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NON-TECHNICAL SKILLS FOR ENGINEERS IN THE 21ST CENTURY: A BASIS FOR DEVELOPING A GUIDELINE

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ABBREVIATIONS	TERMS
9MP	Ninth Malaysia Plan
AMCHAM	The American Malaysian Chambers of Commerce
ICAO	International Civil Aviation Organization
ICT	Information and communication technology
FDI	Foreign direct investment
FMM	Federation of Malaysian Manufacturers
GDP	Gross domestic product
IMP1	The First Industrial Master Plan
IMP2	The Second Industrial Master Plan
IMP3	The Third Industrial Master Plan
MEF	Malaysian Employers Federation
MTEN	National Economic Action Council
NCEQW	National Center on the Educational Quality of the Workforce
NST	New Straits Times
PIC	Pilot in Command
PICS	Productivity and Investment Climate Survey
SCANS	Secretary's Commission on Achieving Necessary Skills
SMI	Small Medium Industry

ABSTRACT

This study aims to determine the non-technical skills: functional and adaptive skills required by entry-level engineers in the manufacturing industry. These skills are divided into seven categories i.e. four functional skills categories (communication, creative thinking and problem solving, information management, leadership and organizational skills) and three adaptive skills categories (group effectiveness and teamwork, work-related dispositions and attitudes and personal traits and self-management). A total of 162 manufacturing firms participated in this study. Questionnaire was the main instrument used while interviews were used to provide an insight into non-technical skills required by entry-level engineers. This study found that non-technical skills are important for entry-level engineers in the manufacturing industry. Analysis of the functional skills found that the ability to follow procedure is the most important followed by the abilities to listen (listening), meet deadlines, manage time (time management) and work to schedule. As for adaptive skills, a majority of the respondents selected the following indicators: responsible, commitment, self-confidence, discipline, committed to the job and willingness to learn as the most valued traits. The findings of this study can be used as a basis for developing a guideline for non-technical skills to be included in the engineering curriculum. It is recommended that the current engineering curriculum at institutions of higher learning enhance both functional and adaptive non-technical skills. In addition, university-industry collaboration should be enhanced to address the skills gap of engineering graduates and the skills requirements of the manufacturing industry.

ABSTRAK

Matlamat kajian ini adalah untuk mengenal pasti kemahiran bukan teknikal: kemahiran fungsian dan kemahiran penyesuaian yang diperlukan oleh jurutera baru dalam industri pembuatan. Kemahiran tersebut dibahagikan kepada tujuh kategori i.e. empat kategori mewakili kemahiran fungsian (kemahiran komunikasi, pemikiran kreatif dan penyelesaian masalah, pengurusan maklumat, kepimpinan dan pengorganisasian) dan tiga kategori mewakili kemahiran penyesuaian (keberkesanan kumpulan dan kerja berkumpulan, disposisi berkaitan pekerjaan dan sikap serta ciri peribadi dan pengurusan diri). Sejumlah 162 firma pembuatan telah mengambil bahagian dalam kajian ini. Soal selidik merupakan instrumen utama yang digunakan sementara temubual digunakan untuk memberikan kefahaman tentang kemahiran bukan teknikal di kalangan jurutera baru. Kajian ini mendapati bahawa kemahiran bukan teknikal adalah penting bagi jurutera baru di dalam industri pembuatan. Analisis terhadap kemahiran fungsian mendapati bahawa keupayaan mematuhi prosedur adalah paling penting diikuti oleh keupayaan mendengar, menepati ketetapan tarikh, mengurus masa (pengurusan masa), dan bekerja mengikut jadual. Bagi kemahiran penyesuaian pula, majoriti responden memillih indikator berikut: bertanggungjawab, komitmen, keyakinan diri, disiplin, komited terhadap tugas dan kesanggupan untuk belajar sebagai ciri-ciri yang paling dihargai. Dapatan kajian ini boleh dijadikan sebagai asas bagi membangunkan satu garis panduan bagi kemahiran bukan teknikal untuk dimasukkan ke dalam kurikulum kejuruteraan. Adalah juga disyorkan agar kurikulum kejuruteraan sedia ada di institusi pengajian tinggi sepatutnya memperkukuhkan kedua-dua kemahiran bukan teknikal fungsian dan penyesuaian. Selanjutnya kolaborasi universiti-industri seharusnya dipertingkatkan bagi menangani masalah jurang kemahiran antara graduan bidang kejuruteraan dengan kemahiran yang diperlukan oleh industri pembuatan.

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Zubaidah Awang (Project Leader)
Hafilah Zainal Abidin
Md. Razib Arshad
Hadina Habil

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CHAPTER 1

INTRODUCTION

1.0 Introduction

Engineers play an important role in a nation's development. In the new millennium, engineers have to face new challenges, which require more than just technical skills. They are expected to be more versatile and possess essential non-technical skills as their work scope will require them to deal with professionals in various disciplines (Inman, 2006).

The National Economic Action Council (MTEN) predicts that Malaysia needs 210,000 engineers by the year 2010 (Abang Abdullah Abang Ali, 2004a). In the year 2005, it was reported that engineering graduates (Electric/Electronic and Telecommunication; Mechanical/Mechatronic and Civil) made up approximately 15% of the total unemployed graduates in Malaysia (The Sun, July 4, 2006). The high unemployment rate among engineering graduates reflects a skills mismatch between the graduates produced by institutions of higher learning and the requirements of industry.

In addressing this issue of skills mismatch, the Malaysian government is continuously reviewing the education system to meet the current and future needs of the

country's economy. The problem of skills mismatch is due to the lack of coordination between industry projections of their human resource requirements and planning on the part of education and training providers (Fong Chan Onn, 2004).

1.1 Background of the Study

Malaysia's industrialization is guided by the Industrial Master Plans (IMP). On 18 August 2006, the Malaysian government launched the third Industrial Master Plan (IMP3), a 15-year plan, towards realizing the vision of becoming a fully developed nation by the year 2020. Prior to this, there were the IMP1 and IMP2 each covering a 10-year period.

The third Industrial Master Plan (IMP3), maintains that the manufacturing sector will remain an important contributor towards the Malaysian economy alongside the service sector. In 2005 the manufacturing sector contributed 31.4% of the gross domestic product (GDP), and 80.5% of total export. This sector also recorded a growth rate of 4.9% during the same year. Despite a decline in economic growth which has affected the region since the 1997 economic crisis, the manufacturing sector is expected to grow at 5.6% annually and contribute 28.5% of the GDP in 2020. Therefore, the manufacturing sector has played and will continue to play a major role in creating job opportunities in the country. For example, in the year 2000, the manufacturing sector contributed 31.9% of employment and this is expected to increase to 32.4% by the end of 2010.

The manufacturing industry in Malaysia is experiencing a changing trend from an industry relying on cheap and relatively less-skilled labour towards knowledge-based activities. Due to the shifting of investment and operation particularly foreign direct investment (FDI) to more cost-effective economies (such as Vietnam, China and Cambodia), Malaysia can no longer rely on labour intensive industries to remain competitive. The new requirement creates a gap in the quality of graduates produced by institutions of higher learning and those required by industries. Thus, institutions of higher learning must address this issue to produce knowledgeable human capital needed by the manufacturing sector as Malaysia moves towards a more knowledge-based economy.

1.1.1 Human Capital: The role of Institutions of Higher Learning in preparing engineering graduates with employable skills.

Institutions of higher learning play an important role in developing and enhancing human capital for the manufacturing industry. One of the ways to achieve this is for institutions of higher learning to reach out to industries to better understand their workforce requirements. This will enable institutions of higher learning to design new curriculum and redesign existing ones to be market-driven, for example, placing emphasis on creativity, innovation and other enabling skills. Such collaboration between institutions of higher learning and industries can ensure a supply of graduates, which match market requirements.

As Malaysia moves towards a more knowledge-based economy, the manufacturing sector seeks engineering graduates who are multi-skilled in engineering and other fields such as management, communication and business. According to Abd. Saman (2004), an engineer is "… a consultant in their respective area of expertise and a skilful manager who manages the implementation of the engineering related decision making process." As such, institutions of higher learning need to produce engineering graduates who are employable. These graduates should possess the "X-factor" i.e. the skills and competencies required by employers, which include both technical and non-technical skills.

For example, the advancement in information and communication technology (ICT), influences the speed of information exchanges and the way business transacts, which requires an engineer to master some basic computer skills to keep abreast with current trends. Hence prospective engineers should be geared towards a knowledge-based environment with emphasis on putting engineering principles into practice as well as emphasis on research and development in new technologies to adapt to new challenges ahead (Mah Soo, 2003).

In addition, non-technical skills are needed to accomplish various tasks and jobs. These skills, also known as soft skills according to Lange (2000), are not adequately addressed in institutions of higher learning. He further asserts that the advancement in technology and the social and economic changes have resulted in the workplace requiring

workers with a broad set of skills which include problem solving, listening, negotiation, communication, teamwork and positive work attitudes.

The human resource requirement outlined in the 9MP, asserts the need for Malaysia to develop human capital who are knowledgeable and highly skilled, flexible and creative as well as imbued with positive work ethics and spiritual values. Thus, there is an urgent need to examine the non-technical skills required by entry-level engineers in the manufacturing industry to ensure that engineering graduates are competitive to serve the industry.

1.1 Statement of the problem

The problem of skills mismatch requires Malaysia to have pragmatic engineering education and training programmes. According to Megat Johari et al. (2001), comprehensive training of engineers is necessary in preparing engineers who are capable of performing useful functions in the industry, and these include emphasis on communication, management and innovative thinking skills.

Arguably, engineering education and training is crucial in ensuring the sustainability of the supply of needed human capital by the manufacturing sector in this knowledge age. There is an urgent need to ensure that the future engineering workforce is appropriately educated, trained and developed to support Malaysia's vision to become

an industrialized nation. According to Abang Abdullah Abang Ali (2004b), countries aspiring to be competitive in the global market are revisiting their technical education and training policies and programmes to ensure that their technical workforce is able to keep up with new advances in knowledge and technology and able to compete in the global market. He further asserts that in order to secure Malaysia's future competitiveness, there must be continuous and concerted effort by the industry, government and academia to enhance Malaysia's skills base.

As the world moves towards a more globalised economy, the importance of innovation in addition to economic and infrastructural development as a driver of sustainable economic growth cannot be understated. Innovation which requires the involvement of engineers at various stages, increases competitiveness, which in turn leads to employment generation and wealth creation (Abang Abdullah Abang Ali, 2004a).

One of the challenges of a changing economy is the increasing importance on providing service. This means that the reliance on services requires employees such as engineers who not only have technical knowledge but also possess the soft skills i.e. people who can communicate effectively, and analyse and solve problems accordingly. Thus, the employability of the average Malaysian graduate is becoming more dependent on the mastery of these soft skills besides the technical skills. The growing number of unemployed graduates, according to the Executive Director of the Malaysian Employers

Federation (MEF), is mainly because many arrive in the job market poorly equipped with the skills required by a changing economy (The NST, March 20, 2005).

A 1999 survey of 115 public and private employers' perception on economic graduates showed that employers viewed personality as the most important criteria when hiring workers. This is followed by communication skills, being presentable, general knowledge and intelligence. Academic performance on the other hand, was ranked eighth out of the twelve criteria surveyed (Rahmah Ismail et al., 2001). In addition, a brief survey on employers by the MEF in 2002 supported this finding and discovered that the employability of graduates was not based merely on academic performance but also based on soft skills.

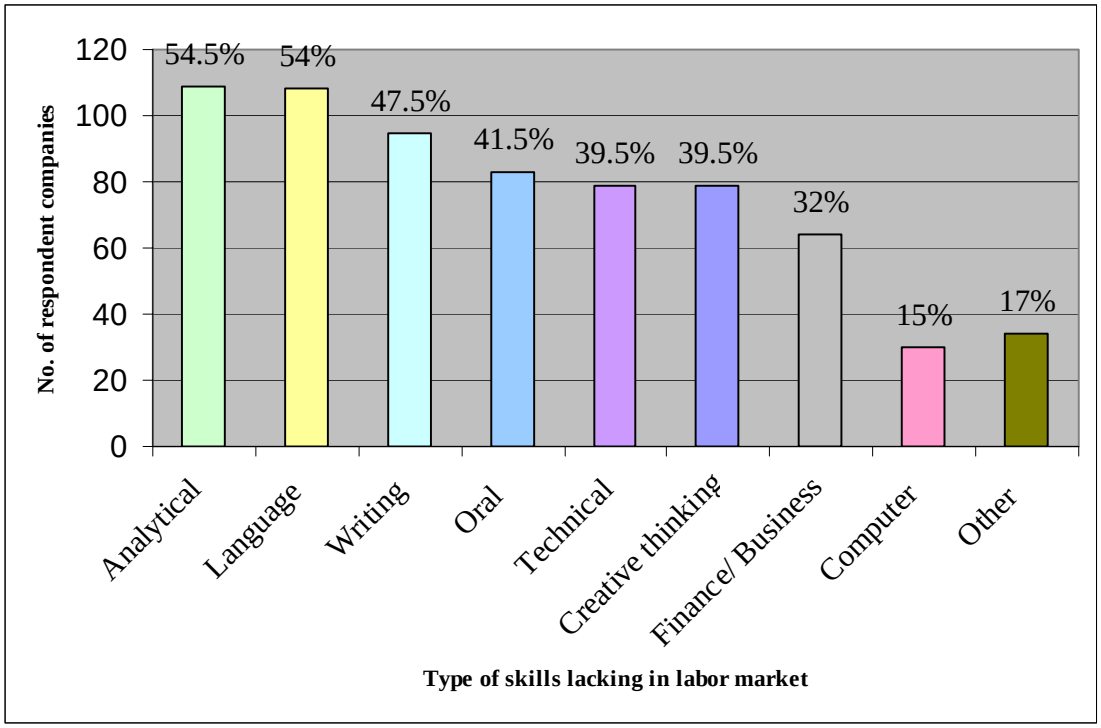
Another survey by the Productivity and Investment Climate Survey (http://bond.npc.org.my) found that most skilled workers lacked the following skills (listed in the order of importance): English language proficiency, Information and Technology skills, Communication Skills, Technical and Professional Skills. Employers surveyed were extremely concerned with the quality of the Malaysian educated professionals. 29 % of the managers perceived foreign trained professionals as better performers than those who were locally trained. This indicates that there might be a gap in the Malaysian education or training systems. The American Malaysian Chamber of Commerce (http://bond.npc.org.my) also found that one of the challenges faced by US firms in Malaysia was the rapid decline in English language skills, as well as lack of creative and innovative thinking skills among engineering graduates.

