Emotional Intelligence Attributes for Engineering Graduates of the Industrial Revolution 4.0

Fathiyah Mohd Kamaruzamani[a], Roszilah Hamid[b], Azrul A. Mutalib[c], Mohamad Sattar Rasul[d*], [a,d]Faculty of Education, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia, [b,c]Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia, Email: [a]fathiyah@ukm.edu.my, [b]roszilah@ukm.edu.my, [c]aazrul@ukm.edu.my, [d*]drsattar@ukm.edu.my

The emergence of the technology wave known as The Fourth Industrial Revolution (IR 4.0) changes the landscape of the future work environment such that graduates will be required to equip themselves with new skills. Emotional intelligence (EI) is among the skills demanded by graduates in facing the current challenges in the IR 4.0 and subsequently, meeting the demands of the job markets. However, previous studies carried out on EI in the engineering field have only focused on the assessment and impact of EI. Nevertheless, the suitable traits or attributes for EI need to be established to enable the effective assessment of EI. Therefore, this study was conducted to derive EI attributes using a systematic review method considering previous studies on emotional quotient (EQ) inventory worldwide. A crosswalk of six selected EQ inventories was produced in this study. Based on the crosswalk, five emerging themes were identified namely: understanding one's emotions, self-emotional awareness, conscientiousness of emotions, emotional influence and managing emotions. The findings of this study formed an appropriate attribute of EI that can be applied to IR 4.0 engineering graduates.

Key words: *emotional intelligence, attributes, crosswalk, engineering graduates, industrial revolution 4.0.*

Introduction

As the new technology wave known as Industrial Revolution 4.0 (IR 4.0) strikes, many scholars have debated about the gains and consequences that will be brought from this phenomenon. Apart from that, the scholars agreed that the new technologies, the use of automation, artificial intelligence, big data and cloud computing will change the landscape of the future work environment and job profiles (McKinsey, 2018; WEF, 2018; Benesova &

Tupa, 2017; Pritfi, Knigge, Kienegger & Krcmar, 2017; Hecklau, Galeitzka, Flachs & Kohl, 2016; Gehrke et al., 2015; Chryssolouris, Mavrikios & Mourtzis, 2013). As the IR 4.0 alters many work profiles, potential employees will have to adapt to these alterations, which may imply that they have to open up to extra training to acquire new skills or upgrade themselves. According to WEF 2016, more than one-third of the core skills required in most occupations by 2020 may involve skills that are deemed unnecessary in today's working world. In another report by The Education Commission (2015), more than half of the world's two billion youth have been estimated to have insufficient technical skills and know-how to be employed by industries by 2030. Thus, it is imperative that future employees possess a variety of skills to be offered a job by the industries (Mohd Kamaruzaman, Hamid, Mutalib & Rasul, 2019; Azmi, Kamin, Noordin & Md. Nasir, 2018; McKinsey 2018; Saud et al., 2018; Skills Development Scotland, 2018; WEF, 2018; Benesova & Tupa, 2017; The Education Commision, 2015; Gehrke et al., 2015; Rasul, Abd Rauf & Mohd Nor, 2014). Even though the future work environment will be filled with automation, human skills are still important (WEF, 2018) in making sure that the development of new products would bring benefits to human beings.

The deficiency of non-technical skills or generic skills among graduates has been highlighted as the main reason why industries were reluctant to hire them (McKinsey 2018; Mohamad Idham, Asliza, Wan Nor Syazana, Wan Effa, & Talib, 2014; Mohd Shamsuri, Anidah, Zanariah, & Izaidin, 2013; Rasul, Abd Rauf, Sulong & Mansor, 2012; Blom & Saeki, 2011; Zaharim, Md Yusof, Omar, Mohamed, & Muhamad, 2009; Zaharim, 2008; Hassan et al., 2007; Lattuca, Terenzini, & Volkwein, 2006; Nguyen, Yoshinari, & Shigeji, 2005; Tong, 2003; Mustapha, 2002). The abilities of an individual are concentrated more by employers rather than academic or professional titles (Pompa, 2015). According to Winthrop, Bulloch, Bhatt and Wood (2013), the failure to secure potential talent with the correct abilities is not only a strategic restriction for business development, which directly impacts the bottom line, but also prohibits companies from expanding their activities, responding to demands at new sites and from launching new products and services. Therefore, it is obvious that the skills related to the Architecture, Computer, Engineering and Mathematical industries are those that will be more demanding since these are the job families that are growing (WEF 2018).

