as many engineer role models as for other careers such as business, medicine or law; lack of knowledge about engineering where engineering is perceived as a technical; and the various career options in engineering are not very well-known by schools and society; hobbies where boys have been encouraged by parents and peers to engage in mechanical oriented hobbies meanwhile women are encouraged to feminine oriented hobbies. The last factor is social status of the profession where engineering has a tradition of being a higher social status for men compared to women.

Many studies have claimed that the number of women in engineering has been increasing in many developed and developing countries (Dean & Fleckenstein, 2007; Burke, 2007; Powell, Bagilhole & Dainty, 2007) especially in soft areas of engineering such as design engineering, computer engineering and material engineering; although their actual number as a whole on average remains smaller than that of their male counterparts. Despite this gender gap, there are success stories in relation to penetration of women in this male-dominated career (Evett, 1996; Ismail & Mohd Rasdi, 2006; Ismail & Ibrahim, 2008; Buse, Hill, & Benson, 2017). However, little is known about the feeling and experience of those women engineers so far in relation to their participation and navigation in the male-dominated career. Therefore, this research aims to explore the experience of women engineers on engineering as a field of profession so that the under-representation of women in the non-traditional field of engineering can be explained and understood. It is hoped that from this analysis, a meaningful insight is obtained towards planning of human resource development and management initiatives as well as recommendations to find ways and means to mitigate this gender gap in employment.

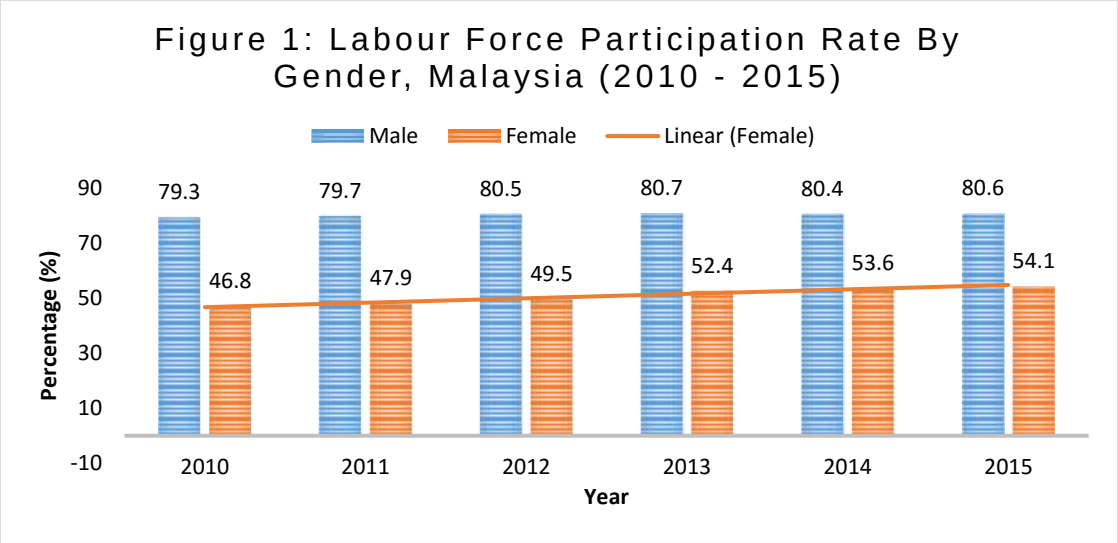
The main purpose of the study is to explore the experience of women engineers on engineering as a career choice. The specific objectives are: i) To identify the experience of women engineers on engineering as a non-traditional field of profession of women in the forms of advantages and disadvantages; and ii) To understand barriers experienced by women engineers in the engineering field. This study is significant as it adds knowledge on the perception of women engineers themselves on engineering as a profession of choice. This contributes to the practical use as management or organisation would consider more opportunities for women and significant others in the family and society to unleash women's talents and potentials; and consequently women could feel they are being appreciated and given the appropriate chances to contribute to the society as what men are given and expected to do.

Literature Review

Engineering as a Non-Traditional Career for Women

Women in many countries are currently being employed in various careers either in traditional or non-traditional career areas. A non-traditional career is defined as a field of occupation that more than 75% of the workforce is of the opposite gender, or put it conversely where less than 25% of the workforce is your gender (Hansen, 2016). Similarly Dudley et al. (2013) claim that any occupation that generally employs far fewer women than men can be described as a non-traditional career for women. It means that the non-traditional career for women is the career in which majority of workforce is occupied by the opposite gender i.e. men. For women, many non-

traditional careers fall into a few broad categories of jobs: labour-intensive, scientific/technical, and supervisory. Therefore examples of traditional career for women are nurses, secretaries and school teachers.