A Bank Negara survey in 2002 (http://bond.npc.org.my) also indicated a wide disparity in the command of basic skills between local graduates and foreign graduates such as in communication skills, spoken and written English skills, action initiating skills, technical knowledge and problem solving skills. The most widely reported skills gap pertained to both communication skills and English language oral skills, where 90.4% of the respondents indicated that local graduates lacked these skills while only 25.7 % of the respondents indicated that foreign graduates lacked these skills. 75.4 % of the respondents indicated that local graduates displayed poor English language and writing skills, whereas only 18.7 % of the respondents indicated that foreign graduates were lacking in these skills.

Looking at the trend around the world, global competition has increased demands for technical, scientific, research, problem solving and thinking skills. The SCANS Report on America in 2000 entitled “What work requires of schools”, defines that knowledge and skills are judged to be the most useful for the workplace. The report identified five competencies and a three-part foundation of skills and personal qualities that are essential to the preparation of all fresh graduates. The five competencies are resources (identifies, organises, plans, and allocates resources); interpersonal (works with others); information (acquires and uses information); systems (understands complex interrelationships) and technology (works with a variety of technologies). These competencies are to be built on a three-part foundation of skills and attitudes. The three-part foundations are basic skills (reads, writes, performs, arithmetic and mathematical

operations, listens and speaks); thinking skills (thinks creatively, makes decisions, solves problems, visualizes, knows how to learn, and reasons) and personal qualities (displays responsibility, self-esteem, sociability, self-management, and integrity) Without this foundation, the five competencies are less likely to be achieved.

A 2003 MEF survey (http://bond.npc.org.my) on the skills lacking among executives in the private sector found that 44.0% of the respondent companies reported a mismatch between the skills / qualifications required and the current pool of skills / qualifications available in the job market. Figure 1.1 shows the type of skills lacking in executives as perceived by respondent companies. About 54.5% of the respondent companies found that executives lacked analytical skills followed by language skills (54.0%), writing skills (47.5%), oral skills (41.5%), technical skills (39.5%), creative thinking skills (39.5%), finance/ business skills (32.0%) and computer skills (15.0%).



Source: MEF

Figure 1.1: Types of Skills Lacking (Executive)

In the case of higher skilled jobs such as managers, engineers and professionals, the skills most frequently cited by respondent companies were lack of planning and organisation skills; problem solving and decision making skills; strategic thinking, innovation and leadership skills.

While these studies by Bank Negara Malaysia and MEF looked at the types of skills lacking among graduates and executives in companies in Malaysia, this study investigated the non-technical skills required by entry-level engineers in the manufacturing industry and the importance of these non-technical skills to the engineers in performing their jobs.

1.3 Objectives of the study

The specific objectives of the study were to:

1. identify the non-technical skills required by entry-level engineers in performing their tasks or responsibilities
2. determine the importance of non-technical skills for entry-level engineers working in the manufacturing industry
3. provide a basis to develop guideline of non-technical skills required by entry-level engineers in the manufacturing industry

1.4 Research questions

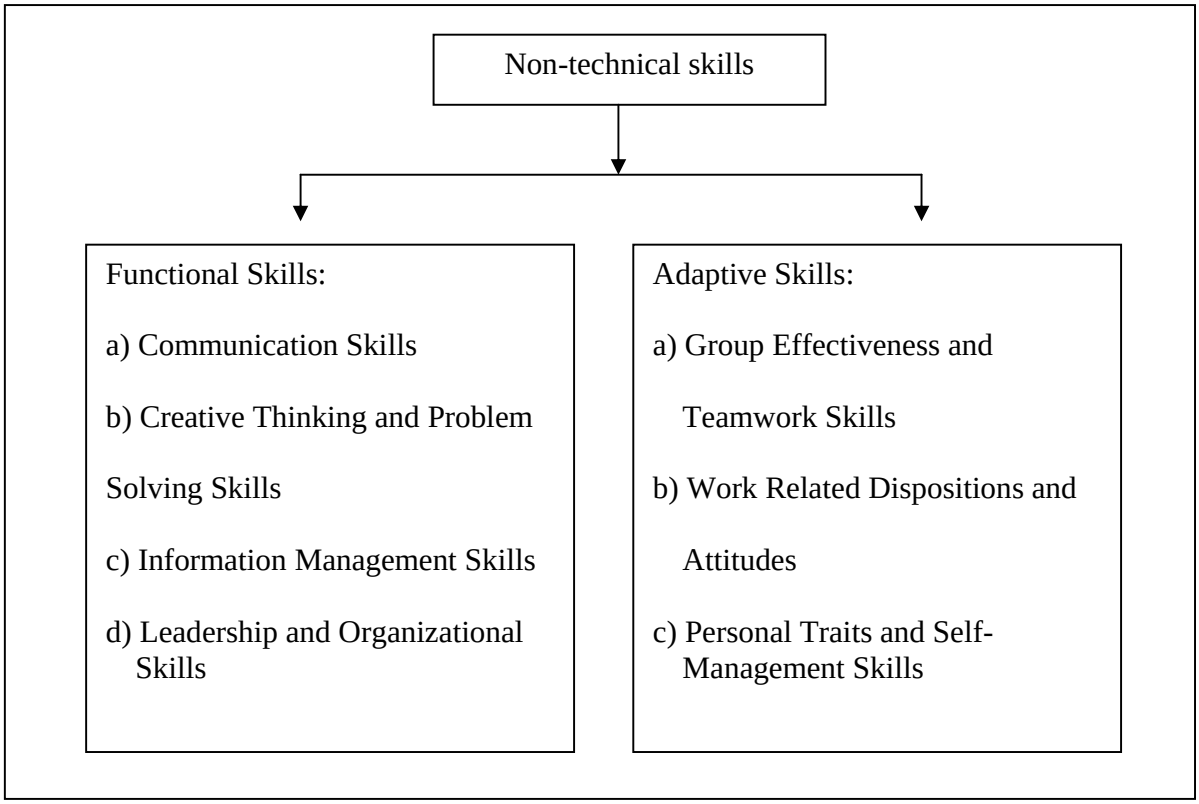
This study attempted to seek answers to the following questions:

1. What are the non-technical skills required by entry-level engineers in the manufacturing industry?
2. What non-technical skills are regarded important for entry-level engineers in the manufacturing industry?

1.5 Scope of study

This study was confined to an investigation of non-technical skills required by entry-level engineers in the manufacturing industry in performing their tasks. The non-technical skills were divided into functional skills and adaptive skills (Lange, 2000). Figure 1.2 illustrates the classification framework of non-technical skills used in this study.

Figure 1.2: Classification framework of non-technical skills



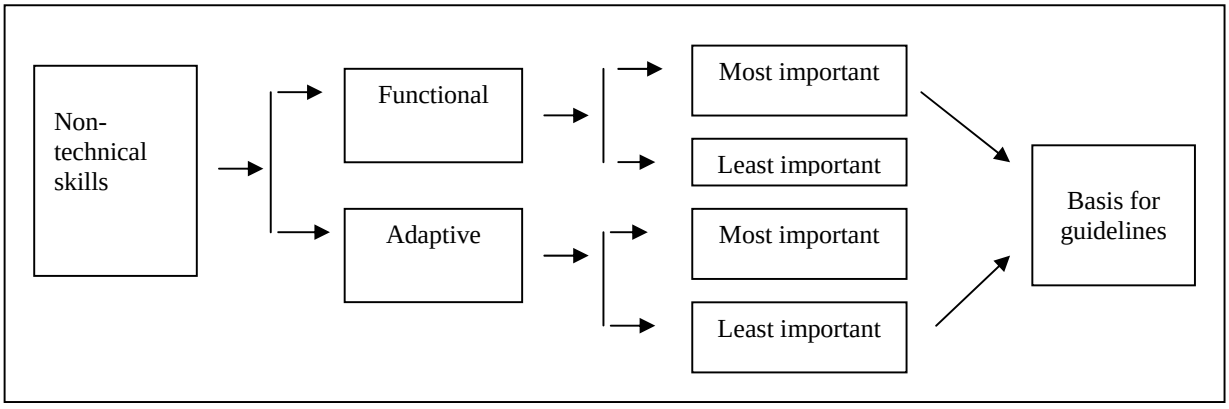
Based on this classification framework, functional skills are basic skills applied to tasks and are used to solve new problems. These skills go beyond one's training and past experience. Some examples of functional skills are questioning, analyzing, communicating and organizing. Adaptive skills, on the other hand, are skills that describe the manner in which employees conduct themselves and interact with the working environment, which include relations with people, organizations, and physical conditions (Murphy and Jenks, 1982).

The study was also limited to an investigation of the non-technical skills for engineers in the manufacturing firms listed in the Federation of Malaysian Manufacturers (FMM) Directory (2004), Small and Medium Industry (SMI) Business Directory (2004) and Bursa Malaysia (2004).

1.6 Framework of study

The framework used in this study is shown in Figure 1.3.

Figure 1.3: Framework of study



The framework depicts the types of information gathered and the flow of analysis of the study. The study identified the most and the least important items in the adaptive and functional skills. This information formed the basis for formulating a guideline on non-technical skills required by entry-level engineers in the manufacturing industry.

1.7 Significance of the study

The findings of this study would benefit the following stakeholders:

1. Ministry of Higher Education and institutions of higher learning
    - Will provide better understanding of the current skills needed by employers
    - Will provide a basis for designing new engineering curriculum and reviewing existing engineering programmes relevant to the needs of industry
2. Engineering graduates
    - Will provide an insight of the needs and expectations of the manufacturing industry.
3. Accreditation bodies such as Board of Engineers
    - Will provide ideas to review the criteria used by the Board in the accreditation process of engineering programs.

4. Employers
    - Will have an increased awareness of the need for them to play a more active role in providing input to institutions of higher learning towards producing human capital to the industry and to address the mismatched between their needs and what the education system produces.
5. Ministry of Education
    - Will provide a basis for a review of the school curriculum towards producing prospective students for institutions of higher learning who have the ability to think and express themselves.

1.8 Definition of terms

The following definitions are used in this study:

- Non-technical skills refer to general skills such as communication, negotiation, teamwork, problem solving, positive work attitudes and cooperation, which are not specific to any particular job position or workplace environment.

- Entry-level engineers refer to fresh engineering graduates who have been working for less than 3 years.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter presents related research on the changing needs of the employers, the definition of non-technical skills, the need for non-technical skills in engineering career, the challenges for higher learning institutions in providing skilled graduates and the importance of specific non-technical skills.

2.1 Changing needs of the employers

For the past two decades, there have been changes in the specific skills required to enter and succeed in the work environment. Employers have talked about the importance of new skills for employees to work more effectively. Among the skills that employers look for are: communication skills and ability to use general skills in the workplace. These include the ability to write, speak and calculate, the ability to work in groups and the ability to listen effectively. Employers are also looking for employees who are adaptable and flexible, have good work ethics, initiative and posses leadership skills. In short, these are essential skills in management, but today they are becoming

increasingly important across disciplines (Inman, 2006; Evers, Rush and Berdow, 1998; Alpern, 1999; Clagett, 1997; Stasz, Ramsey and Eden, 1995). These are some of the essential non-technical skills that create employees who have the ability to look at things from a broader perspective.

The need for non-technical skills is an important element in the era of globalization, liberation and technological change. These skills are required to help employees perform their tasks more effectively as globalization will result in an increase in demand for workers who possess these skills as well as additional skills such as public relations, negotiation and cognitive skills.

The increasing need for a skilled and knowledgeable work force is shown in the job classification in the United States. In 1959, jobs were classified as 20 percent professional, 20 percent skilled and 60 percent unskilled. However, in 1997, the scenario changed where 60 percent of jobs were classified as skilled jobs and only 20 percent unskilled (21st Century Skills for 21st Century Jobs, 1999).