In order to prepare the young engineers for the scenario above, EI is suggested as an essential skill for future engineers to be equipped with (Elegbe, 2015; Skipper & Brandenburg, 2013; Saibani, Deros, Muhamad, Wahab & Sahari, 2012; Chisholm, 2010; Goleman, 1998). EI has further been highlighted as one of important future skills in a report by WEF (2018). Therefore, young graduates have to equip themselves with relevant and appropriate skills to survive in the ever-changing work environment.

Importance of Emotional Intelligence

Undeniably, high academic performance indicates that an individual is an excellent person. This can be measured by Intelligent Quotient (IQ). As the knowledge and demands grow, an individual's excellence can no longer solely depends on their high IQ (Saibani et al., 2015) but must also take into consideration their emotional quotient (EQ) level. Scholars agree that IQ is less important for success in life and work than EI (Goleman, 1995; 1998). Elevated level of EQ shows that the person is compassionate, highly empathetic, adaptable and has self-control. Segal (1997) stated when people reinforce their EQ, they can also reach a healthier equilibrium between their private needs as well as others. Nevertheless, the EQ should not be seen as a replacement for intelligence, but as a reinforcer of employment skills and potential (Riemer, 2003). Past studies discuss numerous advantages of an individual who has a high EQ level. Cited from Mo & Dainty (2007), students who do not possess the required EI will face challenges with communication, problem solving, leadership and creativity. Accordingly, a study by Benson, Ploeg and Brown (2010) shows that there are positive relations between an individual's EI and career commitment. In another study, individuals with elevated EQ rates can deter diseases related to emotions and anxiety disorders, which in return receive more beneficial social interactions as well as increased social support (Kong, Zhao & You, 2012). Saibani et al. (2015) in their study emphasised that individuals with a healthy EQ should have an increased ability to adapt to fresh setting beyond practicing a healthy attitude when dealing with and resolving issues; this eventuates in being able to achieve successfully in their career and life.

Despite increasing attention being paid to the importance of EI on workforce, research in this domain is still scarce. Previous studies on emotional intelligence carried out on EI in the engineering field have only focused on assessment (Owusu-Manu et al., 2018; Saibani et al., 2015; Saibani et al., 2012; Mo, Dainty & Price, 2007) and effectiveness of EI (Deveci, 2015; Narayan & Narashiman, 2014; Skipper & Brandenburg, 2013; Andi, 2012; Jha & Singh, 2012; Kumar, Muniandy & Wan Yahaya, 2012). Nevertheless, the suitable traits or attributes for EI need to be first established to have a good track to assess the EI level. Therefore, the purpose of this paper is to address the research gap by identifying the attributes of EI for IR 4.0 based on the emotional quotient inventory that is available worldwide. It can be used as a guide to assess the EI level of engineering graduates.

This paper is organised as follows: a brief background and introduction about the definition of emotional intelligence and the measurement tools used to measure EI levels through a review of the literature in the first section. The next section present the crosswalk to derive emotional intelligence attributes based from EQ-i that have been reviewed in the first section. Finally, conclusions from this paper are drawn in Section 3.

Literature Review
Definition of Emotional Intelligence

Emotional intelligence (EI) was initiated from the concept of 'social intelligence' which was introduced by Thorndike (1920). As defined by Thorndike (1920), social intelligence is "the ability to understand and manage men and women, boys and girls—to act wisely in human relations". In different contexts, Salovey and Mayer (1990) were the pioneers that introduced the term 'emotional intelligence' in a research world that refers to the ability of people to deal with their emotions towards their surroundings. Thus, EI is defined as "the subset of social intelligence that involves the ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions". Later, the definition is being revised as "The ability to perceive emotion, integrate emotion to facilitate thought, understand emotions and to regulate emotions to promote personal growth" (Mayer & Salovey, 1997). Since then, other scholars began to embark on academic research on EI as evidenced by the work of Goleman (1995). According to Goleman (1998), emotional intelligence refers to "the ability to recognise and regulate emotions in ourselves and others". In another study, Petrides, Pita and Kokkonaki (2007) defined EI as "a constellation of emotional self-perceptions located at the lower level of personality hierarchies". Meanwhile, Raven Baron who initiated the term "Emotional Quotient" defines EI as "an understanding oneself with others, relating to people and adapting to and coping with immediate surroundings to be more successful in dealing with the environmental demands" (Baron, 1997). For this study, the focus is to offer an overview of the traits and attributes of emotional intelligence especially for engineering graduates. Thus, authors did not intend to derive the new definition but rather use the existing definitions of EI by Goleman (1998).