Note: Adapted from Malaysian Statistics on Women, Family and Community. (2016). Retrieved from https://www.kpwkm.gov.my/kpwkm/uploads/files/Publication/StatisticsBook/Statistics2016.pdf

In Malaysia, for instance, many efforts have been taken to empower women towards non-traditional careers such as convincing them to take training and educational opportunities to be involved in the modern sciences and technology field, expanding vocational training opportunities for women and recognition of women's skills in the field of training and work (KPWKM, 2016). Although there have been many positive changes in the status of women in higher education and employment, some professions are still perceived as "manly" (Mishkin et al., 2016; Zohar & Sela, 2003). Similarly in the United States, 'The Packard Scholars Program' emerged as an important and unique opportunity to diversify the STEM workforce that includes women and the minorities in higher education institutions. However, literatures have shown that women face barriers to pursue to engineering–based profession, one of which is stereotype threat (Steele et al., 2007).
As the technology has become the driving force of the current economy, it has become essential that people worldwide, regardless of gender, should pursue in STEM areas, first as a choice in education and followed by a career option. Traditionally, STEM have been dominated by men and only few women choose STEM as a profession especially in the engineering field because women think that has not been a top choice in terms of careers (Burke, 2007; Mishkin et al., 2016). Even though it is said that women engineers will be paid handsomely in engineering field, but there are perception from the female students that think otherwise (Kadayifci & Gedik, 2016; Christie et al., 2017) as some female students claimed that those who graduated from university in STEM were found to be more poorly paid and did not do as well in terms of their careers as did their male counterparts. To what extent is this true remains to be answered in this article.

Working in a non-traditional career has advantages and disadvantages towards women. Hansen (2016) cited that a job-seeker must know the pros and cons before making a final decision about whether to pursue the non-traditional career path. The scholar further asserts that the pros of working in a non-traditional career are the intrinsic benefit of following your childhood dreams and the satisfaction that comes from the empowerment of a job done well and also their impact on society where it will open more doors to gender minority. Women who are succeeded in this path will be the mentors for other women. Not just that, the pay is typically much higher in careers where men dominate (McKay, 2017). Thus, women will have the potential to earn better income in a non-traditional career. Meanwhile, Hansen further explains that the lack of enough mentors in non-traditional careers is one of the disadvantages as mentors who are people in higher positions within the career field, are critical to the success as they can guide, protect, and help along in the career. Another con is the potential negative feelings from co-workers such as sexual harassment. Other than that, the potential to have little or no support from family and friends who may question your motives for entering a more challenging career that imposes both mental and physical challenges that may be overwhelming. But no matter what are the pros and cons faced by the non-traditional workers, it has not stopped them from pursuing the career as the participants in this path are increasing through time.

Initiatives to increase more women in non-traditional areas of engineering and other areas in STEM are numerous including scholarships, research and performance awards and quota system. As such, a growing number of Asian women are making inroads in STEM, thanks to greater opportunities for career development and changing cultural norms (http://www.scidevt/asia-pacific/gender/feature/more-asian-women-find-success-in-science). Experiences of women scientists including engineers across the Asian region reveal that policies and laws that promote gender parity and equal opportunities, alongside changing cultural perceptions on women's roles, more supportive families and the presence of female role models, are helping women cope with the challenges they usually face when choosing a demanding career in science and the academe. For instance, in China, the Chinese Academy of Sciences has identified an increasing women representation in science and engineering as an important priority. In India, the Department of Science and Technology has launched a Women Scientists' Scheme that offers fellowships and grants to women scientists who have to take a sabbatical to raise their families.

In Japan, the government has offered competitive grants for research conducted by female scientists, established programs that encourage women researchers to return to work after having a child as well as protecting them from losing their grants while on extended maternity leave, and increased funding to help universities employ more female scientists. Japanese universities are also working to increase female enrolment by launching science-themed fairs, workshops, campus tours and lab visits. In South Korea, the government and the private sector put up awards that provide cash money and honour the contributions made by female scientists. In Malaysia for instance, L'ORÉAL-UNESCO for women in science fellowship program has awarded 38 Malaysian women scientists and close to one million Malaysian Ringgit (RM), (in which 1USD = RM4.2) in research grants since 2006 (http://www.loreal.my/csr-commitments/loreal-csr/for-women-in- science.htm. All the above initiatives are meant to help women to pursue education, research and employment in a broad-based engineering and science-related careers in the Asian countries.