Busse (1992) points out that as technology has become more instantaneously available, the skills of employees have become the employer's competitive edge. The workplace requires a new kind of worker with a broad set of skills, which include, among others, problem solving, listening, negotiating and communication. Busse further states that employers refer to these competencies as non-technical skills. Modern employers want entry-level employees to possess the correct combination of non-technical skills to

complement job specific skills, such as engineering or accounting skills (Busse, 1992; Wiggill, 1991; Lankard, 1990; and Young, 1986).

This changing needs of the industry poses a new challenge for employers to select the right candidate for a job. According to Alpern (1999) and Murnae and Levy (1999), a majority of employers faced difficulty in selecting candidates during the recruitment process since not many candidates met the criteria. This deficiency is not due to technical skills but in the complementary non-technical skills. Employers will usually select a candidate who exhibits both work knowledge and other more general knowledge and skills (Inman, 2006).

Stasz et al. (1996) believe that the skills gap identified by employers is more about work dispositions and attitudes rather than academic or technical skills. Changes in the workplace and the perceived skills gap have direct implications for the training of engineering students. It is essential in any vocationally oriented educational training that the skills acquired by students meet the requirements of employers as customers. It has become necessary for academic staff to continually compare what they believe to be important in the training of students with what employers believe is important, in order to eliminate any gap between what students learn at institutions of higher learning and what will be needed at the workplace (Wilson, 1987).

2.2 Definitions of non-technical skills

Non-technical skills according to Straub (1990) represent aspects common to all jobs, such as following instructions, communicating effectively, and cooperating with others in teamwork. Neal (1981) states that there are two broad categories of non-technical employment qualities or skills. The first category consists of behaviors such as arriving for work on time, following instructions, displaying social skills and conduct acceptable to others, and effective communication. The second category consists of attitude-related characteristics such as adaptability, self-confidence, persistence, ambition and helpfulness. Bryce (1993) writes that non-technical skills include communication, interpersonal and problem solving skills.

Non-technical skills, also known as generic skills or life skills can be divided into two categories: functional and adaptive (Munce, 1981). According to Lange (2000), functional skills are basic skills used to apply to tasks and to solve new problems and these can go beyond one's training and past experience. Some examples of the skills are communicating, questioning, analyzing and decision-making. On the other hand, adaptive skills are skills that describe the manner in which employees conduct themselves and interact with the working environment. Some examples of these skills include group effectiveness and teamwork skills and leadership and organizational skills.

According to Noor Azizi Ismail et al. (2001), non-technical skills comprise the ability to carry out specific tasks. They include initiative, group work, reading and writing

abilities, computerization, problem solving, personal attitudes, ethical and professional skills, communication skills, accounting and financial skills, leadership, decision-making skill, general knowledge to execute tasks, analytical, mathematical, statistical, interpretation, project management, knowledge from other relevant disciplines, self-projection, and awareness on global issues.

Other researchers like Clagett (1997), Oliver, (1997) Murnae and Levy, (1996) and Mc Nabb, (1977) claim that some non-technical skills needed by employees in carrying out their tasks are learning preparation, writing ability, reading and counting, listening effectively, oral communication, creative thinking, problem-solving, good self-management, initiative, interpersonal skills, ability to work in group, effective leadership and technological skills.

According to Roger (1996), non-technical skills play an important role in supporting technical skills. Employees must not only have technical expertise and experience, but also possess interpersonal communication skills, decision-making, problem solving, reading, writing and counting. These skills are deemed important because tasks could be carried out better if those skills are mastered.

2.3 The need for non-technical skills in engineering career

The changing requirement of employers and the nature of work has made non-technical skills important for engineering graduates. According to Cheung and Lewis (1998), employers expect technical workers to have the work knowledge and positive attitudes during their tenure. Although some employers put more emphasis on technical qualification, they also look for other qualities such as attitude and perseverance. This view can be extended to include technical, organizational, supervision, and other general requirements needed in industry. Most organizational programs would be positively evaluated if there is an improvement in fields related to knowledge, skills and attitude (Torrington and Tan, 1994).

Murnae and Levy (1996) stated that for the past two decades, skills required in the work place have significantly changed in line with technological advancement. Technical skills are undeniably important but employers have increasingly acknowledged other work enabling skills. These skills are labeled among others as "soft skills", "core skills", "non-technical skills", "essential skills", "generic skills" and "new basis" (Alpern, 1999; Murnae and Levy, 1996). These skills require employees to undergo an adaptation process in which they have to face new challenges in organization and management and work in a group where autonomy and responsibility becomes a significant feature in organizations today (21st Century Skills for 21st Century Jobs, 1999).

Natriello (1989) found that employers placed emphasis on correct work attitudes and non-technical skills. American, Australian and British studies also reveal that employers believe that entry-level employees are deficient in the broader non-technical skills and that educational institutions need to begin placing more emphasis on providing teaching and training in non-technical skills (Cotton. 1995). Bradshaw (1989) writes that there is a mismatch between employer needs and educational response. He adds that in the changing workplace, employers require workers with positive personal qualities and work attitudes in addition to academic qualifications.

2.4 Institutions of higher learning: challenges in providing highly skilled graduates.

Institutions of higher learning, as centers for equipping graduates with the required knowledge and skills, should continuously upgrade and update their curriculum to respond to the changing requirements of employers.

Institutions of higher learning are being criticized for their inability to produce graduates that meet the requirement of industries (Parry, et al. 1996). The criticism is due to the approach that emphasizes theories and analytical-based problem solving and not looking at the real environment. This limitation in curriculum content and learning quality has become the issue of discussion among those involved. Universities and colleges are also criticized for changing the learning approach/concept from teaching students *how to*

think to *what to* think. Universities and colleges should include systematic and logical analysis skills based on real life situations. If not, graduates at the entry-level have different expectations on the level and achievement of skills needed by the industries. Specifically, many industries feel that graduates place individual career above the organization's goal (Hotch, 1992).

Hotch (1992) suggests that institutions of higher learning elicit feedback from industries and revise their academic programs if necessary, to meet the requirement of the market and job demands. They should put a benchmark at either regional or national level as a parameter in evaluating the effectiveness of their current academic programs. Feedback from industries is not only beneficial for students in their learning process but also for institutions of higher learning as the data can be analyzed to identify the strengths and weaknesses of certain academic programs.

The importance of non-technical skills is also apparent in a study by Willis and Taylor (1999). In the study, they assert that although employers were satisfied with graduates' technical skills, they also felt that graduates still needed and lacked in general and current knowledge such as international issues, oral and written communication skills.

Rosmawati (2000) in her study posits that there are five skills deemed important by employers. They are ability to render tasks, capability to work in group, computer literate, and initiative skills. She further states that generally, employers feel that the

institutions of higher learning fail to produce students with holistic skills for the job market.

2.5 Importance of specific non-technical skills

There are two categories of non-technical skills: functional and adaptive, as pointed out in chapter 1. The following sections details the importance of each category.

2.5.1 The importance of communication skills

Communication, being the lifeblood of an organization, is one of the substantial elements in an organization. Communication involves verbal and nonverbal elements as well as the ability to use language either written or oral to get a message across. Organizational processes such as employee relations, customer relations, public relations, negotiation, strategic planning, etc. all need communication in order to function effectively. According to Noor Azizi Ismail et al. (2001), reading and writing are two important non-technical skills that are widely used in organizations. Writing skill is needed as most technical reports are in written form while reading skill is necessary because these reports will be read by others in the organizations.

From another point of view, Lowry and Yap (1997) claim that oral and written communication skills are very important at the work place. These skills can be acquired through humanistic subjects offered in institutions of higher learning.

A study by Welfle (2000) indicates that communication skills are very important in an organization's economic development especially those that focus on customer service. In this context employees have to communicate and relate to external customers. Welfle also states that only few works do not require employee to write and read; most works require a good level of communication competency.

Despite general communication skills, English language proficiency is another important non-technical skill that must be acquired by employees. English is not only a popular language, but also widely used and recognized as the language of trade and international relations (Atkinson, 2001).

Due to globalization, the role of other languages has become important to enable us to become a global player. According to Esa Samad (2000) todays job market requires employees who are not only proficient in Malay and English, but also in other languages such as Chinese, Arabic, Japanese, French, etc. Being skillful and fluent in a third language is an added advantage for graduates to secure a job.

Jones (1988) highlights the importance of communication skills in a study among Australian Engineering graduates. The study finds that engineering graduates lack

communication skills. In his report on engineering education in Australia he states that most employers feel that education institutions offering engineering courses emphasize only basic science knowledge, technical skills, knowledge and practice in engineering study, lab works, and computer design. These employers rate the institutions as unsatisfactory in non-technical skills such as industrial relations, management, cost management and communication skills. They claim that institutions fail to adapt engineering aspects to a broader context. Hellinghausen further strengthens the importance of language and communication and Myers (1998) study that 71 percent of employers place ability to follow instructions, speak fluently and clearly as well as attentiveness (listening skills) during discussions and presentations as very important in the workplace. Ability to speak in other languages is rated as important in where 41 percent of the employers evaluate the ability to speak and write in the second language as important.

2.5.2 The importance of creative thinking and problem solving skills

According to Ahmad Mustapa Ghazali (1999), there have been changes in the present business environment as opposed to the early 1970s. A study by Siegel (2000) found that most employees who have skills in solving problems are key factors to having competence in management. They should be able to view the big picture when solving problems. This is achieved by looking at various perspectives to add the level of

understanding and awareness of the present situation. Good decision making enables the management process of an organization to function effieciently.

Carnavale (1991) further states that all employees need to be equipped with the skills of identifying problems and making decision in order to meet the vision and objectives of the organization. This could be achieved through problem solving skills and creative thinking. Problem solving skill is important if one wants to avoid conflict and to ensure a smooth operation of the company.

2.5.3 The importance of information management and computer application skills

Technological competence has become important in line with the development of various equipment that could assist employers in carrying out their jobs more effectively. Siegel (2000) states that technology is the catalyst to changes. This could be seen in the increasing usage of computer to surf the Internet. Gathering and assessing information could be done through database and this provides a fast, efficient way of assessing information.

In addition, Mananghaya (2000) maintains that improvement in the computer system has increased the development rate of new products and the international business transaction as a common phenomenon. This is because through the use of computers, a

lot of product designs could be completed fast and accurately according to the required specifications.

According to Davis (1997), employers have a high expectation towards graduates' computer literacy level where 83.3% said that computer literacy is important or very important in deciding whether the graduates are offered the job. This decision is in line with the improvement in the development of technological advances, which require the employers and employee to act in line with the advancement.

2.5.4 The Importance of leadership and organizational skills

Flin R. et al. (1998) defined effective leadership as managerial skills used as a means to achieve joint task completion within a motivated, fully functioning team through coordination and persuasion. The core of effective leadership is to set the highest priority on the joint completion of a given task. Leadership responsibilities include the active and goal-directed coordination of work activities within the crew. This is always a reciprocal process. Without complementary behavior of the crew, leadership behavior is less effective. All crewmembers are expected to dedicate their efforts and initiatives to the safe and efficient achievement of the organization's goals. However, the final and legal responsibility for the operation on the whole is undivided, with the Pilot in Command (PIC). Crew responsibilities include monitoring and challenging each other whenever differences in concepts or actions are perceived.

Within the scope of delegated tasks crewmembers have the same responsibilities as the PIC.

The International Civil Aviation Organization (ICAO) defines a leader as a person who is able to influence the thought and whose ideas and actions influence the behavior of others using his/her ideas and actions. Through the use of example and persuasion, and an understanding of the goals and desires of the group, the leader becomes a means of change and influence (ICAO, 1989). It is important to distinguish between leadership, which is acquired, and authority, which is assigned. Leadership is one aspect of teamwork, and the success of a leader depends on the quality of his/her relationship in the team. The crewmembers should feel that they are an integral part of a well-run, well-organized operation in which their inputs are essential to reach commonly valued goals and overall success of the operation.

In distinction to the category cooperation, leadership and managerial skills focuses more on the goal-directed initiative the crewmember under consideration is investing into management and coordination functions. This includes also positive influences on the motivation and morale of the crew. Cooperation, on the other hand covers more the interactive processes without explicit appointed roles and is independent of authority differences of the individuals.

The leader has a clear concept for the operation and provides general standards and directions for the completion of the different tasks. The tasks are allocated according

to defined roles, specific experience, as well as to the present level of workload of the crewmembers. This concept for the operation is interactively briefed and always open for the contributions from other crewmembers. In order to ensure proper support and the participation from all members of the crew, active care is taken to establish and maintain closed loop communication. A leader motivates, activates, and monitors others and encourages the crew to monitor and challenge her/himself and each other in a non-degrading way.

2.5.5 The importance of group effectiveness and teamwork skills

According to Fullan (1990), if any changes are to be made, group cooperation then is not an important element if it is not accompanied by suitable management practices that are proper for the specific time, place and situation. Group cooperation can be formed/solicited if all the resistance could be avoided. Katzenbach (1993) states that group work can be formed and behavior of group members could be observed through group work.

Many discussions of new skill requirements in the mention teamwork as a necessary skill. The SCANS (1991, 1992) reports, for example, list "participates as a member of a team" as an interpersonal competency. Others argue that the changing workplace puts a premium on teamwork and the ability of team members to cope with unpredictable problems (Berryman and Bailey, 1992).