Emotional Quotient Inventory (EQ-i)

According to scholars, EI is often associated with two different constructs, trait EI or ability EI. According to Petrides (2011), trait EI is concerned with emotion-related self-perceptions, meanwhile ability EI (or cognitive-emotional ability) is concerned with emotion-related cognition. Table 1 below shows a comparison between trait EI and ability EI adapted from Petrides (2011).

Table 1: Trait EI versus ability EI

Construct	Measurement	Conceptualisation	Example of the measurement tool
Trait EI	Self-report	Personality trait	TEIQue
Ability EI	Maximum performance	Cognitive ability	MSCEIT
			TEMNIT

Accordingly, both trait EI and ability EI can be measured by using specific tools or instruments independently or combined with other personality tests etc. Based on Table 1, trait EI can be measured via self-report, while ability EI can be measured via maximum performance tests. In general, emotional quotient inventory (EQ-i) is a self-report inventory that acts as a tool or instrument to measure the level of EI. Based from anecdotal evidence in the literature search, the attributes of EI can be derived by conducting a meta-analysis on the available emotional quotient inventory worldwide. This section will further discuss the EQ-i items that have been identified from a systematic literature review (SLR). A detailed explanation on the systematic literature review can be found in Mohd Kamaruzaman et al., (2019). Based from the SLR, 16 self-reported inventories on EI have been identified (Perez, Petrides & Furnham, 2005). However, only six self-reported inventories were selected to be used in this study. A list of the aforementioned inventory is shown in Table 2.

Table 2: Emotional quotient inventory

Name of inventory	Founder	Year
Bar-On Emotional Quotient Inventory (EQ-i)	Reuven Bar-On	1997
Emotional Competency Inventory 360 (ECI)	Daniel Goleman	1998
Dulewicz & Higgs Emotional Intelligence Questionnaire (DHEIQ)	Dulewicz & Higgs	2001
Malaysian EQ Inventory (MEQI)	Noriah & Mahmud	2003
Universiti Sains Malaysia Emotional Quotient Inventory (USMEQ-i)	Yusoff, Rahim & Esa	2010

By referring to Table 2, the authors began by listing and giving brief explanations on the available EQ-i, followed by the criteria/competencies that will be used to map each criterion in the next section of this paper.

Historically, Bar-On is among the earliest prominent scholars who developed the self-report inventory of EI back in 1997. It is called Emotional Quotient Inventory (EQ-i). EQ-i contains 133 items in the form of short sentences with a five-point Likert scale. The EQ-i is suitable for individuals 17 years of age and older and takes approximately 40 minutes to complete (Bar-On & Parker, 2000). Table 3 below illustrates the element in Bar-On EQ-I :

Table 3: Elements of EQ-i

Intrapersonal	• Self-Regard • Emotional Self-Awareness • Assertiveness • Independence • Self-Actualization
Interpersonal	• Empathy • Social Responsibility • Interpersonal Relationship
Stress management	• Stress Tolerance • Impulse Control
Adaptability	• Reality-Testing • Flexibility • Problem-Solving
General mood	• Optimism • Happiness

The Emotional Competency Inventory 360 (ECI) is a 360-degree instrument that has been developed based on emotional competencies identified by Goleman (1998). This inventory is used tool to weigh the emotional competencies of individuals and groups. ECI contained 18 competencies which are divided into four main clusters (self-awareness, social awareness, self-management and relation management) as seen in Figure 1.

Figure 1. ECI element

Self-Awareness	**Social Awareness**
• Emotional awareness • Accurate self-assessment • Self-confidence	• Empathy • Organizational awareness • Service orientation
Self-Management	**Relationship Management**
• Emotional self-control • Transparency • Adaptability • Achievement • Initiative • Optimism	• Developing others • Inspirational leadership • Change catalyst • Influence • Conflict management • Teamwork & collaboration

Accordingly, self-awareness is about knowing one's internal state, preferences, resources and institutions. Three competencies under the self-awareness cluster are: a) emotional awareness

– recognizing one's emotions and their effects; b) accurate Self-Assessment - knowing one's strengths and limits; and c) self-confidence - a strong sense of one's self-worth and capabilities. Meanwhile, social awareness denotes how to handle relationships and awareness of others' feelings, needs, and concerns. Three competencies of social awareness are: a) empathy: sensing others' feelings and perspectives, and taking an active interest in their concerns; b) organizational awareness: reading a group's emotional currents and power relationships; and c) service orientation: anticipating, recognising, and meeting customers' needs. The third cluster is self-management which refers to managing ones' internal states, impulses, and resources. This cluster contains six competencies as outlined below:

a) Emotional Self-Control - keeping disruptive emotions and impulses in check.
b) Transparency - maintaining integrity, acting congruently with one's values.
c) Adaptability - flexibility in handling change.
d) Achievement -striving to improve or meeting a standard of excellence.
e) Initiative - readiness to act on opportunities.
f) Optimism - persistence in pursuing goals despite obstacles and setbacks.