The Social Role Theory

The social role theory was introduced by Eagly (1987) as an effort to understand the causes of gender differences and similarities in social behaviour. Some scholars believe that gender roles are the result of a socialization process starting in early childhood and developing during adolescence (Eagly, Wood & Diekman, 2000). Eagly (1987) further explained that historically, sex-division of labour occurred when women were seen as more fragile and assumed entirely suitable for gathering food and domestic responsibilities, while male strength was required for outdoor activities such as hunting. However, based on sex-differences in social behaviour and other modern influences especially women's achievement in higher education, expectations towards men and women have differed nowadays (Galy-Badenas, 2015).

Through the reproduction of these expectations from generation to generation, social behaviour has deeply influenced both genders and has led to sexual stereotypes. Hence, the stereotypes of social roles rule male and female behaviour. In this respect, men develop "agentic" characteristics such as assertiveness, independence and competence that are in line with male social role expectations. In contrast, women develop "communal" characteristics such as friendliness, generosity, relationship, kindness and compassion that are consistent with female social role expectations (Eagly 1987; Ismail, 2008). Consequently, based on such traits, men are considered breadwinners and women homemakers (Diekman & Goodfriend, 2006) and this is being dictated in the clear division of men and women in STEM employment specifically engineering.

Scenario of Women in the Engineering Field Worldwide

Engineering career in many countries has been viewed as one of the highly paid jobs. Financially, the starting salaries are among the best across all industry sectors. Engineering may not be the easiest course to study, but it continues to be in demand globally. For instance, in Malaysia, the demands for engineers will continue to soar as the country is aspiring to achieve the target of a developed status nation by 2020. Furthermore, a lot of public and private education institutions in the country are offering engineering courses to students who are interested to further study in that field. In addition, engineering is a broad term that covers a wide range of industrial applications. It is also a major domain in the areas of STEM. Combining mathematics, science and technology, engineers produce creative solutions to real world problems. They use their expertise in math and science to solve technical problems. There are now six major branches of engineering that are mechanical, chemical, civil, electrical, management, and geotechnical, and literally hundreds of different subcategories of engineering under each branch (Board of Engineers Malaysia or BEM, 2017).

With rapid changes in technology, engineering is one of the preferred career disciplines in developing countries (Sulaiman et al., 2015) and in developed countries (Burke and Mattis, 2007). This career requires its engineers to be competent in matters involving field work, calculation and design. Typically, this career requires high endurance in mental and physical (Kamro, 2012). Moreover, the image of engineering has been framed as heavy, dirty and involving machinery and also seen as a masculine profession by both men and women since long ago. However, thanks to the innovation in digital technologies which has "softened" the field lately, and has attracted more women to involve in this field (Ismail, 2003; Major et al., 2007).

Women's involvement in engineering fields has been increasing despite at a lower rate compared to men. This shows that women are very competitive and cannot be taken lightly in terms of their pursuit in the various fields of STEM. In the US, only about a quarter of workers in STEM are

women in 2011 and men are employed in a STEM occupation at twice the rate of women, which is 31% versus just 15% for women (Fingleton et al., 2014). Research by Hamdan (2013) showed that until 2005, the percentage of women who have registered with the Board of Engineers Malaysia is only 2.7%, meanwhile men is 97%. According to Buse, Hill and Benson (2017), women engineers in the US is only 12% compared to higher percentage of men in 2015. Women account for about 19% of all bachelor's degrees in engineering earned in the US in a given year, as reported by the American Society for Engineering Education (Society of Women Engineers, 2016). This is really concerning despite the number of enrolment of women in engineering course in university is higher than men but lower in career phase.

Table 1 shows the number of registered professionals by gender in Malaysia, which is adapted from Malaysian Statistics on Women, Family and Community (2016) as an example. These data clearly indicate that the percentage of female graduate engineers in 2016 has increased to 25% compared to the previous year. Meanwhile enrolment for professional women engineers in 2016 was increasing from the previous year by 0.4%. In an era of growing engineering enrolments, these data represent relatively important increases in the numbers of female engineering graduates. Still, women continue to be a minority in engineering careers, and the progress, while real, has been extremely slow. The gap percentage between male and female engineers is still large. A research by Fernando (2011) in Australia cited that there is gender imbalance in the engineering industry. It means that despite the increased participation of women in university, there is still gender gap in the labour force. This is again reflecting the reality of the leaky pipe syndrome as advocated by Zywno et al. (1999).