As Darrah (1992) points out, teamwork is not a "skill" but a description of how work is organized. What constitutes a team is subject to local definition and thus must be defined in relation to the working context. Thus, the "skill" or "interpersonal competency" needed to participate in a team will depend on the work organization.

Oganizational behavior literature provides some relevant definitions. Hackman and Oldham's (1980) classical work, for example, distinguishes between self-managing and co-acting work groups. A self-managing work group is an intact and definable social system, with a defined piece of work and authority to manage the task on its own. Self-managing work teams are also called autonomous work groups, semi-autonomous work groups, self-regulating work teams, or simply work teams (Levine and Moreland, 1991). In co-acting groups, individuals may report to the same supervisor and work close to one another, but they have individually defined tasks (Hackman and Oldham, 1980).

Sociocultural literature has looked at the culture of work groups and the reasons why work is often socially distributed, rather than individual. An important research question concerns the optimal distribution of knowledge in work groups and how the conditions in which the group works and the nature of the actions it must take shape knowledge distribution (e.g., Levine and Moreland, 1991; Hutchins, 1991). Other studies examine the processes by which newcomers become members of work groups or communities of practice (e.g., Levine and Moreland, 1991; Lave and Wenger, 1991).

2.5.6 The importance of work related dispositions and attitudes

In the skills debate, much attention has been paid to the dispositions and attitudes needed to succeed on the job. Some studies suggest that the skills gap identified by employers may be more about attitudes than academic or technical skills (Cappelli, 1992; Cappelli and Ianozzi, 1995). While survey data indicate that employers value "attitudes" (Natriello, 1989; NCEQW, 1995), it is not clear what they mean by this. Some employers may seek workers who have initiative, whereas others might want workers who follow orders.

Other studies of employers' perceptions of noncognitive skills attempt to distinguish different characteristics, such as "personal traits" and "social skills" (Bikson and Law, 1994) or "motivation" and "prosocial behavior" (Cappelli, 1992). Similarly, surveys of workers indicate that workers perceive noncognitive factors (e.g., dedication, resourcefulness) as essential for skilled work (Billett, 1993). Although surveys asking about skills--cognitive or noncognitive--provide evidence of general trends, the answers do not reveal what characteristics workers really have or how they play out in actual work situations (Darrah, 1992).

Theoretical work on the interplay of cognitive and other factors in learning and performance is still in development. Relevant psychological theories examine such factors as volition (Corno, 1993), motivation (Dweck and Leggett, 1988; Dweck and Elliot, 1983), and dispositions (Prawat, 1989; Perkins, Jay, and Tishman, 1993a, b) as individual traits, yet recognize that situational context plays a role in shaping them. If

context plays a role and traits are not static, then understanding noncognitive factors is important for public policy. Actions to develop positive dispositions toward work through education and training make sense only if they can be shaped (Cappelli, 1992).

Volition--paying attention to and working toward appropriate goals--is described by adjectives such as conscientiousness, disciplined, self-directed, resourceful, and striving. Volition directs intellectual and emotional energy to achieving goals, especially when the situation calls for it (e.g., if the task is difficult and there are distractions) (Corno, 1993).

Motivation accounts for the discrepancy between what individuals can do and what they actually do. Research distinguishes between "mastery" or "performance" orientations toward learning (Dweck and Leggett, 1988; Dweck and Elliott, 1983). A mastery approach seeks challenging tasks and persists under failure; it correlates with constructive views of ability, feelings of efficacy and confidence, and efficiency in complex learning situations. Individuals with a performance orientation are more concerned with how they might look to others than with what they might learn; this can influence how they value a task and the effort they put into it.

Dispositions or "habits of mind" are individuals' tendencies to put their capabilities into action and are thought to influence how individuals deal with various situations (Prawat, 1989; Perkins, Jay, and Tishman, 1993a). Dispositions are essential for

performance because "unless one has the inclination to use it, ability will lay fallow" (Perkins, Jay, and Tishman, 1993a).

2.5.7 The importance of personal traits and self-management skills

Welfle (2000) found that personal skills is an individual trait which is part of the communication skills, decision making and problem solving. A good personal skill is difficult to reveal because the ability to communicate carries a different meaning at different places.

A study by Centko (1995) revealed that positive interpersonal interaction is the key to success while working or otherwise. He further stated that a lack in the interpersonal skills would affect work. It is very critical where staff increase awareness on how the interpersonal relationship affects work productivity. Interpersonal skills could be developed through group formation. Every member in the group is encouraged to understand the dynamics of the work environment because formal education does not focus on that aspect. To succeed, employees must learn the skills related to oral communication, idea development, consultation, and objective setting.

Those basic skills are important in a person’s career and they are needed to show the success between work group at present and in the future. According to Cuevas (1998), potentials/ability in non-technical areas such as interpersonal relationship, project

management, consultation, presentation, understanding business situations and networking should be combined with the technical skills/ ability. Those employees who show a good combination of both the technical and non-technical skills are prime candidates for promotions.

Spoon and Schell (1998) identified the needs for the combined development of cognitive ability and academic ability that are required to increase maturity in career. Recognition will be given to employees who are able to solve problems and make complex decision in a difficult situation.

2.6 Conclusion

This chapter has discussed previous work on the changing requirements of employers, the challenges faced by institutions of higher learning in response to the changing requirements and the need for non-technical skills in the engineering career. It also presented the importance of specific non-technical skills discussed by various researchers and how those skills enhanced employability and equipped engineering graduates for their career.

CHAPTER 3

METHODOLOGY

3.0 Introduction

This chapter discusses the research methodology used in this study.

3.1 Research Design

This study combined quantitative and qualitative research methodologies to investigate the importance of non-technical skills for entry-level engineers employed in manufacturing firms. Mail survey and interviews were used to gather feedback for the study.

3.2 Sample of the study

A population of 3251 manufacturing firms in Malaysia was identified from the Federation of Malaysian Manufacturers Directory 2004, Bursa Malaysia Handbook 2004 and SMI Business Directory 2004. Based on this population frame 1605 firms were

randomly selected. The type of ownership and size of the 162 firms which participated in the study are shown in Table 3.1.

Table 3.1: Firm ownership and size

Items	Frequency N= 162	Percentage %
1. Type of ownership		
Malaysian	81	50.00
Japanese	19	11.73
American	11	6.79
Singaporean	4	2.47
French	2	1.23
Malaysian & Singaporean	2	1.23
Malaysian & Taiwanese	2	1.23
Taiwanese	2	1.23
Anglo Dutch	1	0.62
Australian	1	0.62
British	1	0.62
Indian	1	0.62
Italian	1	0.62
Korean	1	0.62
Malaysian & German	1	0.62
Malaysian & Italian	1	0.62
Malaysian & Japanese	1	0.62
Malaysian & Turkish	1	0.62
No information provided	29	17.90
TOTAL	162	100
2. Size of firms according to number of full-time employees in company		
<50 (small)	5	3.09
50 - 149 (medium)	52	32.10
>150 (large)	71	43.83
No information provided	34	20.99
TOTAL	162	100

3.3 Research instrument

Questionnaire was the main instrument used in this study. In addition, interviews were used to provide insight and to support information obtained from the questionnaire**.**

3.3.1 Questionnaire

The questionnaire used in this study was adapted from a study by De Lange (2000). The questionnaire retained the functional skills and adaptive skills used in De Lange's study. Based on his definition of functional skills as "basic skills used to apply to tasks and to solve new problems", this study regarded leadership and organizational skills as a functional skill.

The questionnaire consisted of three parts:

- Part I: Demographic profile.
- Part 2: Functional skills and adaptive skills categories.
    A. Functional skills category: A Likert-scale ranging from 1 to 6 (1 – Not important at all to 6 – Extremely important) was used to measure respondents' perception on the importance of items in this category. Respondents were also asked to rate the usage of each item based on the following scale: always, seldom, rarely and never.
    B. Adaptive skills category: Respondents were asked to tick five most important items that entry-level engineers should possess.
- Part 3: Overall comments on the importance of non-technical skills requirement for entry-level engineers.

Table 3.2 provides a description, objectives and number of items for each part of the questionnaire.

Table 3.2: Details of the questionnaire

Part	Description	Number of items	Objective
I Demographic Profile	Section A: Respondent Background Section B: Company Profile	11 8	To identify background of the respondent and the company.
II The Importance of Non-Technical Skills	<u>Functional Skills</u> 1. Communication Skills 2. Creative Thinking and Problem Solving Skills 3. Information Management and Computer Application Skills 4. Leadership and Organizational Skills <u>Adaptive Skills</u> 5. Group Effectiveness and Teamwork Skills 6. Work-Related Dispositions and Attitudes 7. Personal Traits and Self-Management Skills	 19 16 15 24 22 27 22	To identify the importance of non-technical skills for entry-level engineers (fresh graduates) in manufacturing firms.
III Overall Comments	Additional Comments	8	To obtain respondent's comments on the importance of non-technical skills for entry-level engineers (fresh graduates) in manufacturing firms.
	Total:	**172**	

3.3.2 Interview

The purpose of the interviews was to get an insight on the importance of non-technical skills needed by entry-level engineers in the manufacturing industry when performing their tasks.

3.4 Pilot Study

A pilot study was conducted between October 2004 and November 2004 to gauge the clarity of the questionnaire for the actual study. This involved a mail survey of 157 questionnaires and also interviews. Eight questionnaires were returned and eight interviews were conducted with personnel from the Human Resource and Engineering/Technical Departments.

Based on feedback from the pilot study, an example column was added to illustrate what was expected of respondents in the adaptive skills category.

Due to the poor response rate of the mail survey, the study also employed enumerators to distribute the questionnaires. Thus, the method used in the actual study was mail survey and enumerators.

3.5 Data collection procedure

3.5.1 Questionnaire

3210 questionnaires were distributed to 1605 manufacturing firms. Two questionnaires were sent to each firm where one questionnaire was to be completed by the Human Resource Manager/Executive and the other by an engineer. Two methods of

distribution were used: mail and enumerators. Respondents were asked to return the completed questionnaire in the self-addressed envelopes provided.

The return rate was 15.14% (243 questionnaires). Table 3.3 shows the return rate in terms of the respondents' designation. This is consistent with the return rate of other studies involving the manufacturing industry in Malaysia such as Mohd. Khairuddin Hashim et al. (2003), Lee (2003), Mohd. Hanizam Zalazilah et al. (1999), Siti Maimun et al. (1986) (Refer Appendix).

Table 3.3: Designation of respondents

Designation	N	Percentage
Human Resource Manager/Executive	139	57.2
Engineer	104	42.8
	243	100

3.5.2 Interviews

Unstructured interviews were conducted after data from the questionnaires was analyzed. Respondents were contacted by telephone and interviews were conducted with those who were willing to be interviewed.

22 persons consisting of personnel from the Human Resource and Engineering/Technical Departments from various manufacturing firms were interviewed

between February and April 2006. In addition, the Executive Director of the Malaysian Employers Federation was interviewed to get an overall perspective of non-technical skills required.

3.6 Data analysis

3.6.1 Questionnaire

Descriptive statistical measurement i.e. mean and frequency were used to analyze data in Parts I and 2 of the questionnaire. Open-ended questions in Part 3 were analyzed qualitatively.

3.6.2 Interviews

Data collected from the interviews provided an insight into the importance of non-technical skills needed by entry-level engineers. The interviews were transcribed and then sorted according to categories.

CHAPTER 4

FINDINGS AND DISCUSSIONS

4.0 Introduction

This chapter presents the findings of the study. Findings are presented based on the research questions of the study:

RQ 1: What are the non-technical skills required by entry-level engineers in manufacturing industry?

RQ 2: What are the non-technical skills regarded as important for entry-level engineers in manufacturing industry?

Non-technical skills in this study are divided into functional and adaptive skills. The first part of this chapter presents the findings on functional skills while the second part presents findings on the adaptive skills.

4.1 Non-technical skills: the functional skills

This section discusses the functional skills of communication, creative thinking and problem solving, information management and leadership and organizational skills. The functional skills are discussed according to the level of importance based on the descriptors in Table 4.1

Table 4.1: Level of importance based on mean value

Important			Less Important	Not important	
Extremely	Very	Important		Not important	Not important at all
* ≥ 5.2	4.4 – 5.1	3.5 – 4.3	2.8 – 3.4	2.0 – 2.7	<2.0

* Mean value

4.1.1 The importance of functional skills

The findings of the functional skills confirm the importance of non-technical skills for entry-level engineers in the manufacturing industry. Our data indicates that none of the categories was considered as not important and this is confirmed by the high overall mean scores of items within each category as shown in Tables 4.2 and 4.3 respectively.

Table 4.2: Distribution of functional skills items

Category	Extremely important (>5.2)	Very important (4.4 – 5.2)	Important (3.5 – 4.3)	Less important (2.8 – 3.4)	Not important (2.0 – 2.7)	Not important at all (<2.0)	Total
Communication	1	12	5	0	0	0	18
Leadership & Organizational Skills	4	20	0	0	0	0	24
Information Management	0	13	1	0	0	0	14
Creative Thinking & Problem Solving	0	14	2	0	0	0	16
Total items	5	59	8	0	0	0	72

Table 4.2 shows the mean score distribution of functional skills ranging from extremely important (mean score >5.20) to not important at all (mean score <2.0). All 72 items had a mean score above 3.5 and are considered important by the respondents. Although all the items are considered important, the level of importance differs. A majority of the items (59) are regarded as very important while eight items are considered as important only. A total of five items were found to be extremely important where one item is from the communication category, four from leadership and organizational skills category and none from the information management and creative thinking and problem solving categories.