The fourth cluster of ECI is relationship management that refers to the skills or adeptness at inducing desirable responses in others. Six competencies under this cluster are as follows:

a) Developing Others - sensing others' development needs and bolstering their abilities.
b) Inspirational Leadership - inspiring and guiding individuals and groups.
c) Change Catalyst – initiating or managing change.
d) Influence - wielding effective tactics for persuasion.
e) Conflict Management - negotiating and resolving disagreements.
f) Teamwork & Collaboration - working with others toward shared goals.

In 2001, Dulewicz & Higgs (2001) designed a self-report inventory to specifically assess seven elements of an individual's EI. It is called the Dulewicz & Higgs Emotional Intelligence Questionnaire (DHEIQ). The aforementioned elements of DHEIQ are shown in Table 4.

Table 4: Elements of DHEIQ

Element	Description
Self-awareness	being aware of one's feelings and managing them
Emotional resilience	being able to maintain one's performance when under pressure
Motivation	having the drive and energy to attain challenging goals or targets
Inter-personal sensitivity	showing sensitivity and empathy towards others
Influence	influencing and persuading others to accept one's views or proposals
Intuitiveness	making decisions using reason and intuition when appropriate
Conscientiousness	being consistent in one's words and actions, and behaving according to prevailing ethical standards.

In the Malaysian context, we have identified two emotional intelligence inventories which are i) Malaysian EQ Inventory (MEQI) and ii) Universiti Sains Malaysia Emotional Quotient Inventory (USMEQ-i). Generally, these two inventories were developed based on existing EQ-I by prominent scholars and incorporated with the cultures and characteristics of Malaysian citizens. MEQI is a product from a group of researchers from Universiti Kebangsaan Malaysia (UKM) (Noriah & Mahmud, 2003). Originally, the test started as a paper-and-pencil test that focused on an individuals' emotional intelligence development and provided insights that would help individuals to become better leaders. The validity test, reliability test and also normalisation has been done as reported by other researchers. MEQI were designed according of five domains of EI as suggested by Goleman (1995), however two dimensions were added as these five domains were insufficient to define Malaysian EI. The domains of EI in MEQI are stated in Table 4:

Table 4: Domain and subdomains of MEQI

Domain	Subdomain
Self-awareness	Emotional awareness, Accurate self-assessment, Self-confidence, Honesty
Self-regulation	Self-control, Trustworthiness, Responsibility, Adaptability, Innovation
Self-motivation	Achievement drive, Commitment, Initiative, Interest
Empathy	Understanding others, Helping others, Leverage diversity, Service orientation, Developing other's potential
Social skill	Influence, Conflict management, Change catalyst, Building bonds collaboration and cooperation, Team capabilities, Communication
Spirituality	No description
Maturity	No description

USMEQ-i was designed in attention to measure EQ level of medical students in Malaysian universities. Apparently, USMEQ-i was written in Malay language making it suitable and comparable with local culture and the values of Malaysians (Yusof, Rahim & Esa, 2010). This instrument contained of seven dimensions of EQ as follows:

Table 5: Domains of USMEQ-i

Domain	Description
Emotional control	The ability of self-control from disruptive emotions and impulsive feelings.
Emotional maturity	The ability to facilitate and guide emotional tendencies to achieve and reach intended goals.
Emotional conscientiousness	The ability of taking responsibility and maintaining integrity for personal performance.
Emotional awareness	The ability of knowing and understanding one's own and other persons' internal states, preferences, resources and intuitions as well as their effects.
Emotional commitment	The ability of aligning and working with others in a group or organization towards common goals.
Emotional fortitude	The ability of negotiating and resolving disagreements as well as sending convincing messages.
Emotional expression	The ability of conveying and adjusting one's emotions, thoughts and behaviors to changing situations and conditions.

Crosswalk of emotional intelligence attributes

In this section, a crosswalk based from six self-reported inventories was done. Based on this mapping, this study has derived five attributes for emotional intelligence as shown in Table 6. The five attributes of EI are understanding one's emotions, self-emotional awareness, conscientiousness of emotions, emotional influence and managing emotions.