Although engineering is a very well-paid profession, many Americans, particularly minorities and women, are not choosing engineering as a profession (Charity-Leeke, 2012). In Japan and the Republic of Korea, women represent just 5% and 10% of the countries' engineers, respectively. In addition, these two countries have the widest gaps in wage between men and women professionals among the member countries of the Organization for Economic Cooperation and Development (OECD), namely 29% for Japan and 39% for the Republic of Korea (UNESCO, 2017).

Table 1: Number of Registered Professionals by Gender: An Example in a Developing Country, Malaysia (2015 – 2016)

Profession	*2015*				*2016*			
	Total	Male	Female	Female (% of total)	Total	Male	Female	Female (% of total)
Accountants	31,395	15,252	16,143	51.4	32,361	15,536	16,825	52.0
Professional Architects	1,891	1,549	342	18.1	1,926	1,549	377	19.6
Architects	1,923	1,245	678	35.3	2,045	1,280	765	37.4
Professional Engineers	16,746	15,869	877	5.2	17,403	16,434	969	5.6
Graduate Engineers	85,417	64,905	20,512	24.0	92,040	69,020	23,020	25.0
Dentists	6,054	2,044	4,010	66.2	6,676	2,219	4,457	66.8
Medical Doctors	36,042	18,574	17,468	48.5	-	-	-	-
Veterinary Surgeons	2,083	1,163	920	44.2	3,593	2,351	1,242	34.6
Land Surveyors	453	446	7	1.5	452	445	7	1.5
Quantity Surveyors	2,508	1,394	1,114	44.4	1,353	954	399	29.5
Lawyers	16,537	7,986	8,551	51.7	17,237	8,283	8,954	51.9
O & G	643	396	247	38.4	705	428	277	39.3
Psychiatrist	158	91	67	42.4	168	97	71	42.3

Note: - Adapted from Malaysian Statistics on Women, Family and Community. (2016). Retrieved from https://www.kpwkm.gov.my/kpwkm/uploads/files/Publication/StatisticsBook/Statistics2016.pdf

- The shaded rows are two areas of concern about the field of engineering.

Perceptions on Women in Engineering

Much research has been carried out on reasons for under-representation of women in the non-traditional careers. However, one of the knowledge gaps about women in engineering is how women and society view the involvement of women in this field (Blaisdell, 2006). Historically, women were not encouraged to pursue this field as it is dangerous and considered rigorous. Previously, girls who are interested in science are encouraged to pursue home economic rather than engineering meanwhile boys are geared toward engineering, which they started with familiarization using technical toys (Bix, 2002; Charity-Leeke, 2012). Even women who work in the engineering sector believe that engineering is seen as a 'male career' which associated with cars, construction, and heavy machinery (Atkins, 2013).

A research by Zula (2014) revealed that women have challenges in the engineering field that include sex-role socialization, discrimination and harassment, transportation and childcare issues, the workplace may be hazardous, which requires special equipment or gear, extreme weather conditions, and the potential job related injuries. Other studies by Balamuralithara, Foon & Azman (2015) and Blaisdell (2006) claim that society rates engineering consistently masculine and difficult, and women are not suitable to be in the field. The statement also agreed by Mahajan and Golahit (2017), which they stated that engineering is viewed in the public sphere as masculine, competitive, objective, impersonal qualities that are at odds with the images of what women are and because engineering is a traditionally male-dominated field, women may be less confident about their abilities, even when performing equally. This is called the stereotypical threat on women leading to their perceived lower status to engineering and technology occupations compared with, for example, health and social sciences (Myers, 2010).

In Palestine, it has been observed that the directors of contracting companies hesitate to hire women engineers in their companies owing to the reasons as they perceive women engineers cannot endure hard work as men, women engineers might have to take maternity leave for certain period of time leading to delay in their projects, lack of qualified women engineers and women engineers indecisive to introduce themselves directly to contracting firms owing to culture boundaries (Enshassi, Ihsen, & Al Hallaq, 2008). Women in the Gulf countries are already participating in engineering and computing in a variety of ways, and they should be empowered to support each other, to support the next generation of female engineers, and to accelerate the growth of the burgeoning and diversifying STEM enterprises in the region (DeBoer & Ater Kranov, 2017). However, similar performance in terms of trends and opportunities are found in relation to gender imbalance due to socio-cultural reasons.