Table 4.3: Average mean score by category

	Category	No. of items	Average mean score
1.	Leadership and organizational skills	24	4.87
2.	Information management	14	4.79
3.	Creative Thinking & Problem Solving	16	4.62
4.	Communication	18	4.60
	Total	72	4.72

Table 4.3 shows the average mean score of functional skills based on category. Leadership and organizational skills has the highest mean score of 4.87. This is followed by information management skills (4.79), creative thinking and problem solving skills (4.62) and communication skills (4.60).

The average mean score of all categories is 4.72 (Table 4.3). This score is consistent with the findings in Table 4.2 and confirms that non-technical skills are very important as perceived by the respondents. Thus, it cannot be denied that non-technical skills are important for entry-level engineers in the manufacturing industry. Our interviews with personnel from manufacturing firms support these findings. One of the respondents said " non-technical skills support or enhance technical skills." He further explained that while technical skills play an important role in the workplace, it cannot function on its own. Thus, non-technical skills are needed to enhance technical skills. For example, when faced with a problem technical skills are needed to analyze the problem data while non-technical skills are needed to present the information to customers. These include skills such as data collection and observation.

Along the same line, another respondent said that entry-level engineers must have common sense in order to manage their work. According to him:

> *(The) Engineering field is very technical, very black and white (and) there is no grey area. However, in life there are some grey areas (where) we need to apply non-technical skills.*

4.1.2 Five items with the highest mean score

Table 4.4 shows the five items with the highest mean score as perceived by the respondents.

Table 4.4: Five items with the highest mean scores

No.	Item	Category	Mean Score
1.	Follow procedure	Leadership & Organizational Skills	5.40
2.	Listening	Communication	5.37
3.	Meet deadlines	Leadership & Organizational Skills	5.27
4.	Time Management	Leadership & Organizational Skills	5.22
5.	Work to schedule	Leadership & Organizational Skills	5.21

The ability to follow procedure has the highest mean score (5.40). This is followed by listening (5.37), meeting deadlines (5.27), time management (5.22) and work to schedule (5.21). As such, follow procedure can be regarded as the most important non-technical skills in the functional skills category.

4.1.3 Five items with the lowest mean scores

Table 4.5 shows the five items with the lowest mean scores as perceived by the respondents.

Table 4.5: Five items with lowest mean scores

No.	Item	Category	Mean Score
1.	Scenario building	Creative thinking & problem solving	4.25
2.	Persuasion	Communication	4.20
3.	Grievance handling	Communication	4.18
4.	Interviewing	Communication	3.97
5.	Selling	Communication	3.71

Selling has the lowest mean score (3.71). This is followed by interviewing (3.97), grievance handling (4.18), persuasion (4.20) and scenario building (4.25). It is important to note that even though all the items above have the lowest mean scores, they are still important based on their mean scores (Refer Table 4.2).

Persuasion, grievance handling and selling are now becoming essential functional skills because of Malaysia's changing economy. According to the Executive Director of Malaysian Employers Federation :

> *With the changing economy, we are the 16th biggest trading nation now, you need to sell, you need to buy or you need to negotiate.*

In addition, another respondent commented about the skill of selling:

> *(We deal) directly (with) customers… the engineers need to know, we (engineers) (come up with a) quotation… that means from (the) design, (prepare) the quotation, communicate with the customers and sell what end-customers require. Our capability is not limited in this organization only, we have to communicate (with) sales (department); we have to communicate... to the customers also, that's why I find this job difficult"*

4.1.4 Importance of functional skills by category

This section discusses the importance of functional skills by category. The data indicates that all the categories - communication, creative thinking and problem solving, information management and leadership and organizational skill are very important.

4.1.4.1 Communication skills category

Communication skills are perceived as very important for entry-level engineers in the manufacturing industry based on the overall mean score of 4.60 (refer Table 4.3) average mean score by category). The Executive Director of the Malaysian Employers Federation concurs with the findings of this study on the importance of communication skills. He says, "… *regardless of all other attributes, without good communication skills you will not be able to impress others."*

The importance of communication is further illustrated by most of the respondents regardless of the departments they are attached to. For example, people who are confined to a specific task such as Research and Development (R&D) are also required to communicate effectively with others. According to one:

> *Because R&D (is) in our department, we need to communicate with all departments. That's the problem!*

This statement illustrates that although communication takes place, the communication is not effective. In the current situation, most engineers have technical competence, but lack non-technical competence. As stated by one of the respondents:

> *I wish (I could have) two types of person, for example, (one) who can communicate with others and one who back him up (a person with technical expertise) … so what he has to do is he has to talk with people (from) purchasing, planning (departments) or outside also, so the other guy… what I need is (to) just do the job.*

While this would be an ideal situation, it is not feasible. This demonstrates that in the workplace, an engineer must have both communication and technical skills. This would enable him to function effectively when dealing with other departments and customers. Therefore engineers need to understand that they must now have the package of technical skills coupled with non-technical skills as this is what employers are looking for.

An engineer's ability to communicate with customers from other countries may also reflect the organization's reputation internationally. According to one of the respondents:

> *… especially my job requires communication with the customers and most of the customers … UK customers… also bring the standard of the company, what kind of company is , what kind of people is working with the company…, what kind of image…*

Good communication skills enable collegiality among personnel from different departments when dealing with work-related issues. In the case of entry-level engineers, good communication skills would enhance their learning process especially when interacting with more experienced technical personnel. One respondent said,

> *… young graduates, need to communicate between (with) much more experienced (personnel), so (they) need … apply everything that they know.*

4.1.4.1.1 Communication skills category by items

Table 4.6 shows the mean scores of 18 items in the communication skills category. The overall average mean of this category is 4.60 which is regarded as very important. The top five items are listening, conversing, verbal communication, explaining and technical report writing. On the other hand, visual and graphic presentation, persuasion, grievance handling, interviewing and selling had the lowest mean scores in the category.

Table 4.6: Communication skills - average mean score by item

No.	Item	Mean
1.	Listening	5.37
2.	Conversing	5.18
3.	Verbal communication	5.10
4.	Explaining	5.07
5.	Technical report writing	4.89
6.	Instruction	4.76
7.	Presentation	4.68
8.	Reading	4.67
9.	Meeting procedure	4.61
10.	Negotiating	4.59
11.	Training	4.56
12.	Demonstrating	4.56
13.	Managing conflict	4.47
14.	Visual & graphic presentation	4.27
15.	Persuasion	4.20
16.	Grievance handling	4.18
17.	Interviewing	3.97
18.	Selling	3.71
	Av. Mean	4.60

The five most important skills in the communication category are listening, conversing, verbal communication, explaining and technical report writing. It is the norm that entry-level engineers are usually not expected to make major decisions but to carry out instructions. In some organizations an entry-level engineer is attached to a senior engineer where he is expected to apply good communication skills especially listening, conversing, explaining and reporting. According to one respondent:

> *… Normally, we just follow (listen and learn) … normally (we'll be) given (instructions) …*

> *… we have to explain what we have learnt…*

Another respondent, a senior engineer, said:

> *… Most are blank (unable to explain)*
>
> *… therefore, it is important to ask/seek clarification when in doubt …*
>
> *… from the reports they write, (I am clueless) as to where they got the information from… (Translated)*

An overview of the importance of the skills required by entry-level engineers was provided by another respondent who feels that successful communication requires active listening and the ability to compose an audience-centered message:

> *We have to study what the audience want(s), that's the first thing of communication, like (when) we are talking to the boss, the boss always wants profit, so we go to that first, then we go for the second one, if we are talking to the human resource department they only need maybe the number of person to hire and all this, of course you are also talking about if he work in the… money, all the talking about is cost…. All this is related to profit money talking, so that is the keyword of how he wants your listener to listen to you. Interesting, you are the boss or you are the second boss you always want to hear this, so we go to this first, if they want to listen to you then….*

Composing an audience-centered message is also important when writing a report as mentioned by this particular respondent:

> *… we need to know who we are writing the report for…*

These remarks encapsulate the importance of the top five communication skills items. It is therefore, essential for entry-level engineers, apart from having good listening skills to also have good verbal communication skills which include the ability to converse and explain, and write technical reports.

Selling, interviewing, grievance handling, persuasion and visual and graphic presentation are identified as the five skills ranked low in this category. This could probably be due to the fact that entry-level engineers are currently not expected to perform selling or marketing tasks. Furthermore, they may also not be entrusted to conduct interviews, handle grievances and give visual and graphic presentations since these are presumably tasks done by senior engineers. However, this scenario may change due to Malaysia's changing economic trend towards a more service-oriented. Thus, future engineers are expected to be able to multi-task and therefore, they need to equip themselves with more than one skill. The Executive Director of Malaysian Employers Federation explains:

> *When we talk about employability… you need various skills, because the one skill regime, I think… is more like dead.*

4.1.4.1.2 Communication skills items: Comparison between HR executives and engineers

Table 4.7 shows the comparison in the top five communication skills items (based on mean scores) as perceived by HR executives and engineers.

Table 4.7: Comparison of top five communication skills items perceived by HR executives and engineers

No.	HR Executives	Mean	Engineers	Mean
1.	Listening	5.36	Listening	5.39
2.	Conversing	5.22	Conversing	5.14
3.	Verbal communication	5.16	Explaining	5.08
4.	Explaining	5.07	Verbal communication	5.02
5.	Technical report writing	4.85	Technical report writing	4.93

Both HR executives and engineers selected the same items i.e. listening, conversing, verbal communication and explaining as the most important skills required by entry-level engineers. The difference was only in the ranking of verbal communication and explaining skills in which verbal communication was ranked third by HR executives and fourth by engineers while explaining was ranked fourth by HR executives and third by engineers.

It can therefore be concluded that there is no difference in the importance of communication skills items required by entry-level engineers as perceived by HR executives and engineers.

4.1.4.1.3 Languages in the manufacturing industry

While language is essential in communication, this study addresses it in terms of type of language rather than skills. Therefore, this section discusses the importance and usage of the types of languages in the manufacturing industry. Table 4.8 shows the importance and usage of languages among entry-level engineers in the manufacturing industry.

Table 4.8: Language - importance and usage

No.	Language	Importance (mean) *(Scale of 6)*	Usage (mean) *(Scale of 4)*
1.	English	5.33	3.90
2.	Bahasa Melayu	4.52	3.58
3.	Mandarin	3.54	2.82
4.	Japanese	2.44	1.80
5.	Arabic	1.56	1.22

Among the five languages, English is regarded as the most important language. It has a mean score of 5.33 which indicates that it is an extremely important language needed by entry-level engineers. English is also the language most used among engineers in the manufacturing industry with a mean score of 3.9 from a maximum score of 4.0.

The importance of the English language is emphasized by most of the respondents interviewed. Among the statements made are:

> *Normally, when we deal with multi-national companies basically we use English, …because normally the paper work (are) all in English.*
>
> *(Most of the) reports are in English.*

Bahasa Melayu is also another important language used in the manufacturing industry. The mean score for the importance of Bahasa Melayu is 4.52 while the mean score for its usage is 3.58.

In most organizations, both English and Bahasa Melayu are used. While English is more commonly used in formal communication contexts, Bahasa Melayu is more

commonly used in informal contexts especially when dealing with subordinates. This is illustrated by the following responses:

> *They (entry-level engineers) still get help along the way because they can communicate in Bahasa Melayu.*
>
> *Communication with senior staff (is) in English … operators in Malay, documentation in English.*
>
> *… daily communication with workers basically in Bahasa Melayu. (With) top management (it) depends. I will use the language that they use whether Bahasa Melayu or English.*
>
> *Dominant(ly) English…*
>
> *… for local suppliers, a mixture of both languages.*

It cannot be denied that English is the main language of communication in the manufacturing industry. However, other languages in particular Mandarin, is also becoming more important as stated by the Executive Director of Malaysian Employers Federation. Our data supports this view where Mandarin has a mean score of 3.54 i.e., rated third in terms of importance and usage after Bahasa Melayu (refer Table 4.8).

4.1.4.1.4 Language items: Comparison between HR executives and engineers

Table 4.9 shows the comparison in language items (based on mean scores) as perceived by HR executives and engineers.

Table 4.9: Comparison of language items perceived by HR executives and engineers

No.	HR Executives	Mean	Engineers	Mean
1.	English	5.27	English	5.41
2.	B Melayu	4.50	B Melayu	4.55
3.	Mandarin	3.46	Mandarin	3.64
4.	Japanese	2.40	Japanese	2.49
5.	Arabic	1.56	Arabic	1.58

Both HR executives and engineers ranked the language items in the same order of importance.

4.1.4.2 Creative thinking and problem solving skills

Table 4.10 shows the mean scores of 16 items in this category. The skills in the creative thinking and problem solving skills category are classified as very important based on its overall mean score of 4.62.