Table 6: Crosswalk of EI attributes

EQ-i	ECI	DHEIQ	MEQI	USMEQ-i	Derived attributes from crosswalk
Interpersonal - Empathy - Responsibility	Social awareness - Empathy - Organisational awareness	Interpersonal sensitivity	Empathy	Emotional fortitude	**Attribute 1: Understanding one's emotions**
Intrapersonal -Independence -Self-awareness -Self-regard	Self-awareness - Emotional awareness - Self confidence	Self-awareness	Self-awareness	Emotional awareness	**Attribute 2: Self-emotional awareness**
Adaptability	Self-management - Adaptability - Transparency - Self-control	Conscientiousness	Self-regulation - Responsibility - Adaptability - Self-control	Emotional conscientiousness	**Attribute 3: Conscientiousness of emotions**
Not mentioned	Relationship managemen	- Motivation - Influence - Intuitivenes	- Self motivation	Emotional commitment	**Attribute 4: Emotional**

	t - Influence - Teamwor k - Developin g others	s	- Social skill		**influence**
Stress managemen t	Not mentioned	Emotional resilience	Maturity	Emotional control	**Attribute 5: Managing emotions**

According to Table 6, the first attribute mentioned by each EQ-i is understanding one's emotions. This attribute emphasises the importance of identifying and understanding other people's emotions rather than oneself. Understanding the emotions of others emphasises empathy, a sense of responsibility for others' problems or problems, as well as a negotiation to resolve the misunderstanding that occurs between one another. Cited from Davis (2011), being sensitive and caring to other people's emotions is essential for a project manager to resolve conflicts and problems that occur in an organisation. This also can be shown in Skipper and Brandenburg (2013) who emphasised that the capacity to comprehend as well as handle moods and feelings of oneself and others helps to achieve efficient organisational management.

The second attribute derived from the crosswalk is self-emotional awareness. This attribute relates to awareness of emotions or feelings of oneself about many things such as problems, viewpoints, experiences and attitudes. Reflection on one's own emotions is critical to ensure that every decision and reaction taken can positively impact others. In the context of the world of work, Sunindijo, Hadikusumo and Ogunlana (2007) asserted that a high EI project manager or engineer could boost team efficiency and enhance innovation more effectively. In another study, Saibani et al., (2015) mentioned that individuals with a healthy EQ should have extra ability to adapt to fresh settings as well as practicing a healthy attitude when dealing with and resolving issues and eventually able to achieve success in career and life.

The next attribute of emotional intelligence is conscientiousness of emotions which narrates responsibility, maintaining ethical and integrity of one's action and others involved in the same situation. Meanwhile, the fourth attribute derived is emotional influence. In this regard, it shows how a person emotion can act as a cure or a poison to others. An engineer with high EI should be able to motivate others, be a good role model, an innovative leader and have good social skills. According to Mo and Dainty (2007), a person who has lower EI will face difficulties in conveying good communication, lack of creativity and will not be a great leader.

The fifth attribute of EI is managing emotion. Based on the mapping, an engineer with a high level of EI should be able to manage and control their emotions, be mature enough in making a good decision and be able to perform well even under pressure situation. Cited from Segal (1997) a person with high EQ is able to strike a healthy balance between their life and career.

Conclusion

This study was done to identify the engineering leadership attributes for IR 4.0 graduates. Using a systematic literature review, five attributes of emotional intelligence that are common across five self-reported emotional intelligence inventories have been identified: understanding one's emotions; self-emotional awareness; conscientiousness of emotions; emotional influence and managing emotions. The results from this research were not proposed as the ultimate solution, but for other related scientists, they are useful and vital as a fundamental insight into developing engineering students' leadership abilities. Further study should be carried out to verify the outcomes that can be utilised by researchers to create an IR 4.0 skills framework for graduates in engineering.

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[i] **Fathiyah Mohd Kamaruzaman**, Centre of Innovation in Teaching and Learning, Faculty of Education, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor D.E., Malaysia

☐ Corresponding author: fathiyah@ukm.edu.my

Roszilah Hamid, Smart and Sustainable Township Research Centre, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor D.E., Malaysia
roszilah@ukm.edu.my

Azrul A. Mutalib, Smart and Sustainable Township Research Centre, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor D.E., Malaysia
aazrul@ukm.edu.my

Mohamad Sattar Rasul STEM Enculturation Centre, Faculty of Education, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor D.E., Malaysia
drsattar@ukm.edu.my