A research by Corbett and Hill (2015) claims that women are more likely than men to prioritize helping and working with other people over other career goals. Typically, women seem to feel that engineering is not fulfilling that priorities not knowing that engineering also given the opportunity to help and work for people. Engineering is rather viewed by women as unsocial occupations that offer few opportunities for social contribution, especially in IT engineering (Major et al., 2007). Meanwhile according to Silim and Crosse (2014), despite the fact that career in medicine also requires science A-levels, yet it is perceived as a 'normal' or desirable choice for women, because it is seen as a caring or nurturing profession consistent with prevailing attitudes about women, resulting women outnumber men at medical schools.

Barriers faced by Women Engineers

Women who worked with greater numbers of women individuals in their work groups or departments were less likely than others to perceive barriers to career advancement. This is unlikely to happen to those women who worked with men-majority like engineering field. The women need to face a lot of challenges in order to survive and success in this field. Foust-Cummings, Sabattini and Carter (2008) claimed that women in technology often faced with barriers like a lack of role models similar to themselves, not having a mentor, sponsor, or champion to make accomplishments known, and being excluded from important networks of decision-makers. These barriers are happening because the number of women in the non-traditional career are already few than men, so women received not enough support and mentoring from women superiors to pursue in this field. Majority of the women do not believe in themselves that they can

afford to succeed in this male-dominant career. Moreover, a lower participation rate of women such as in construction are because there are several major barriers which are the image of the industry, culture and working environment, family commitments, male-dominated training course, and recruitment practices (Elvitigala et al., 2006). Women entering the field are expected to fit into that career patterns, which they tend to be working full-time, involve a life time commitment and require employees to focus on that career only.

Researchers are mostly agreed that the major barrier faced by women engineers is family commitment (Mishkin et al., 2016; Ismail, 2003; Christie et al., 2017). While men and women both need to balance the demands of work and home life, women still bear the primary responsibility for domestic duties in most households (Higgins et al., 2000; Ismail & Mohd Rasdi, 2006). Engineering field is usually subject to changing work locations. This can involve travelling substantial distances or long periods away from home. This situation can present serious difficulties in terms of transport and child-care to the women. In addition, women engineers face higher work-family conflict as women continue to do more of the household and child care work than men do (Ahmad, 2007), despite gains made in the last decades. Because women are more likely to take part-time employment, sick days, and family leave, they are slower to be promoted to positions of power.

Methodology

This article is based on a comprehensive literature review method. The analysis is based on insights from 75 sources of literature that include journals articles, books, book chapters, and website documents. Several databases were used to obtain the online sources such as Google Scholar, Sage Journals, Emeralds, JURN and Science Direct. The relevant sources consisting studies on women in engineering professions were conducted globally including Malaysia. The sources also contain secondary data on women's participation in various science-related occupations. This exercise used constant comparative analysis and thematic insights were obtained that become the results of this study. This literature review article is important because it enhances knowledge on perception of women engineers on engineering as their non-traditional career. It further triggers insight on what takes to be a successful woman engineer in the current era of industrialization worldwide.

Results and Discussion

Based on the literature reviews, major thematic insights of women in engineering as a field of profession are given next. The thematic insights also include barriers that women engineers faced.

i) Women can build a successful career in engineering

Globally, majority of women who are involved in engineering field believed that being in this field it can build a successful career for women in future. UNESCO (2017) found that Emirati female engineering students have said that they are attracted to a career in engineering for reasons of financial independence, the high social status associated with this field, the opportunity to engage in creative and challenging projects and the wide range of career opportunities. This is supported by Atkins (2013) who found that 98% of female engineers in Britain think that their job is rewarding, and 84% say their job makes them happy or extremely happy. Specifically, 70% said that they believe being a woman made no difference to their prospects when they applied for a job and 17% even said their gender was an advantage. Tunnicliffe (2013) is of the same opinion that four in five female engineers surveyed say that the most satisfying aspect of being an engineer is seeing the

successful completion of a project on, which they have worked. Gender can be an advantage to the women as only few of them who participate in the field. This concurs with the opinion of Hansen (2016) in which one of the advantages of the non-traditional career. This means that women engineers are optimistic about their profession as many countries nowadays have various affirmative actions and gender-sensitive policies to support women in the engineering fields.