Table 4.10: Creative thinking and problem solving skills

No.	Item	Mean
1.	Problem analysis	5.11
2.	Observing	4.93
3.	Questioning	4.87
4.	Investigating	4.83
5.	Prioritizing	4.74
6.	Innovating	4.69
7.	Anticipating	4.67
8.	Integrating	4.59
9.	Interpreting	4.57
10.	Formulating	4.56
11.	Facilitating	4.48
12.	Forecasting	4.47
13.	Conceptualizing	4.47
14.	Simulating	4.43
15.	Predicting	4.30
16.	Scenario building	4.25
	Av. Mean	4.62

Analyzing problem (problem analysis), observing, questioning, investigating and prioritizing are the five most important skills in this category. A common scenario in the manufacturing industry is that entry-level engineers are assigned to be in charge of projects. The specific skills required explain the high mean scores of the five most important skills.

The involvement of entry-level engineers in the implementation of projects as described by the respondents, indicate that entry-level engineers are in a situation where the probability for problems to occur exists. Hence, they are expected to troubleshoot which involves investigating, observing, questioning and prioritizing. The need for these skills are emphasized by the respondents.

On the need for observation skill one respondent said:

> *When you do the job they must watch. In this company, at entry-level a graduate is not appointed as an engineer but as an apprentice. He/she will be given OJT training and work under an engineer. Therefore, observation skill is very important. (Translated)*

He further elaborated on the need for questioning skill:

> *That's why while in training there is a need to ask if there are things that you do not understand. If there are things that you think are unusual, ask!*

Another respondent summarizes:

> *… if they do not understand, (they should) ask..…*

On the need for prioritizing skill a respondent said:

> *Deadline is very important, semua (everything is) urgent.*

This scenario implies that entry-level engineers must be able to meet project deadlines. As such entry-level engineers must be able to incorporate the ability to prioritize tasks when dealing with problems. A respondent explains:

> *If we can prioritize, which do you think we can put on top of the list?*

On the other hand, scenario building, predicting, simulating, conceptualizing and forecasting are identified as the five skills ranked low in this category. This could probably be that the scope of work of entry-level engineers is task-oriented and more focused.

4.1.4.2.1 Creative thinking and problem solving skills items: Comparison between HR executives and engineers

Table 4.11 shows the comparison in the top five creative thinking and problem solving skills items (based on mean scores) as perceived by HR executives and engineers.

Table 4.11: Comparison of top five creative thinking and problem solving skills items perceived by HR executives and engineers

No.	HR Executives	Mean	Engineers	Mean
1.	Problem analysis	5.06	Problem analysis	5.17
2.	Observing	4.88	Observing	5.00
3.	Questioning	4.84	Investigating	4.93
4.	Prioritizing	4.79	Questioning	4.90
5.	Investigating	4.76	Prioritizing	4.67

It was found that HR executives and engineers selected the same items i.e. problem analysis, observing, questioning, prioritizing and investigating as the top five skills items required by entry-level engineers.

4.1.4.3 Information management skills

Table 4.12 shows the mean scores of 14 items in the information management skills category. The overall average mean of this category is 4.79, which falls under the very important category.

Table 4.12: Information management

No.	Item	Mean
1.	Analyzing information	5.09
2.	Logical thinking	5.07
3.	Collecting information	5.01
4.	Reporting	5.01
5.	Scheduling	4.90
6.	Retrieving information	4.89
7.	Organizing	4.87
8.	Prioritizing	4.86
9.	Researching information	4.74
10.	Valuating	4.70
11.	Recording	4.61
12.	Collating	4.49
13.	Synthesizing	4.43
14.	Sorting	4.38
	Av. Mean	4.79

The top five items are analyzing information, logical thinking, collecting information, reporting and scheduling. In contrast, valuating, recording, collating, synthesizing and sorting had the lowest mean scores in the category.

Since entry-level engineers are involved in the implementation of projects, troubleshooting may sometimes be required. This means that when a problem occurs, entry-level engineers are expected to identify the problem and formulate and solve the

problem. In order to do this they need to have the ability to analyze information, think logically, collect information, report and prepare schedules to ensure successful completion of the project as scheduled.

Statements by the following respondents demonstrate the need for these skills among entry-level engineers in the manufacturing industry:

> *… we need to analyze data to present to our customers, we need to observe the data, collect the data …*

The following statement illustrates the importance of scheduling:

> *Pick schedule, in the meeting we plan for the next project.*

4.1.4.3.1 Information management skills items: comparison between HR executives and engineers

Table 4.13 shows a comparison between the top five information management skills items (based on mean scores) as perceived by HR executives and engineers.

Table 4.13: Comparison of top five information management skills items perceived by HR executives and engineers

No.	HR Executives	Mean	Engineers	Mean
1.	Logical thinking	5.07	Analyzing information	5.16
2.	Analyzing information	5.04	Logical thinking	5.07
3.	Reporting	5.00	Reporting	5.03
4.	Collecting information	4.99	Collecting information	5.03
5.	Prioritizing	4.92	Scheduling	4.93

Note: 1. Prioritizing ranked 8th in the overall Information Management Skills category.
2. Scheduling ranked 5th in the overall Information Management Skills category.

Both HR executives and engineers agreed that logical thinking, analyzing information and collecting information to be among the top five information management skills items required by entry-level engineers. However, HR executives perceived prioritizing as one of the top five skills items in comparison to scheduling which was selected by engineers.

4.1.4.3.2 Computer application

In information management, ability to use specific computer application is essential. This study addresses the types of computer application used among entry-level engineers in the manufacturing industry. This section discusses the importance and usage of computer application in the manufacturing industry.

Table 4.14 shows the importance and usage of computer application among entry-level engineers in the manufacturing industry.

Table 4.14: Computer application

No.	Item	Importance (mean) *(Scale of 6*	Usage (mean) *(Scale of 4)*
1.	Microsoft Excel	5.38	3.90
2.	Microsoft Word	5.25	3.85
3.	Microsoft Power Point	4.84	3.58
4.	Internet usage	4.83	3.43
5.	Accounting software usage	3.29	2.35

Among the five computer applications, Microsoft Excel and Microsoft Word are the most important tools for entry-level engineers in the manufacturing industry with a mean score of 5.38 and 5.25 respectively. The software is used to prepare reports and other in-house documents.

In addition, Microsoft Excel and Microsoft Word had a mean score of 3.90 and 3.85 respectively from a maximum score of 4.0 making them the most commonly used computer software among engineers in the manufacturing industry.

Comments by the respondents provide an insight into the high mean scores of the two computer applications. One respondent said:

> … *we need to analyze data to present to our customers, we need to observe the data, collect the data, so one of the skills that mostly used (is) Excel, so that the Excel must be very good in sort of …. Excel programming (program) (is) very good.*

According to another respondent:

> *Computer application (software) mostly used here is Excel, and then Windows, that's normal …. We need to learn or know other computer software too. That would benefit us.*

Another respondent said:

> *When writing reports, Word (Microsoft Word) and Excel are important. But AutoCAD is important for drawing ….*

4.1.4.3.3 Computer application skills items: comparison between HR executives and engineers

Table 4.15 shows a comparison between the top five computer application skills items (based on mean scores) as perceived by HR executives and engineers.

Table 4.15: Comparison of Computer Application skills items perceived by HR executives and engineers

No.	HR Executives	Mean	Engineers	Mean
1.	Microsoft Excel	5.38	Microsoft Excel	5.38
2.	Microsoft Word	5.23	Microsoft Word	5.28
3.	Internet usage	4.83	Microsoft Power Point	4.95
4.	Microsoft Power Point	4.75	Internet usage	4.83
5.	Accounting software usage	3.40	Accounting software usage	3.14

Both HR executives and engineers agreed that Microsoft Excel and Microsoft Word were the most important Computer Application skills required by entry-level engineers.

4.1.4.4 Leadership and organizational skills

Table 4.16 shows the mean scores of 24 items in the leadership and organizational skills category in descending order. The overall average mean of this category is 4.87 and can be categorized as very important.

Table 4.16: Leadership and organizational skills

No.	Item	Mean
1.	Follow procedures	5.40
2.	Meet deadlines	5.27
3.	Time management	5.22
4.	Work to schedule	5.21
5.	Goal directed	4.98
6.	Motivate	4.97
7.	Assume responsibility	4.95
8.	Set objectives	4.94
9.	Work under pressure	4.92
10.	Prioritize	4.88
11.	Co-ordinate	4.86
12.	Make suggestions	4.86
13.	Manage	4.83
14.	Supervise	4.83
15.	Handle Stress	4.82
16.	Lead	4.82
17.	Have vision	4.81
18.	Apply policies	4.79
19.	Put theory into practice	4.69
20.	Instruct	4.65
21.	Straight forward	4.59
22.	Recommend	4.58
23.	Delegate	4.55
24.	Administer	4.49
	Av. Mean	4.87

Out of the 24 items, follow procedures, meet deadlines, time management, work to schedule and be goal directed are the five most important skills for engineers in the manufacturing industry. In some organizations, entry-level engineers are not given the responsibility to lead a project. They have to work under the supervision of a more experienced engineer and assume the roles of an apprentice. During this training period they are normally required to perform two roles: implementers and intermediaries. As implementers, they are expected to carry out the tasks assigned within the set time frame. Therefore, they are expected to follow procedures, meet deadlines, manage time, work to schedule and be goal directed. Hence, these skills are rated as the top five skills in the leadership and organizational skills category.

The importance of these skills are reflected by the respondents statements:

> *" (They need to) follow and report. Within two months (of working) we already have the basic but (during this time) we were not exposed (directly) to the job (because) if we are not technically sound (it may be) dangerous. (This is because) everything involves process, therefore we must (follow procedures)"*

> *"(sometimes) I have to complete his report myself. (Because we have a) time frame, I cannot wait for him"*

> *"Normally, (as trainees) we just follow him (the seniors)…"*

> *"(The) first month, we will attach them to all (departments) – production, environment(al) process… (We explain) what products we make, the process flow…"*

> *"Everything is urgent, (therefore, meeting) deadline is very important"*
>
> *"(We need to be able to) pick schedule. In the meeting we plan for the next project"*
>
> *"Organization skills, how do we organize staff … and time management, how do we prioritize… problems what is important, not important, urgent, not urgent … it helps to reduce our stress…"*

On the other hand, the limited authority normally given to entry-level engineers suggests that they do less *administering, delegating, recommending and instructing*. This explains why these skills are rated relatively low. Surprisingly, despite entry-level engineers are expected to be more straightforward, our findings indicate that it is also rated relatively low in terms of its importance.

However, it is important to note that while *administering, delegating, recommending being straight-forward and instructing* are rated as the lowest five in this category, their mean scores (4.49 – 4.65) indicate that they fall under the very important scale i.e. mean scores 4.4 – 5.1 (refer Table 4.1). This is because to perform their role as intermediaries, entry-level engineers are not only expected to handle machines but also interact and deal with human beings. Although they are young engineers, they also have several subordinates working with them. Thus, we can conclude that to be good engineers, it is necessary for entry-level engineers to possess all the skills in this category.

4.1.4.4.1 Leadership and organizational skills items: comparison between HR executives and engineers

Table 4.17 shows a comparison between the top five leadership and organizational skills items (based on mean scores) as perceived by HR executives and engineers.

Table 4.17: Comparison of top five leadership and organizational skills items perceived by HR executives and engineers

No.	HR	Mean	Eng	Mean
1.	Meet deadlines	5.30	Follow procedures	5.92
2.	Work to schedule	5.26	Time management	5.24
3.	Time management	5.20	Meet deadlines	5.23
4.	Goal directed	5.04	Work to schedule	5.13
5.	Follow procedures	5.03	Work under pressure	5.04

Note: 1. Goal directed ranked 5th in the overall Leadership and Organizational Skills category.
2. Work under pressure ranked 9th in the overall Leadership and Organizational Skills category.

It was found that four out of five items were selected by both HR executives and engineers. The items were meet deadlines, work to schedule, time management and follow procedures. It was also found that goal directed was the item perceived as very important by HR executives whereas work under pressure was emphasized more by engineers. A possible explanation for the engineers' choice of this item could be related to the nature of their jobs which is project-based and also another job requirement i.e. to be on-call whenever a problem arises at anytime of the day.

4. 2 Non-technical skills: adaptive skills

This section discusses non-technical skills grouped under adaptive skills. A total of 71 items representing all three categories were compiled from previous research. Respondents were asked to select only five items they considered most important from each of the following categories:

1. Group effectiveness and teamwork skills (22 items)
2. Work-related dispositions and attitudes (27 items)
3. Personal traits and self-management skills (22 items)

Data was analyzed based on the frequency the items were selected by the respondents. Items selected by more than 50% of the respondents are considered as most important while items selected by less than 5% are considered as least important (refer to Table 4.18).

4.2.1 Most adaptive skills

Table 4.18 shows the overall frequency of adaptive skills items selected by the respondents.