ii) Engineering field provides good salary

The engineers are to be considered as salaried professionals where they are employees with ambition, autonomy, authority, career expectations, fringe benefits and a certain security (Evetts, 1996). There is no doubt that this non-traditional career for women offers handsomely pay than traditional career because mostly the job is vigorous and people who work in that field are technical experts. Hansen (2016) supports the opinion that women who venture into a non-traditional career such as engineering enjoy a high salary compared to other women-dominated careers such as teaching and administration. Similarly, McKay (2017) in her article, *Non-Traditional Careers for Women* asserted that non-traditional career such as engineering offers a higher payment to women as they advance in their careers. This is owing to the fact that this career is challenging and need specific technical knowledge.

Tunnicliffe (2013) further cited that a survey of female chemical engineers finds that 98% of them think that engineering is a rewarding job. She added with 83% of engineering graduates in paid work, the discipline is second only to medicine. In the United Kingdom, the average annual salary for a chemical engineer six months after graduation is £28,992 (or RM159,456.00, in which £1 = RM5.5), second only to dentistry and 35% higher than the average starting salary of a graduate. In Malaysia, according to a website named Glassdoor.com (2017) where it is a website for job-seeker to find potential job in the country stated that the average annual salary for an engineer is RM50,000. These salary estimates are based on 1,777 salaries submitted anonymously to Glassdoor by engineer employees in Malaysia. The starting salary itself is very tempting for women graduate engineers to join the field.

iii) Women engineers face tough competition with men engineers

Being in a workplace of men-majority, it is no doubt that women engineers faced tough competition with men. Women who seek entry into male-dominated cultures either have to act like men in order to be successful (Wajcman, 1998), leave if they are not adaptable to the culture, or remain in the industry while maintaining unimportant positions (Walby, 1990; Powell, Bagilhole & Dainty, 2008; Mohammaden, 2013). Fernando (2011) cited that women engineers are smart people, but they still have to put in more time, deliver better quality to earn the status, reputation or appreciation a man gets by doing less. In other words, women engineers tend to feel that they have obstacles to getting ahead in the workplace.

Gutknecht (2016) stated that women feel less respected in male-dominated workforce. She claimed that it is going to take a lot of strength from current and future female engineers to equalize the gap in a field dominated by the opposite gender. Hansen (2016) further asserts

that women in non-traditional careers such engineering face the burden of heavy competition with men in terms of promotion and recognition.

iv) Consistent gender bias and stereotype threats

Gender stereotypes are categorical beliefs regarding the traits and behavioural characteristics recognized to individuals based on their gender. Eagly and Carli (2007) provide a thorough literature review and conclude that biases do exist and are a particularly difficult obstacle. Bias will impact women's career choice, self-esteem, and self-efficacy, which lead to stereotype threat (Buse, Hill & Benson, 2017). Combination of stereotype threats and values caused women to report that they do not feel as if they belong to the field of engineering (Mohammadi, 2017). UNESCO (2017) reported that Arabian women have to face family bias against working in mixed-gender environments after graduated. This situation makes it difficult for them to choose engineering as a career. Engineering continues to be perceived as "masculine," so young women do not see it as a viable option for themselves. Sagebiel (2003) added that the atmosphere of dominant masculinity is the reason that women are driven away from technology, rather than because of lack of ability. Corbett and Hill (2015) further cited that biases continue to affect women once they move into the workplace. From hiring decisions to project assignments and to promotions, the findings reveal that female engineers are likely to be evaluated as less competent, less hireable, and less valuable than identically qualified male counterparts. The authors also found that there is discrimination in hiring an employee between male and female engineers where no matter what type of information employers had about applicants, employers' bad hiring decisions usually favoured a low-performing male candidate over a high-performing female candidate. Frequently, these biases will lead employers to hire the less capable male candidates.

v) Women over forty years old are not appropriate for work in engineering field as men in the same age

Lee (2006) found that the biggest obstacle for the aged between 31 to 40 women engineers was time management, specifically, that of balancing the demands of family against those of career ultimately having no time for themselves. Her respondents between the ages of 41 to 50 cited discrimination, primarily gender-based, as their biggest obstacle, some citing age discrimination as their career issue.

The Society of Women Engineers (SWE) in the United States recently reported that one in four women who enter engineering have left the profession after the age 30, compared to one in ten male engineers. Meanwhile, Older Women's League (OWL) (2012) stated that mature women face a number of challenges re-entering the workforce, or continuing to work as they reach age 50 and beyond. One of the biggest hurdles is age discrimination, based on stereotypes and myths about the limitations of older workers. Women face age discrimination earlier in life than men do, and the combination of age, gender discrimination and stereotype threat is particularly difficult for women to overcome.

vi) Women engineers are bound with family commitment

Mishkin et al. (2016) reported that traditionally, a woman's role in society has been defined by husband's career, bearing and raising children, and caring for elderly family members;

as such women are traditionally regarded as primary care-givers. This perception is still strongly held by the society. Women with socio-cultural background, which women are expected to perform duties as wife and mother might struggle in this field and lead to leaving the career. According to Brown and Barbosa (2001) and Ismail (2003) women saw childcare as a potential barrier to their career success. In addition, Galloway (2004) has found out that engineering career is incompatible for women with families due to the nature of the engineering profession, which are often pressing and demanding and they need to allocate more time for their career than family especially those who are involved in project-to-project tasks.

Meanwhile, participants in Christie et al. (2017) research claimed that as STEM is male-dominated industry, women have to think what happens when they have kids in the future. Questions arise such as: Are companies going to be flexible enough for women to raise a family or are women just going to end up with no kids when they are older? Women felt that if they get into an industry dominated by males it would be harder for them to get a job as well because men have less commitments to the family than a woman does.

Other than that, Balamuralithara, Foon & Azman (2015) in their research found that women engineers in both Japan and Malaysia tend to leave the engineering field after they have children. In a research conducted by Fernando (2011), a question asked that if there was (will be) a time in the respondents' engineering career when they had (will have) to choose between family and career? 74% of the respondents agreed to choose family. This may imply that majority women are thinking on leaving engineering career after they are married or having children because the desire to prioritise family. For unmarried women, they find no difficulties to fulfil the career demand as they have no responsibilities as a wife or a mother. To respond to this, a research by Charity-Leeke (2012) therefore suggested that engineering companies should provide family-friendly policies, in which the policies are likely able to retain women engineers from leaving the engineering career. Somehow it is not the same as the married women where they will have problem to adapt with both work and family, which somehow this problem is less felt by men.

vii) Women engineers subjected to sexual harassment in the workplace

Women face sexual harassment in the workplace where women are exposed to unwelcome hints and sexual comments, demands for sexual favours and, in the most extreme cases, rape, at the hands of their supervisors and co-workers (Johnson, 1999). Based on concept of gender relations, this is related to power relation as men are considered physically stronger than women (Connell, 2002). In relation to this, Sherbin (2008) in her research stated that 63% of female respondents said that they had experienced behaviour in the job that they described as sexual harassment. Furthermore, many of these women were the only female workers in the department or being the minority. It is not surprising when women quit the job looking for a greener pasture.

Hansen (2016) also stated non-traditional career is exposed to the potential adversity from co-workers such as sexual harassment. It is owing to a situation where women are surrounded by majority of men in the workplace and become an easy target for men as women are seen weak. This might be one of the reasons for women to leave the industry because of the anticipated psychological and physical impact on them from the co-workers.

viii) Glass ceiling effect faced by women engineers

"Glass ceiling" is a metaphor for the hard-to-see informal barrier that keeps women from getting promotions, pay raises and further opportunities. It is glass because it is not usually a visible barrier, and a woman may not be aware of its existence until she "hits" the barrier (Lewis, 2015). According to Baxter and Wright (2000) the concept of a glass ceiling is generally viewed as a set of impediments and/or barriers to career advancement for women and minority people.

Women engineers are difficult to be promoted up to levels of authority hierarchies within workplaces as Babcock and Laschever (2003) stated that women are not expected to be aggressive or to be too demanding. This means that women often lose out in situations where men would negotiate higher salary, start-up packages, bonuses, or other incentives. Women also feel that there are insufficient supporting systems for them to move upwards in this field. It was noted that women were more likely to leave non-traditional careers than men because of fewer resources and lack of social support. The lack of superior mentors that can motivate and help women in this field leads to less chances for women to go higher in the job hierarchy.

Conclusion

Overall, the literature findings conclude that engineering industry is a patriarchal (male-dominant) workplace environment, where women engineers feel that their existence is not necessary as compared to men. Engineering fields are using the symbolic of masculinity to express that women are less belonged to the sector. It was highlighted that the most obvious effects of patriarchal work culture are the discriminatory practices that in turn undermine, devalue and subordinate women's contributions to the field.