Table 4.18: Overall frequency for adaptive skills items

No.	Items	Category	Frequency	%
1.	Responsible	Personal traits	160	65.84
2.	Commitment	Group effectiveness	159	65.43
3.	Self-confidence	Personal traits	145	59.67
4.	Disciplined	Personal traits	136	55.97
5.	Committed to the job	Work dispositions	129	53.09
6.	Willingness to learn	Work dispositions	123	50.62
7.	Co-operative	Group effectiveness	121	49.79
8.	Lead and manage	Group effectiveness	119	48.97
9.	Responsive	Group effectiveness	118	48.56
10.	Motivated	Personal traits	116	47.74
11.	Ability to take initiative	Work dispositions	101	41.56
12.	Receptive to ideas	Group effectiveness	100	41.15
13.	Co-ordination	Group effectiveness	85	34.98
14.	Interest in work	Work dispositions	80	32.92
15.	Ability to work as a team member	Work dispositions	78	32.10
16.	Task oriented	Work dispositions	57	23.46
17.	Mature	Personal traits	57	23.46
18.	Positive self-esteem	Personal traits	55	22.63
19.	Ability to handle pressure	Work dispositions	54	22.22
20.	Make extra effort	Work dispositions	54	22.22
21.	Group process skills	Group effectiveness	53	21.81
22.	Good work habits	Work dispositions	49	20.16
23.	Open to criticism	Work dispositions	42	17.28
24.	Honest	Personal traits	42	17.28
25.	Flexible / Open-minded	Personal traits	42	17.28
26.	Tactful	Group effectiveness	38	15.64
27.	Helpful	Group effectiveness	37	15.23
28.	Willing to be trained	Work dispositions	37	15.23
29.	Solicit ideas	Group effectiveness	33	13.58
30.	Punctual	Work dispositions	32	13.17
31.	Integrity	Personal traits	32	13.17
32.	Ability to negotiate	Group effectiveness	30	12.35
33.	Patient	Personal traits	30	12.35
34.	Understanding of the work environment	Work dispositions	28	11.52
35.	Sincere	Personal traits	28	11.52
36.	Sensitive to cultural diversity	Group effectiveness	27	11.11
37.	Dependable	Personal traits	27	11.11
38.	Ability to handle stress	Work dispositions	26	10.70
39.	Enthusiastic	Personal traits	25	10.29
40.	Firm	Personal traits	23	9.47
41.	Understand team-work	Work dispositions	22	9.05
42.	Open-minded	Work dispositions	22	9.05
43.	Adaptable	Personal traits	22	9.05
44.	Respect for others	Work dispositions	20	8.23
45.	Outgoing	Group effectiveness	19	7.82
46.	Compatible	Group effectiveness	17	7.00
47.	Ethical	Personal traits	17	7.00
48.	Determined	Personal traits	17	7.00
49.	Objective	Personal traits	16	6.58
50.	Consultative	Group effectiveness	15	6.17
51.	Accommodating	Group effectiveness	14	5.76
52.	Persuasive	Group effectiveness	14	5.76
53.	Take pride in work	Work dispositions	14	5.76
54.	Assertive	Personal traits	13	5.35
55.	Persistent	Personal traits	13	5.35
56.	Thoroughness	Work dispositions	12	4.94
57.	Summarizing	Group effectiveness	10	4.12
58.	Tolerance	Work dispositions	10	4.12
59.	Good appearance	Personal traits	10	4.12
60.	Put people at ease	Group effectiveness	9	3.70
61.	Self-control	Work dispositions	9	3.70
62.	Conscientious	Personal traits	9	3.70
63.	Willing to take risks	Work dispositions	8	3.29
64.	Give and take	Work dispositions	8	3.29
65.	Respect for company's property	Work dispositions	7	2.88
66.	Precise	Work dispositions	6	2.47
67.	Even tempered	Group effectiveness	5	2.06
68.	Empathy	Group effectiveness	4	1.65
69.	Considerate	Work dispositions	3	1.23
70.	Recognition	Work dispositions	2	0.82
71.	Praise	Group effectiveness	0	0.00

Responsible, commitment, self-confidence, disciplined, committed to the job and willingness to learn are perceived as the most valued traits for entry-level engineers. These items are selected by more than 50% of the respondents. Out of these six items, three items are from personal traits and self-management skills category, two items are from work-related dispositions and attitudes skills category and one item is from group effectiveness and teamwork skills category.

4.2.2 Group effectiveness and teamwork skills

Table 4.19 shows the frequency of items selected by respondents for group effectiveness and teamwork skills category.

Table 4.19: Group effectiveness and teamwork skills

No.	Items	Frequency	%
1.	Commitment	159	65.43
2.	Co-operative	121	49.79
3.	Lead and manage	119	48.97
4.	Responsive	118	48.56
5.	Receptive to ideas	100	41.15
6.	Co-ordination	85	34.98
7.	Group process skills	53	21.81
8.	Tactful	38	15.64
9.	Helpful	37	15.23
10.	Solicit ideas	33	13.58
11.	Ability to negotiate	30	12.35
12.	Sensitive to cultural diversity	27	11.11
13.	Outgoing	19	7.82
14.	Compatible	17	7.00
15.	Consultative	15	6.17
16.	Accommodating	14	5.76
17.	Persuasive	14	5.76
18.	Summarizing	10	4.12
19.	Put people at ease	9	3.70
20.	Even tempered	5	2.06
21.	Empathy	4	1.65
22.	Praise	0	0.00

The five items most frequently selected by respondents are commitment, co-operative(ness), lead and manage, responsive(ness) and receptive to ideas. On the other hand, the five least frequently selected items are praise, empathy, even-tempered, put people at ease and summarizing.

Our interviews with personnel from a number of manufacturing firms support the findings of the five most important items in the group effectiveness and teamwork skills category. Since most of the jobs are project-based, entry-level engineers in manufacturing

industry should be able to function effectively in a team and to work with people at various levels and departments to ensure successful completion of the tasks.

Commitment is the most important skill (65.43%) while cooperative(ness) is considered the second most important skill in group effectiveness and team-work skills category. They also ranked second and sixth most important skills out of the 71 adaptive skills. According to some respondents, commitment and cooperativeness *include "willingness to sacrifice part of your personal time"* as some manufacturing companies operate 24 hours. Thus, entry-level engineers should be willing to work shifts and overtime. In the case of breakdowns, they are also expected to be on-call and to work at odd hours. The importance of being committed and cooperative is portrayed in the statements by some respondents interviewed:

> *"Because for us … engineering members … on call is very important. (If there is) any breakdown, we ask you to come back … and then (you) give us good response - willing to work"*
> *"Normally we asked …Hari Raya boleh kerja? (Can you work during Hari Raya?) Those (who) said no, we don't hire them"*

> " *It is the culture…. Working hour is until 5 pm but everyday we (only) go back after eight…"*

> *"Previously (we) work until 12 … 2 am. (Then) come back in the morning … and was called again at night … It was very tough"*

> *"Production rotate… because here we work 24 hours in 2 shifts … (It is) compulsory for them to go for 4 hours OT"*

“ To me, what I practised… whether we like it or not, we have to do it … I will support”

“He has no choice, once you are here, you have to do it (what you are asked to do)”

The ability to lead and manage is another important skill needed by entry-level engineers in the manufacturing industry especially when they are involved in team-based projects. It is rated as the third important item in this category and seventh out of 71 items in the adaptive skills category. Since the ability to lead and manage also requires a person to be responsive and receptive to ideas, these two skills are rated as the fourth and fifth important skills in the group effectiveness and teamwork skills category. The statements made by the respondents support these findings:

“Basically yes (have to manage people) because when they are production executives; they have their own people (under their supervision)”

“ … like QA department, there are two engineers, a few leaders, supervisors, superiors and a few inspectors. There are ranks … QA engineer will control few leaders. Like me, I am the leader for my subordinates”

“ (in the interview)… we see their activities (while study).. if they lead one group or whatever…”

4.2.2.1 Group effectiveness and teamwork skills items: comparison between HR executives and engineers

Table 4.20 shows a comparison between the top five group effectiveness and teamwork skills items (based on the frequency the items were selected by the respondents) as perceived by HR executives and engineers.

Table 4.20: Comparison of top five group effectiveness and teamwork skills items perceived by HR executives and engineers

No.	HR Executives	Frequency	Engineers	Frequency
1.	Commitment	88	Commitment	71
2.	Co-operative	69	Responsive	55
3.	Lead and manage	67	Lead and manage	52
4.	Responsive	63	Co-operative	52
5.	Co-ordination	51	Receptive to ideas	50

Note: 1. Co-ordination ranked 6th in the overall Group Effectiveness Skills category.
2 Receptive to ideas ranked 5th in the overall Group Effectiveness Skills category.

It was found that four out of five items were selected by both HR executives and engineers. The items were commitment, co-operative, lead and manage and responsive. Co-ordination was the item perceived as more important by HR executives compared to receptive(ness) to ideas by engineers.

4.2.3 Work-related dispositions and attitudes

Table 4.21 shows the frequency of adaptive skills items selected by the respondents for work-related dispositions and attitudes skills category.

Table 4.21: Work-related dispositions and attitudes

No.	Items	Frequency	%
1.	Committed to the job	129	53.09
2.	Willingness to learn	123	50.62
3.	Ability to take initiative	101	41.56
4.	Interest in work	80	32.92
5.	Ability to work as a team member	78	32.10
6.	Task oriented	57	23.46
7.	Ability to handle pressure	54	22.22
8.	Make extra effort	54	22.22
9.	Good work habits	49	20.16
10.	Open to criticism	42	17.28
11.	Willing to be trained	37	15.23
12.	Punctual	32	13.17
13.	Understanding of the work environment	28	11.52
14.	Ability to handle stress	26	10.70
15.	Understand team-work	22	9.05
16.	Open-minded	22	9.05
17.	Respect for others	20	8.23
18.	Take pride in work	14	5.76
19.	Thoroughness	12	4.94
20.	Tolerance	10	4.12
21.	Self-control	9	3.70
22.	Willing to take risks	8	3.29
23.	Give and take	8	3.29
24.	Respect for company's property	7	2.88
25.	Precise	6	2.47
26.	Considerate	3	1.23
27.	Recognition	2	0.82

The five adaptive skills items most frequently selected by the respondents are commitment to the job (committed to the job), willingness to learn, ability to take initiative, interest in work and ability to work as a team member. On the other hand, the five least frequently selected items are give and take, respect for company's property, precise, considerate and *recognition*.

Our interviews with personnel from a number of manufacturing firms support the findings of the five most important work-related dispositions and attitudes. On the importance of being committed to the job, one of the respondents said:

> *…what the company (is) looking for (are) fresh grads (graduates) (who are) dedicated person(s), hard-work(ing), and must have correct attitude. I think that should be the most important...*

One respondent pointed out that entry-level engineers must be committed to their work which may require a person to work long hours and at anytime of the day. This implies that an engineer is required to be on call. He explains:

> *… there are times we have to work until midnight, or even until two in the morning; and (yet we have to)come back (work) in the morning … (and can) be called again at night.*

Another important work-related dispositions and attitudes skills item i.e. the willingness to learn is very important especially for entry-level engineers. This view is shared by engineers and managers interviewed through certain scenarios:

> *(We look for entry level engineers who are) aggressive... willing to learn, must be humble, willing to take up any jobs …*

> *My expectation – they (entry-level engineers) have to know what's happening (outside their field). For example, mechanical people lack exposure to electrical or/and quality.*

> *If you are willing to learn, you will have no problem. I explained (to them) don't rely 100% on what you have studied. Therefore, they need to learn – fast!*

A person's willingness to learn can further be seen from his willingness to be trained in other areas that may not be directly related to his daily routine as an engineer. It

is considered a valuable experience and as preparation for other assignments in the organization. As stated by several respondents:

> *I believe that should I be assigned to the Human Resource (department) I will be OK…wherever I go, I am willing to learn.*
>
> *We should not be saying that what we learned will only be applicable to our (existing) task. Perhaps we will change our field.*
>
> *We told them (the juniors) whatever field we should be ourselves ready to face anything that will happen in the future.*
>
> *The company provides (the opportunity to learn), therefore we should learn.*

However, the willingness to learn may not be sufficient without the ability to make some initiatives. For example, citing his own experience when he was a junior engineer, one respondent has the following to say on his effort, indicating how he personally values willingness to learn and ability to take initiative as important work-related disposition for entry-level engineers.

> *…therefore those who just joined (the organization), we want them to approach us and greet us… then (make) request for us to teach them. Do not expect us to ask them whether they were having problem (with their work). …The concept here is that they will have to seek us (the seniors)…they have to learn ourselves.*

> *When I was (training) in Japan, everything was in a hurry and they (the Japanese trainers) were busy. I appeal to them to learn few things… asking them when they would be available…made appointment… They were normally available at 6.00 pm to 6.15 pm (where they) taught me a little bit, followed by another appointment the next day.*

In order to learn, entry-level engineers must put aside their ego of being university graduates. They may have to learn from other members of the organization who may be lower ranked staff such as supervisors of general workers. A respondent has the following to say about this attitude towards learning:

> *… it's either we want to learn or not... it does not matter whether learning from (our) superior or subordinates. Should we need (to learn) from one of our subordinates we will have to put aside our level (relative position).*

Another important work-related dispositions and attitudes item expected from entry-level engineers is the ability to work as a team member. Failing to work as a team member would only jeopardize a person's role as a representative of the team which is either a unit, department or a division. According to one of the respondents:

> *…industry consists of people from various departments, because each department kind of representative, so that we form a team and get the things done, so being the team you have to be a team member, team player and requires sometimes leadership skills.*

4.2.3.1 Work-related dispositions and attitudes items: comparison between HR executives and engineers

Table 4.22 shows a comparison between the top five work-related dispositions and attitudes items (based on the frequency the items were selected by the respondents) as perceived by HR executives and engineers.