Women entering the labour market are expected to fit into a career patterns, which according to Driver (1994) they tend to be full time, involve a linear life time commitment, seek an ordered vertical progression and require employees to exhibit a high degree of career focus. This concludes to the very nature of male's standards in employment. Specifically, organizations do manipulate indirectly the involvement of women in the company through recruitment (control over the types of people that gain entry to organization), promotion and demotions (control over who reaches positions of influence within the organization, which is related to the concept of glass ceiling), induction and socialization (a strong influence over the social dynamics within the organization) and reward appraisal systems.

Another conclusion is the presence of job insecurity where women engineers think that they are in the field which is not secured because of gender bias and stereotype threats towards them. Practically, it is extremely important for organisations to identify ways that can enhance employees' assurance of their job security. It is true that the management should also consider reviewing and readjusting the salary structure within the organization and ensuring that employees are being paid according to skills and experience they possessed. There is strong suggestion for the creation and adoption of gender-sensitive policies in both government and private companies (Ahmad, 2007), in which the minority women professionals such as women engineers would be protected in relation to their career well-being. For some successful women engineers they have to sacrifice their family life, and to some they have to forgo this exciting career concentrating on family. Hence, through the various gender-sensitive policies in the forms of work arrangements,

family care benefits, and child care facilities (Ahmad, 2007) women would not consider engineering as a precarious field for them to develop their career.

Implication to Theory and Practice in HRD

There are strong literature evidences that the under-representation of women in engineering is supported by the Social Role Theory leading to gender division of labour, and engineering indeed a non-traditional career for women. This scenario relates to how society views women's participation and contributions to the field. The theory strongly assumes that gender roles reflect a society's distributions of men and women into breadwinner and homemaker roles. Roles of a women are still perceived appropriate in the domestic work and although women are employed, they have lower wages or receive less other job benefits than men. Women are also described as less powered, and with lower status in relation to men. Women are more vulnerable and often expect help from others who are stronger, especially from men.

Many women still consider engineering a 'man's job', and it is associated with a workplace culture that may put off potential female workers. These attitudes pose real challenges when attempting to correct the gender imbalances in employment sector. Better training for education providers and teachers would help to break down the stereotype threats. We need to be enthusiastic in our interaction with school students, showing them what it is possible to achieve and that they can do it too. However, it is also very important to reach out to the teachers and show them how satisfying and realistic engineering careers can be for girls so that they nurture and encourage the talent when they spot it early in their life. Raising the proportion of female engineers may have its own snowball effect. As more and more girls decide to study engineering and go on to have a fulfilling career in engineering, then more and more friends, cousins, sisters and daughters of these women will follow in their footsteps, and the stereotype that engineering is just for boys will gradually fade out of existence. Much still needs to be done to change the negative perceptions that discourage women from becoming engineers.

It is therefore recommended for the management and organization to give opportunity to women engineers to voice up and to be heard their opinion; as well as their talents and contributions be valued by their colleagues, supervisors and employers in the engineering field in order women feel they are welcomed, equal and assimilated. Moreover, flexible work hours and family-friendly policies at workplaces are necessary to be enforced in organizations to retain working mothers in the engineering industry. Hence, this will make engineering more lively and dynamics that support principle of diversity, which is in line with the inclusiveness model in many countries such as the tripartite goals of New Economic Model of Malaysia, as well as the equal opportunity goals as found in the UK. These recommendations for action attempt to challenge misconceptions and ignorance about the reality of engineering career in relation to gender.

This piece of research is not without its limitations. As it is a literature review-based article, future research on the same focus is recommended to involve women respondents from different engineering industries in developing and developed countries. These empirical evidences are necessary to validate the thematic insights generated from this study based on specific engineering contexts. Future study that involves men engineers as the research subject is also crucial, as the evidences are truly obtained from both genders, instead of women only respondents. The approaches suggested for future research are survey research that entirely dependent on questionnaire, focus group discussion involving a group of women engineers including those who are in the chief executive positions in organizations as well as men engineers.

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To cite this article:
Ismail, M., Zulkifli, N., Hamzah, S.R. (2017). Insights on Engineering as a Non-Traditional Career Field for Women. *Global Business and Management Research: An International Journal*, 9(4), 17-36.