Table 4.22: Comparison of top five work-related dispositions and attitudes items perceived by HR executives and engineers

No.	HR Executives	Frequency	Engineers	Frequency
1.	Committed to the job	70	Committed to the job	59
2.	Willingness to learn	67	Willingness to learn	56
3.	Ability to take initiative	56	Ability to take initiative	45
4.	Interest in work	46	Ability to work as a team member	40
5.	Ability to work as a team member	38	Interest in work	34

Both HR executives and engineers agreed that committed to the job, willingness to learn, ability to take initiative, interest in work and ability to work as a team member were the top five work-related dispositions and attitudes items required by entry-level engineers.

4.2.4 Personal traits and self-management skills

Table 4.23 shows the frequency of items selected by respondents for Personal traits and self-management skills category.

Table 4.23: Personal traits and self-management skills

No.	Items	Frequency	%
1.	Responsible	160	65.84
2.	Self-confidence	145	59.67
3.	Disciplined	136	55.97
4.	Motivated	116	47.74
5.	Mature	57	23.46
6.	Positive self-esteem	55	22.63
7.	Honest	42	17.28
8.	Flexible / Open-minded	42	17.28
9.	Integrity	32	13.17
10.	Patient	30	12.35
11.	Sincere	28	11.52
12.	Dependable	27	11.11
13.	Enthusiastic	25	10.29
14.	Firm	23	9.47
15.	Adaptable	22	9.05
16.	Ethical	17	7.00
17.	Determined	17	7.00
18.	Objective	16	6.58
19.	Assertive	13	5.35
20.	Persistent	13	5.35
21.	Good appearance	10	4.12
22.	Conscientious	9	3.70

The five items most frequently selected by the respondents are responsible, self-confidence, discipline, motivated and mature. On the other hand, the five least frequently selected items are conscientious, good appearance, persistent, assertive(ness), and objective(ness).

A person's self-confidence is a valuable personal trait for entry-level engineers to survive and reap rewards in a dynamic working environment. Self-confidence provides a person (especially those new to an organization) with a better chance to win the trust of others. seniors in particular, to offer them more challenging tasks and responsibilities (which are normally rewarding). As stated by several respondents:

> … *so I can survive on how to catch-up…. So, It is a bit difficult* (must have self confidence)…

> *Because I think we already, quite knowledgeable of this product, for to write a report also very confidence.*

The importance of personal traits such as self-confidence is crucial for entry-level engineers not only in performing their job but as a determining factor to being hired. The following statements illustrate this point:

> *That's the value, so interview skills require them to get confident(ce) than other criteria counts (looked at).*

> …… *Therefore, from there we know that whether they can perform or not. Maybe they are confident or not.*

> *You can evaluate yourself, where your weaknesses are, why you are not being employed, on what ground you are not being hired… or perhaps you do not have the confidence….*

> *When we want to hire people, during the interview, if they can show the confidence because(if they are) nervous, even to speak then we say that…Can you work or not?*

> *If our impression of you is that you are not very confident, if we employ you, you (will) cause problem (to) us.*

There are also instances where a person's academic achievement may not guarantee success during job interviews. A respondent has the following to say about an engineering graduate's interview session:

> *I ask(ed) him about his final paper and he showed me, but he cannot explain…I asked him (a) simple (question)… (if)I take this thing (to) a third party can it be sold? He just could not explain (the paper), whatever he do(es), finding though is good but he failed to explain that it (the finding) is good for the rest of (other) people. So like communication again. But during the interview, to me his confidence (is low), pity the candidate. His CGPA is 3.7 (and he is) still unemployed because he lacks confidence to speak during the interview.*

4.2.4.1 Personal traits and self-management skills items: comparison between HR executives and engineers

Table 4.24 shows a comparison between the top five personal traits and self-management skills items (based on the frequency the items were selected by the respondents) as perceived by HR executives and engineers.

Table 4.24: Comparison of top five Personal traits and self-management skills items perceived by HR executives and engineers

No.	HR Executives	Frequency	Engineers	Frequency
1.	Responsible	92	Responsible	68
2.	Self-confidence	80	Self-confidence	65
3.	Disciplined	77	Disciplined	59
4.	Motivated	64	Motivated	52
5.	Mature	31	Mature	26

Both HR executives and engineers agreed that responsible, self-confidence, disciplines, motivated and mature were the top five personal traits and self-management skills items required by entry-level engineers.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter summarizes the findings, conclusions, limitations, and recommendations of the study.

5.1 Summary of the findings

The objectives of the study were to:

1. identify the non-technical skills required by entry-level engineers in performing their tasks or responsibilities
2. determine the importance of non-technical skills for entry-level engineers working in the manufacturing industry
3. provide a basis to develop a guideline of non-technical skills required by entry-level engineers in the manufacturing industry

A total of 162 manufacturing firms participated in this study. Questionnaire was the main instrument used while interviews were used to provide an insight into non-

technical skills (functional and adaptive skills) among entry-level engineers required by manufacturing firms.

In general, there was a tendency for HR executives and engineers to select the same top five items required by entry-level engineers in the functional and adaptive skills categories.

Analysis of the functional skills (based on mean scores) found that leadership and organizational skills category was the most important followed by information management skills, creative thinking and problem solving skills and communication skills categories.

All items in the four categories were found to be important. However, the level of importance of each item varied from important to extremely important. The ability to follow procedure is the most important followed by the abilities to listen (listening), meet deadlines, manage time (time management) and work to schedule.

The adaptive skills of group effectiveness and teamwork skills, work related dispositions and attitudes and personal traits and self-management skills were analyzed according to frequency. A majority of the respondents (more than 50 percent) selected the following items as the most valued traits: responsible, commitment, self-confidence, discipline, committed to the job and willingness to learn.

Out of these six items, three were from personal traits and self-management skills category i.e. responsible, self-confidence and discipline, two items were from work-related dispositions and attitudes i.e. committed to the job and willingness to learn, and one item was from group effectiveness and teamwork skills i.e. commitment.

5.2 Conclusions

The following conclusions can be drawn from the findings of this study:

- Non-technical skills are important for entry-level engineers in the manufacturing industry.
- The findings on the importance of non-technical skills are consistent with Bank Negara (2002), Lange (2000), Nor Azizi Ismail (2001), Nguyen (1998), Busse (1992). Therefore, it can be concluded that the basic requirement of non-technical skills is a global phenomenon that needs to be addressed.
- Follow procedure, listening, meet deadlines, time management, work to schedule are the five most important functional skills items. While emphasis should be placed on these five items, the other functional skills items cannot be ignored.
- Responsible, commitment, self-confidence, discipline, committed to the job and willingness to learn are the six most important adaptive skills items. It was found that employers valued personal traits and

self-management items as more important compared to items from group effectiveness and teamwork skills and work related dispositions and attitudes.

5.3 Limitations of the study

While the study gathered valuable insights on the importance of non-technical skills among entry-level engineers in the manufacturing industry, it is not without limitations. The limitations are:

- this study only identified the importance of non-technical skills in the manufacturing industry and did not identify the non-technical skills lacking in entry-level engineers.
- this study looked at non-technical skills requirements by the manufacturing industry as a whole. Comparison of the non-technical skills required between the different sub-sectors of the manufacturing industry could not be made.

5.4 Recommendations

This study found that non-technical skills are important for entry-level engineers in the manufacturing industry. The findings of this study can be used as a basis for

developing a guideline for non-technical skills to be included in the engineering curriculum. Therefore, the following recommendations are made:

- The current engineering curriculum at institutions of higher learning should enhance skills, both functional and adaptive non-technical.
- Functional skills that should be emphasized in the engineering courses are follow procedure, listening, meet deadlines, time management, and work to schedule.
- Adaptive skills that should be emphasized in the engineering courses are responsible, commitment, self-confidence, discipline, committed to the job, and willingness to learn.

It is also recommended that the following initiatives be taken to prepare engineering graduates to meet the demands of human capital requirements of the manufacturing industry:

1. Stakeholders responsible for training and developing human capital in the highly scientific and technical fields should keep abreast with the current and constantly changing needs of industry.
2. Institutions of higher learning should seriously address non-technical skills in the engineering curriculum and training with emphasis on functional and adaptive skills.
3. Institutions of higher learning should adopt a more innovative, comprehensive and creative approach in incorporating non-technical skills into:
    - the design and implementation of the engineering courses

- the application and delivery of these skills in the engineering courses

4. University-Industry collaboration should be further enhanced:
    - Institutions of higher learning should continue to provide students with opportunities to learn from industry e.g. through industrial training and inviting guest speakers from industry.
    - Institutions of higher learning should provide lecturers with more opportunities to keep abreast with current changes in the industry such as through industrial attachments and research collaboration.
    - Industry should be willing to provide opportunities for students to undergo industrial training and provide more communication channels for communication exchanges.

5.5 Suggestion for future research

Future research should look into:

- The types of non-technical skills lacking in engineering graduates.
- The non-technical skills requirements in the different types of manufacturing sectors e.g. electronics and food.
- The non-technical skills requirements in the different types of industry e.g. services, and construction.

- The non-technical skills currently incorporated within the engineering curriculum, particularly in engineering courses.

It is hoped that information from such studies together with findings from this study would enable the development of a comprehensive guideline of non-technical skills required by engineering graduates.

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Appendix: Return rate (Studies on manufacturing industries in Malaysia)

No.	Title	Year	Researchers	Population	Respondent	Methodology	Returned	Percentage
1.	Corporate Turnaround In the Manufacturing Sector Of Malaysia	1986	Siti Maimun Kamso Wan Rafaei, June Poon Meaw Ling, Arawati Agus, UKM	FMM 1986		643 mailed	94	15
2.	Factors Contributing to the Success of Human Resources Information Systems (HRIS) in Malaysian Manufacturing Firms	1996	Mohamed Sulaiman, Ohio University, Suhaya Manap & Zainal A. Ahmad, School of Management USM	FMM 1995/96 (more than 300 employees)	Human Resource Manager or HRIS manager/ administrator	350 mailed	77	22
3.	Purchasing Strategy Among Manufacturing Firms in the Northern Region of Malaysia	1999	Mohd Hanizan Zalazilah, Emmy Pong Chung Moi, Khaw Yew Bin, UUM.	FMM 1999, northern, proportionate stratified sampling		114 mailed, follow-up letter, telephone calls	28	12
4.	KPMG Malaysia Fraud Survey 2000	2000	KPMG Malaysia Forensic and Litigation Support Services	KLSE	CEO	795	143	18
5.	The CEO and AMT Adoption in Malaysian Small and Medium Scale Manufacturing Industries	2001	Muhamad Jantan, T. Ramayah, Noraini Ismail, Ali Hikmat Mohamed Salehuddin, USM.	FMM 1999, firms near the government gazetted industrial zones, random sampling	CEOs, Managing Directors or those at the top most level in the organization	472 mailed, 22 door -to-door visit	72	15
6.	Towards Exporting Excellence: Perceived Usefulness Of MATRADE Services	2001	Osman Mohamed, T. Ramayah, Ong Peng Woon, School of Management, USM	MATRADE	CEO, MD, Director of Marketing, Export Manager, Business /Trade Enquiries Manager	915 e-mailed out and 80 by "hand distributed"	66, 5 had missing information = 61	6
7.	Comparison of TQM Implementation Practices in Malaysian Electrical and Electronics Industry - A Survey	2001	Quek Eng Eng, Sha'ri Mohd Yusof, FKM, UTM	FMM, SMIDEC 2000		248 mailed	60	24.2
8.	Innovations in Penang's Manufacturing Sector	2001	Socio-Economic & Environmental Research Institute (SERI)	Manufacturing firms (Penang)		951 mailed	191	20.7
9.	Relationship between organizational structure, human resource practices, organizational culture and innovation activity in Malaysian SMEs	2003	Mohd Khairuddin Hashim, Mustafa Zakaria, Dzulhilmi Ahmad Fawzi	SMIDEC		300	48 personal interviews	16
10.	Knowledge management in 25 award winning Malaysian companies	2003	LEE PENG TAN - Faculty of Business and Accountancy, Universiti Malaya	Enterprise 50, FMM, SMIDEC		437 e-mailed and fax	38	8.7

UNIVERSITI TEKNOLOGI MALAYSIA

BORANG PENGESAHAN
LAPORAN AKHIR PENYELIDIKAN

TAJUK PROJEK : Non-Technical Skills For Engineers In The 21st Century:
A Basis For Developing A Guideline

Saya **ZUBAIDAH AWANG**
(HURUF BESAR)

Mengaku membenarkan **Laporan Akhir Penyelidikan** ini disimpan di Perpustakaan Universiti Teknologi Malaysia dengan syarat-syarat kegunaan seperti berikut :

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2. Perpustakaan Universiti Teknologi Malaysia dibenarkan membuat salinan untuk tujuan rujukan sahaja.
3. Perpustakaan dibenarkan membuat penjualan salinan Laporan Akhir Penyelidikan ini bagi kategori TIDAK TERHAD.
4. * Sila tandakan (/)

[ ]	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau Kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972).
[ ]	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh Organisasi/badan di mana penyelidikan dijalankan).
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TANDATANGAN KETUA PENYELIDIK

Nama & Cop Ketua Penyelidik

Tarikh : _____

CATATAN : ***** *Jika Laporan Akhir Penyelidikan ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan ini perlu dikelaskan sebagai SULIT dan TERHAD.*